Integrating the Healthcare Enterprise

IHE Radiology (RAD) Technical Framework

Volume 2
IHE RAD TF-2
Transactions

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1 Introduction

This document, Volume 2 of the IHE Radiology (RAD) Technical Framework, defines transactions used in IHE Radiology profiles.

1.1 Introduction to IHE

Integrating the Healthcare Enterprise (IHE) is an international initiative to promote the use of standards to achieve interoperability among health information technology (HIT) systems and effective use of electronic health records (EHRs). IHE provides a forum for care providers, HIT experts and other stakeholders in several clinical and operational domains to reach consensus on standards-based solutions to critical interoperability issues.

The primary output of IHE is system implementation guides, called IHE Profiles. IHE publishes each profile through a well-defined process of public review and trial implementation and gathers profiles that have reached final text status into an IHE Technical Framework, of which this volume is a part.

For more general information regarding IHE, refer to www.ihe.net. It is strongly recommended that, prior to reading this volume, the reader familiarizes themselves with the concepts defined in the IHE Technical Frameworks General Introduction.

1.2 Intended Audience

The intended audience of IHE Technical Frameworks Volume 2 is:

- IT departments of healthcare institutions
- Technical staff of vendors participating in the IHE initiative
- Experts involved in standards development

1.3 Overview of Technical Framework Volume 2

Volume 2 is comprised of several distinct sections:

- **Section 1** provides background and reference material.
- **Section 2** presents the conventions used in this volume to define the transactions.
- **Section 3** provides an overview of the concepts of IHE actors and transactions used in IHE to define the functional components of a distributed healthcare environment.
- **Section 4** defines transactions in detail, specifying the roles for each actor, the standards employed, the information exchanged, and in some cases, implementation options for the transaction.
- **Volume 2x** contains appendices to this volume that provide clarification of technical details of the IHE data model and transactions.

Due to the length of the document, some domains may divide Volume 2 into smaller volumes labeled 2a, 2b, etc. In this case, the Volume 2 appendices are gathered in Volume 2x.

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Code and message samples may also be stored on the IHE Google Drive at https://drive.google.com/drive/folders/1aHW4ChzRzaYSoyewi9zGIRHwVphgXQst. In this case, explicit links to Google Drive will be provided in the transaction text.

For a brief overview of additional Technical Framework Volumes (TF-1, TF-3, TF-4), please see the IHE Technical Frameworks General Introduction, Section 5 - Structure of the IHE Technical Frameworks.

A glossary of terms and acronyms used in the IHE Technical Framework, including those from relevant standards, is provided in IHE Technical Frameworks General Introduction, Appendix D.

1.4 Comment Process

IHE International welcomes comments on this document and the IHE initiative. Comments on the IHE initiative can be submitted by sending an email to the co-chairs and secretary of the Radiology domain committees at radiology@ihe.net. Comments on this document can be submitted at https://www.ihe.net/Radiology_Public_Comments.

1.5 Copyright Licenses

IHE technical documents refer to, and make use of, a number of standards developed and published by several standards development organizations. Please refer to the IHE Technical Frameworks General Introduction, Section 9 - Copyright Licenses for copyright license information for frequently referenced base standards. Information pertaining to the use of IHE International copyrighted materials is also available there.

1.6 Trademark

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http://www.ihe.net/Patent_Disclosure_Process. Please address questions about the patent disclosure process to the secretary of the IHE International Board: secretary@ihe.net.

1.8 History of Document Changes

This section provides a brief summary of changes and additions to this document.

Date	Document Revision	Change Summary
2020-09	19.0	Integrate Scheduled Workflow.b as a Final Text Profile. Integrate the DBT Extensions Supplement into Final Text. Incorporate Change Proposals from 2019 CP Ballots. Refer to the IHE RAD CP Tracking Sheet and IHE Radiology's Incorporated CPs for details. Update TF Volumes to move all transaction definitions to Volume 2 and align Volume 3 with the current template.
2022-03-10	20.0	Integrate Management of Radiology Report Templates (MRRT) as a Final Text Profile. Incorporate Change Proposals from 2020-2021 CP Ballots. Refer to the IHE RAD CP Tracking Sheet and IHE Radiology's Incorporated CPs for details.
2023-06	21.0	Integrate Radiation Exposure Monitoring for Nuclear Medicine (REM-NM) as a Final Text profile Incorporate Change Proposals from CP Ballot 2023A and CP-RAD-460. Refer to the IHE RAD CP Tracking Sheet and IHE Radiology's Incorporated CPs for details.

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2 Conventions

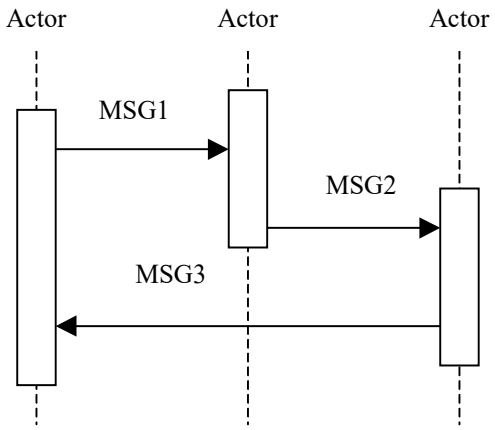
This document has adopted the following conventions for representing the framework concepts and specifying how the standards upon which the IHE Technical Framework is based shall be applied.

2.1 The Generic IHE Transaction Model

Transaction descriptions are provided in Section 4. In each transaction description, the actors, the roles they play, and the transactions between them are presented as use cases.

The generic IHE transaction description includes the following components:

- *Scope*: a brief description of the transaction.
- *Use case roles*: textual definitions of the actors and their roles, with a simple diagram relating them, e.g.,:
- *Referenced Standards*: the standards (stating the specific parts, chapters or sections thereof) to be used for the transaction.
- *Interaction Diagram*: a graphical depiction of the actors and transactions, with related processing within an actor shown as a rectangle and time progressing downward, similar to:



The interaction diagrams used in the IHE Technical Framework are modeled after those described in Grady Booch, James Rumbaugh, and Ivar Jacobson, *The Unified Modeling Language User Guide*, ISBN 0-201-57168-4. Simple acknowledgment messages are omitted from the diagrams for brevity.

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- *Message definitions*: descriptions of each message involved in the transaction, the events that trigger the message, its semantics, and the actions that the message triggers in the receiver.

2.2 DICOM Usage Conventions

For some DICOM transactions described in this document, IHE has strengthened the requirements on the use of selected Type 2 and Type 3 attributes. These situations are explicitly documented in the transaction specifications in Volume 2 and in the appendices in Volume 2x.

IHE specifically emphasizes that DICOM Type 2 attributes (for instance, Patient Name, Patient ID) shall be transmitted with zero length if the source system does not possess valid values for such attributes; in other words, the source system shall not assign default values to such attributes. The receiving system must be able to handle zero-length values for such attributes.

IHE has defined requirements related to the support for and use of attributes in DICOM storage transactions by both Service Class Users (SCUs) and Service Class Providers (SCPs):

- **O** The attribute or its value is optional, i.e., in DICOM it is Type 2 or 3.
- **R** The attribute is required, and is not an IHE extension of the DICOM requirements; i.e., it is already Type 1 in DICOM, but additional constraints are placed by IHE, for example on the value set that may be used for the attribute.
- **R+** The Requirement is an IHE extension of the DICOM requirements, and the attribute shall be present with a value in images created by the Acquisition Modality, i.e., is Type 1, whereas the DICOM requirement may be Type 2 or 3.
- **RC+** The Requirement is an IHE extension of the DICOM requirements, and the attribute shall be present with a value in images created by the Acquisition Modality when the condition is satisfied, i.e., is Type 1C, whereas the DICOM requirement may be Type 2 or 3.

IHE has also defined requirements related to the support for and use of matching and return keys in DICOM queries by both Service Class Users (SCUs) and Service Class Providers (SCPs). Matching keys are used to select instances for inclusion in the response by the query SCP to the SCU, whereas return keys only return specific data and are not used for matching.

- Required matching key SCU:

  A key that the Query SCU shall have the ability to offer to its user as a selection criterion. The definition of the means offered to the user of the Query SCU to trigger the sending of a matching key in the Query request is beyond the scope of IHE (e.g., enter a value, select an entry). A Query SCU shall include as a Matching Key in each C-FIND request all attributes specified as R or R+ for which the user provided a value. If the user does not provide a value, the Query SCU shall send the attribute zero-length (i.e., as a Return Key).

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- Required matching key SCP:

  An IHE required matching key is processed by the Query SCP just as if it were a DICOM-required matching key. In most cases, IHE-required matching keys are also DICOM-required matching keys.

- Required return key SCU:

  A key that the Query SCU requests from the Query SCP and receives in the query responses. The definition of the means offered to the user of the Query SCU to request a return key (e.g., by default, check a box) and to make it visible to the user is beyond the scope of IHE. A Query SCU shall include as Return Keys in each C-FIND request all attributes specified as R, R+, R*, or R+*. A Query SCU shall display for the user the returned value of all attributes specified as R or R+ in the normal user interface.

- Required return key SCP:

  IHE-required return keys specified within DICOM as type 1 or type 2 return keys are processed according to their DICOM type. IHE-required return keys specified within DICOM as type 3 will be processed as if they were type 2.

Query Key Requirement Tables in the framework use the following legend to specify requirements for SCUs and SCPs:

- **R** Required
- **O** Optional

The following modifiers are also used:

- **R+** The Requirement is an IHE extension of the DICOM requirements
- **R*** The attribute is not required to be displayed
- **R+*** The Requirement is an IHE extension of the DICOM requirements, but the attribute is NOT required to be displayed

Table 2.2-1 provides an example table defining matching and return keys. Note that sequence attributes are used as a structuring header in these matching and return key tables, and requirements are given for individual sequence items.

Table 2.2-1: Images Query Matching and Return Keys

Attributes Name	Tag	Query Keys Matching		Query Keys Return		Notes
		SCU	SCP	SCU	SCP	
Scheduled Human Performers Sequence	(0040,4034)					
>Human Performer Code Sequence	(0040,4009)					
>>Code Value	(0008,0100)	R+	R	R+*	R	

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Attributes Name	Tag	Query Keys Matching		Query Keys Return		Notes
		SCU	SCP	SCU	SCP	
>>Coding Scheme Designator	(0008,0102)	R+	R	R+*	R	
>>Code Meaning	(0008,0104)	-	-	R+	R	Query Keys Matching SCU or SCP do not use the Code Meaning values ("-").
>Human Performer's Name	(0040,4037)	R+	R+	R+	R+	
>Human Performer's Organization	(0040,4036)	O	O	O	R+	
Input Information Sequence	(0040,4021)					
>Study Instance UID	(0020,000D)	O	O	R+*	R	
…	…	…	…	…	…	…

2.3 HL7 Profiling Conventions

The HL7 tables included in this document have been modified from the corresponding HL7 standard documents. Such a modification is called a profile using static definitions as described for HL7 constrainable message profiles; refer to HL7 v2.5.1, Chapter 2, Section 2.12.6.

The static definition of an IHE-profiled message is represented within tables in the Technical Framework. The message level table represents the IHE-profiled message structure with its list of usable segments. The segment level table represents the IHE-profiled content of one segment with its usable fields.

2.3.1 Static definition – Segment level and Data Type level

The Segment table and the Data Type table each contain 8 columns (HL7 v2.3.1 messages use only 7 columns) as described below:

- **SEQ**: Position (sequence) of the field within the segment.
- **LEN**: Maximum length of the field.

  Since version 2.5, the HL7 standard also defines the maximum length of each component with a field. IHE profiled HL7 messages shall conform to the HL7 standard if not otherwise stated in this Technical Framework.
- **DT**: Field Data Type
- **Usage**: Usage of the field (column noted as **OPT** in HL7 v2.3.1 message static definition.)

  The coded values used in this column are:

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R: Required: A compliant sending application shall populate all "R" elements with a non-empty value. A compliant receiving application may ignore the information conveyed by required elements. A compliant receiving application shall not raise an error due to the presence of a required element, but may raise an error due to the absence of a required element.

R+: Required as IHE extension: This is a field optional in the original HL7 standard but required in the IHE-profiled messages. Only HL7 v2.3.1 messages use this notation to indicate the difference between OPT in the IHE profiles and in the base HL7 standard.

RE: Required but may be empty. ("**R2**" in HL7 v2.3.1 messages)

The element may be missing from the message, but shall be sent by the sending application if there is relevant data. A conformant sending application shall be capable of providing all "RE" elements. If the conformant sending application knows a value for the element, then it shall send that value. If the conformant sending application does not know a value, then that element may be omitted.
Receiving applications may ignore data contained in the element, but shall be able to successfully process the message if the element is omitted (no error message should be generated if the element is missing).

O: Optional. The usage for this field within the message is not defined. The sending application may choose to populate the field; the receiving application may choose to ignore the field.

C: Conditional. This usage has an associated condition predicate. (See HL7 v2.5.1, Chapter 2, Section 2.12.6.6, "Condition Predicate".)

If the predicate is satisfied: A compliant sending application shall populate the element. A compliant receiving application may ignore data in the element. It may raise an error if the element is not present.
If the predicate is NOT satisfied: A compliant sending application shall NOT populate the element. A compliant receiving application shall NOT raise an error if the condition predicate is false and the element is not present, though it may raise an error if the element IS present.
The condition predicate is not explicitly defined when it depends on functional characteristics of the system implementing the transaction and it does not affect data consistency.

CE: Conditional but may be empty. This usage has an associated condition predicate. (See HL7 Version 2.5, Chapter 2, Section 2.12.6.6, "Condition Predicate".)

If the conforming sending application knows the required values for the element, then the application must populate the element. If the conforming sending application does not know the values required for this element, then the element shall be omitted. The conforming sending application must be capable of populating the element (when the predicate is true) for all 'CE' elements. If the element is present, the conformant

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receiving application may ignore the values of that element. If the element is not present, the conformant receiving application shall not raise an error due to the presence or absence of the element.
If the predicate is NOT satisfied: The conformant sending application shall not populate the element. The conformant receiving application may raise an application error if the element is present.

X: Not supported. For conformant sending applications, the element will not be sent. Conformant receiving applications may ignore the element if it is sent, or may raise an application error.

- **Cardinality**: Minimum and maximum number of occurrences for the field in the context of this Transaction.
  - This column is not used in IHE-profiled HL7 v2.3.1 message.
- **TBL#**: Table reference (for fields using a set of defined values)
- **ITEM#**: HL7 unique reference for this field
- **Element Name**: Name of the field in a Segment table. / Component Name: Name of a subfield in a Data Type table.

Table 2.3-1 provides a sample profile for an imaginary HL7 segment. Tables for actual segments are copied from the corresponding HL7 standard versions with modifications made only to the OPT (Usage) column.

Table 2.3-1: Sample HL7 Profile

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	1	ST	R		xx001	Element 1
2	4	ST	O		xx002	Element 2
3	180	HD	R2		xx003	Element 3
4	180	HD	C		xx004	Element 4
5	180	HD	O		xx005	Element 5
6	180	HD	R		xx006	Element 6

Note: This sample table is made for HL7 v2.3.1 message definition in this Technical Framework. For HL7 v2.5.1, one more column “Cardinality” will be added between columns OPT and TBL#.

The lengths of the fields specified in the **LEN** column of profiling tables shall be interpreted in accordance with HL7 standard, where it indicates the calculated length of the single occurrence of the field based on the expected maximum lengths of its individual components.

As such, IHE requires that the receiving actors are able to properly process the fields where each occurrence is up to the maximum length specified in the HL7 profiling tables. Sending actors shall be able to generate messages where single occurrences of fields do not exceed maximum lengths specified in the profiling tables. Both receiving and sending actors shall take into account the mapping of values between HL7 and DICOM (see Section 2.5) so that values of components that are mapped into DICOM do not exceed length limitations of that standard.

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Handling of fields with single occurrence longer than maximum length is out of scope of IHE specifications.

2.3.2 Static definition - Message level

The message table representing the static definition contains 5 columns (HL7 v2.3.1 messages use only 3 columns) as described below:

- **Segment**: gives the segment name, and places the segment within the hierarchy of the message structure designed by HL7.
  - The beginning and end lines of a segment group (see HL7 v2.5.1, Chapter 2, Section 2.5.2 for definition) are designated in this column by --- (3 dashes). The square brackets and braces that designate optionality and repeatability are hidden.
- **Meaning**: Meaning of the segment as defined by HL7.
- **Usage**: Usage of the segment. Same coded values used in the segment level: R, RE, O, C, CE, and X (see Section 2.3.1).
  - This column is not used in HL7 v2.3.1 messages.
- **Cardinality**: Minimum and maximum number of occurrences authorized for this segment in the context of the IHE-profiled HL7 message.
  - This column is not used in HL7 v2.3.1 messages.

HL7 chapter: Reference of the HL7 standard document chapter that describes this segment.

2.4 HL7 Implementation Notes

This section describes the guidance and requirements for the general aspects of implementing IHE-profiled HL7 messages, e.g., message control, acknowledgement, version policy and network associations. Section 2.4.1 lists common requirements for HL7 messages of all versions supported in this Technical Framework, followed by specific requirements for each supported version in individual sections starting from Section 2.4.2.

2.4.1 Common HL7 Message Implementation Requirements

Systems implementing IHE-profiled HL7 messages shall do so according to the HL7 Standard unless otherwise specified in Section 2.4 or the specific transaction.

2.4.1.1 Network Guidelines

The HL7 standards do not define a network communications protocol. The HL7 v2.1 standard defines lower layer protocols in its Appendix C. These definitions were moved to the Implementation Guide in 2.2 and subsequent versions, but are not HL7 requirements. The IHE Framework makes these recommendations:

1. Applications shall use the Minimal Lower Layer Protocol defined in Appendix C of the HL7 Implementation Guide.

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2. An application that wants to send a message (initiate a transaction) will initiate a network connection to start the transaction. The receiver application will respond with an acknowledgement or response to query but will not initiate new transactions on this network connection.

2.4.1.2 Acknowledgement Mode

Applications that receive HL7 messages shall send acknowledgments using the HL7 Original Mode (versus Enhanced Acknowledgment Mode) unless otherwise specified in an IHE RAD transaction.

2.4.1.3 HL7 Versioning

The selection of a particular version of HL7 for any given HL7 based transaction within the Technical Framework is based upon a number of factors. These include:

- Whether the version of HL7 provides the functionality needed for the transaction.
- How widely the version of HL7 is supported at the time of specification

Since the transactions are self-contained communications, the implementation of each HL7 transaction may use a different version of HL7.

An application implementing an IHE transaction with HL7 messages must comply with the message structure and contents defined by the specified version(s) of the HL7 standard as defined in the transaction technical specification, as well as in this section. It is acceptable if the HL7 standard version value (MSH-12) in a conformant message is higher than that specified in the transaction specification of the Technical Framework as long as the message structure and contents meet the requirements of the specification.

2.4.1.4 Empty Field

According to the HL7 standard, if the value of a field is not present, the receiver shall not change corresponding data in its database. However, if sender includes explicit NULL value (i.e., two double-quotes “”), it shall cause removal of any values for that field in the receiver’s database.

2.4.1.5 Z-Segment

IHE prohibits sending Z-segments unless one is defined for a transaction in the IHE Technical Framework.

2.4.2 HL7 v2.3.1 Message Implementation Requirements

2.4.2.1 Acknowledgement Message

The IHE Technical Framework provides for each HL7 message to be acknowledged by the HL7 ACK message sent by the receiver of an HL7 message to its sender. The segments of the ACK message listed below are required, and their detailed descriptions are provided in the following subsections. The ERR segment is optional and may be included if the *MSA-1 Acknowledgment Code* field identifies an error condition.

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Table 2.4-1: Common ACK Message static definition

Segment	Meaning	HL7 chapter
MSH	Message Header	2
MSA	Message Acknowledgement	2
[ERR]	Error	2

Adapted from the HL7 Standard, version 2.3.1

2.4.2.2 Message Control

The MSH (message header) segment contains control information set in the beginning of each message sent.

Table 2.4-2: IHE Profile - MSH segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	1	ST	R		00001	Field Separator
2	4	ST	R		00002	Encoding Characters
3	180	HD	R+		00003	Sending Application
4	180	HD	R+		00004	Sending Facility
5	180	HD	R+		00005	Receiving Application
6	180	HD	R+		00006	Receiving Facility
7	26	TS	R		00007	Date/Time Of Message
8	40	ST	O		00008	Security
9	13	CM	R	0076/ 0003	00009	Message Type
10	20	ST	R		00010	Message Control ID
11	3	PT	R		00011	Processing ID
12	60	VID	R	0104	00012	Version ID
13	15	NM	O		00013	Sequence Number
14	180	ST	O		00014	Continuation Pointer
15	2	ID	O	0155	00015	Accept Acknowledgment Type
16	2	ID	O	0155	00016	Application Acknowledgment Type
17	3	ID	O	0399	00017	Country Code
18	16	ID	C	0211	00692	Character Set
19	250	CE	O		00693	Principal Language Of Message
20	20	ID	O	0356	01317	Alternate Character Set Handling Scheme

Adapted from the HL7 Standard, version 2.3.1

IHE requires that applications support HL7-recommended values for the fields *MSH-1-Field Separator* and *MSH-2-Encoding Characters*.

Field *MSH-18-Character Set* shall only be valued if the message utilizes character sets other than ISO IR-6, also known as ASCII.

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Implementations supporting sequence number protocol (and using the field *MSH-13-Sequence Number)* shall be configurable to allow them to perform transactions without such protocol.

2.4.2.3 Acknowledgement Modes

This segment contains information sent while acknowledging another message.

Table 2.4-3: IHE Profile - MSA segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	2	ID	R	0008	00018	Acknowledgment Code
2	20	ST	R		00010	Message Control ID
3	80	ST	O		00020	Text Message
4	15	NM	O		00021	Expected Sequence Number
5	1	ID	O	0102	00022	Delayed Acknowledgment Type
6	100	CE	O		00023	Error Condition

Adapted from the HL7 standard, version 2.3.1

Field *MSA-1 Acknowledgement Code* shall contain the value AA, AE or AR when using Original Acknowledgement Mode, or CA, CE or CR when using Enhanced Acknowledgement Mode. See HL7 v2.3.1 Chapter 2 Section 2.2.2, 2.2.3 and 2.24.2.1 for details.

Field *MSA-2 Message Control ID* shall contain the Message ID from the *MSH-10 Message Control ID* of the incoming message for which this acknowledgement is sent.

2.4.2.4 ERR – Error Segment

This segment contains information sent while field MSA-1 (acknowledgement code) identifies an error condition.

Table 2.4-4: IHE Profile - ERR segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	80	ID	R		00024	Error code and location

Adapted from the HL7 standard, version 2.3.1

2.4.3 HL7 v2.4 Message Implementation Requirements

HL7 v2.4 is fully backward compatible with HL7 v2.3. Refer to Section 2.4.2 when implementing HL7 v2.4.

2.4.4 HL7 v2.5 Message Implementation Requirements

2.4.4.1 Acknowledgement Message

The IHE Technical Framework provides for each HL7 message to be acknowledged by the HL7 ACK message sent by the receiver of an HL7 message to its sender. The segments of the ACK message listed below are required, and their detailed descriptions are provided in the following

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subsections. The ERR segment is optional and may be included if the *MSA-1 Acknowledgment Code* field identifies an error condition.

Table 2.4-5: Common ACK Message static definition

Segment	Meaning	Usage	Card.	HL7 chapter
MSH	Message Header	R	[1..1]	2
MSA	Message Acknowledgement	R	[1..1]	2
ERR	Error	C	[0..*]	2

Adapted from the HL7 Standard, version 2.5.1

1630 #### 2.4.4.2 Message Control

The MSH (message header) segment contains control information set in the beginning of each message sent.

Table 2.4-6: IHE Profile - MSH segment

SEQ	LEN	DT	Usage	Card.	TBL#	ITEM#	Element name
1	1	SI	R	[1..1]		00001	Field Separator
2	4	ST	R	[1..1]		00002	Encoding Characters
3	227	HD	R	[1..1]		00003	Sending Application
4	227	HD	R	[1..1]		00004	Sending Facility
5	227	HD	R	[1..1]		00005	Receiving Application
6	227	HD	R	[1..1]		00006	Receiving Facility
7	26	TS	R	[1..1]		00007	Date/Time of Message
8	40	ST	X	[0..0]		00008	Security
9	15	MSG	R	[1..1]		00009	Message Type
10	20	ST	R	[1..1]		00010	Message Control Id
11	3	PT	R	[1..1]		00011	Processing Id
12	60	VID	R	[1..1]		00012	Version ID
13	15	NM	O	[0..1]		00013	Sequence Number
14	180	ST	X	[0..0]		00014	Continuation Pointer
15	2	ID	O	[0..0]	0155	00015	Accept Acknowledgement Type
16	2	ID	O	[0..0]	0155	00016	Application Acknowledgement Type
17	3	ID	RE	[1..1]	0399	00017	Country Code
18	16	ID	C	[0..1]	0211	00692	Character Set
19	250	CE	RE	[1..1]		00693	Principal Language of Message
20	20	ID	X	[0..0]	0356	01317	Alternate Character Set Handling Scheme
21	427	EI	RE	[0..*]		01598	Message Profile Identifier

Adapted from the HL7 standard, version 2.5.1

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MSH-1 Field Separator, required: IHE requires that applications support any ASCII value for field separator as specified in the HL7 standard. The value recommended by HL7 is "|" (ASCII 124).

MSH-2 Encoding Characters, required: This field contains the four characters in the following order: the component separator, repetition separator, escape character, and subcomponent separator. IHE requires that applications support any ASCII values for encoding characters as specified in the HL7 standard. The values recommended by HL7 are "^~\&" (ASCII 94, 126, 92, and 38, respectively).

MSH-9 Message Type (MSG), required:

Components: <Message Code (ID)> ^ <Trigger Event (ID)> ^ <Message Structure (ID)>

Definition: This field contains the message type, trigger event, and the message structure ID for the message. All three components are required.

MSH-10 Message Control Id (ST), required:

Definition: This field contains a number or other identifier that uniquely identifies the message in the context of exchange between trading partners. Each message should be given a unique identifier by the sending system. The receiving system will echo this ID back to the sending system in the Message Acknowledgment segment (MSA). The combination of this identifier and the name of the sending application (MSH-3) should be unique across the message exchange environment.

MSH-12 Version ID (VID), required:

Components: <Version ID (ID)> ^ <Internationalization Code (CE)> ^ <International Version ID (CE)>

Definition: This field is matched by the receiving system to its supported version(s) to be sure the message will be interpreted correctly.

The first component SHALL be populated with the value "2.5.1" or higher, representing HL7 Version 2.5.1 or higher. See Section 2.4.1.3.

MSH-17 Country Code (ID), required if available.

Definition: This field contains the country of origin for the message. The values to be used are those of ISO 3166, using the 3-character alphabetic form. Refer to *HL7 Table 0399 - Country code*.

Examples of valid values:

JPN = Japan
USA = United States
GBR = United Kingdom
ITA = Italy
FRA = France
NLD = Netherlands.

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MSH-18 Character Set (ID), conditional.

Definition: This field contains the character set for the entire message. Refer to *HL7 Table 0211 - Alternate character sets* for valid values.

Examples of valid values:

ASCII:	The printable 7-bit ASCII character set.
8859/1:	The printable characters from the ISO 8859/1 Character set used by Western Europe. This character set can still be used, but 8859/15 should be used by preference. This character set is the forward-compatible version of 8859/1 and includes new characters such as the Euro currency symbol.
ISO IR87:	Code for the Japanese Graphic Character set for information interchange (JIS X 0208-1990).
UNICODE UTF-8:	UCS Transformation Format, 8-bit form.

Condition predicate: This field shall only be valued if the message uses a character set other than the 7-bit ASCII character set. Though the field is repeatable in HL7, IHE authorizes only one occurrence (i.e., one character set). The character set specified in this field is used for the encoding of all of the characters within the message.

MSH-19 Principal Language of Message (CE), required if available. Coded from ISO 639.

Examples:

DE = German
EN = English
ES = Spanish
JA = Japanese
FR = French
NL = Dutch
IT = Italian

MSH-20 Alternate Character Set Handling Scheme (ID), not supported: Character set switching is not allowed HL7 transactions of the IHE Technical Frameworks.

MSH-21 Message Profile Identifier (EI), required if available.

This field shall be valued in the messages for which a Message Profile has been officially registered with HL7. When multiple message profiles are listed in this field, they should be vendor specific and/or country specific message profiles constraining the official one.

2.4.4.3 Acknowledgement Modes

This segment contains information sent while acknowledging another message.

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Table 2.4-7: MSA - Message Acknowledgement

SEQ	LEN	DT	Usage	Card.	TBL#	ITEM#	Element name
1	2	ID	R	[1..1]	0008	00018	Acknowledgement code
2	20	ST	R	[1..1]		00010	Message Control Id
3	80	ST	X	[0..0]		00020	Text Message
4	15	NM	O	[0..1]		00021	Expected Sequence Number
5			X	[0..0]		00022	Delayed Acknowledgment Type
6	250	CE	X	[0..0]	0357	00023	Error Condition

Adapted from the HL7 standard, version 2.5.1

MSA-1 Acknowledgment Code (ID), required.

This field shall contain the value AA, AE or AR when using Original Acknowledgement Mode, or CA, CE or CR when using Enhanced Acknowledgement Mode. See HL7 v2.5.1 Chapter 2 Section 2.9.2 and 2.9.3 for details.

MSA-2 Message Control ID (ST), required.

Definition: This field contains the message control ID from Field *MSH-10-Message Control ID* of the incoming message for which the acknowledgement is sent.

MSA-3 Text Message (ST), not supported. See Section 2.4.4.4 for the ERR segment.

MSA-6 Error Condition (CE), not supported. See Section 2.4.4.4 for the ERR segment.

2.4.4.4 ERR - Error segment

This segment is used to add error comments to acknowledgment messages.

Table 2.4-8: ERR – Error segment

SEQ	LEN	DT	Usage	Card.	TBL#	ITEM#	Element name
1	493	ELD	X	[0..0]		00024	Error Code and Location
2	18	ERL	RE	[0..*]		01812	Error Location
3	705	CWE	R	[1..1]	0357	01813	HL7 Error Code
4	2	ID	R	[1..1]	0516	01814	Severity
5	705	CWE	O	[0..1]	0533	01815	Application Error Code
6	80	ST	O	[0..10]		01816	Application Error Parameter
7	2048	TX	O	[0..1]		01817	Diagnostic Information
8	250	TX	O	[0..1]		01818	User Message
9	20	IS	O	[0..*]	0517	01819	Inform Person Indicator
10	705	CWE	O	[0..1]	0518	01820	Override Type
11	705	CWE	O	[0..*]	0519	01821	Override Reason Code
12	652	XTN	O	[0..*]		01822	Help Desk Contact Point

Adapted from the HL7 standard, version 2.5.1

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ERR-1 is deprecated since HL7 Version 2.5 (i.e., retained for backward compatibility only) and therefore not supported by IHE.

ERR-2 is populated except when the error is not within an HL7 field, component or subcomponent. For example, if the receiver returns an acknowledgement containing *MSA-1-acknowledgement code* value **AR** or **CR** to indicate that the receiving application was unavailable, ERR-2 is not populated

ERR-3 HL7 Error Code (CWE) is required. It identifies the HL7 (communication) error code. Valid values are given by HL7 Table 0357:

In case that the receiving application does not recognize either the message type (MSH-9.1) or the trigger event (MSH-9.2) in a message, the components of Field ERR-2 of the acknowledgement shall be populated as follows.

ERR-2.1: **MSH**

ERR-2.2: **1**

ERR-2.3: **9**

ERR-2.4: **1**

ERR-2.5: **1** if an unrecognized message type

2 if an unrecognized trigger event

The components of Field ERR-3 of the acknowledgement shall be populated as follows.

ERR-3.1: **200** if an unrecognized message type

201 if an unrecognized trigger event

ERR-3.2: **Unsupported message type** or

Unsupported trigger event as appropriate

ERR-3.3: **HL70357**

ERR-4 Severity (ID) is required. It identifies the severity of an application error. Valid values are given by HL7 Table 0516.

2.5 HL7 and DICOM Mapping Considerations

Field lengths are explicitly defined in the DICOM standard, but an HL7 element might consist of multiple components that do not have a defined maximum length. It is recognized that there are some HL7 component lengths that could be longer than the DICOM attribute lengths. Data values for mapped fields are required not to exceed the smaller of either the HL7 or the DICOM field length definitions. Systems supporting alternative character sets must take into account the number of bytes per character in such sets. All systems are required to support the DICOM Default Character Set (ISO-IR 6 or ASCII). In addition, other character sets may be supported. Maintaining consistency of data encoded using alternative character sets is outside of the scope of the IHE Technical Framework.

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Value Representations are not explicitly addressed. Attention shall be given to the mapping of the HL7 representation and the DICOM representation. Examples of these include Patient Name, dates and times.

2.6 Use of Coded Entities and Coding Schemes

Where applicable, coding schemes required by the DICOM, HL7, LOINC, and SNOMED standards are used in IHE Profiles. In the cases where such resources are not explicitly identified by standards, implementations may utilize any resource (including proprietary or local) provided any licensing/copyright requirements are satisfied.

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3 Framework Overview

The IHE Technical Framework is based on actors that interact through transactions.

Actors are information systems or components of information systems that produce, manage, or act on information associated with operational activities in the enterprise.

Transactions are interactions between actors that transfer the required information through standards-based messages.

Specific sets of actors and transactions are specified in the Integration Profiles in the Radiology Technical Framework, Volume 1.

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4 IHE Transactions

This section defines each IHE transaction in detail, specifying the standards used, the information transferred, and the conditions under which the transaction is required or optional.

4.1 Patient Registration [RAD-1]

4.1.1 Scope

This transaction involves the patient information, including demographics, captured at the point of encounter. This may occur when the visit is scheduled, if that precedes patient arrival at the institution. This transaction is used for both in-patients (i.e., those who are assigned a bed at the facility) and outpatients (i.e., those who are not assigned a bed at the facility).

4.1.2 Actor Roles

Actor: ADT

Role: Adds and modifies patient demographic and encounter information.

Actor: Order Placer

Role: Receives patient and encounter information for use in order entry.

Actor: Department System Scheduler / Order Filler (DSS/OF)

Role: Receives and stores patient and encounter information for use in fulfilling orders by the Department System Scheduler.

4.1.3 Referenced Standards

HL7 v2.3.1 Chapters 2, 3

HL7 v2.5.1 Chapters 2, 3, 7, 15

IHE ITI Technical Framework

4.1.4 Messages

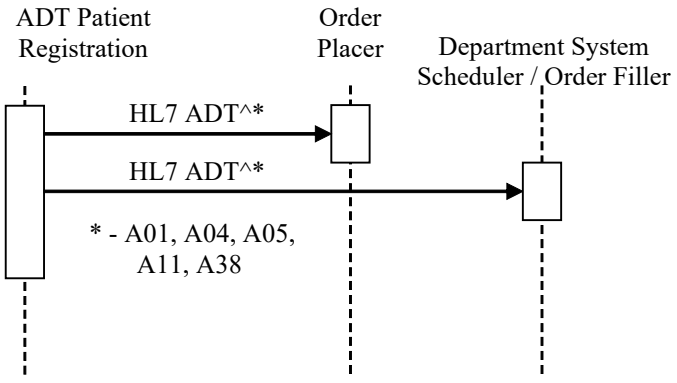

Figure 4.1.4-1: Interaction Diagram

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4.1.4.1 Patient Management – Admit/Register Patient

4.1.4.1.1 Trigger Events

The following events will trigger one of the Admit/Register messages:

- A01 – Admission of an in-patient into a facility
- A04 – Registration of an outpatient for a visit of the facility
- A05 – Pre-admission of an in-patient (i.e., registration of patient information ahead of actual admission).

4.1.4.1.2 Message Semantics

Message semantics are defined for both HL7 v2.3.1 and HL7 v2.5.1. The Profile and/or Options being claimed that incorporate this transaction will specify whether actors are required to support one, the other, or both sets of semantics.

4.1.4.1.2.1 Message Semantics (HL7 v2.3.1)

The Patient Registration transaction is conducted by the HL7 ADT message. The ADT Actor shall generate the message whenever a patient is admitted, pre-admitted or registered. In the event that a new patient will be seen as an outpatient at some future time, an ADT A04 message shall be used to convey patient information required by the Order Placer or Order Filler. Pre-admission of inpatients shall use the A05 message. The segments of the message listed below are required, and their detailed descriptions are provided in the following subsections.

One or more AL1 segments shall be present if any allergies are identified for the patient at the time of registration. It may be absent otherwise.

One or more OBX segments shall be present if the information about patient weight and/or height is present. They may be absent otherwise.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.3.

Required segments are defined below. Other segments are optional

ADT	Patient Administration Message	Chapter in HL7 2.3.1
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
PV1	Patient Visit	3
[{OBX}]	Observation/Result	7
[{AL1}]	Allergy Information	3

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of ADT message to its sender. See Section 2.4.3 “Acknowledgement Modes” for definition and discussion of the ACK message.

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4.1.4.1.2.1.1 MSH Segment (HL7 v2.3.1)

MSH segment shall be constructed as defined in the Section 2.4.2.2 “Message Control”.

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of “ADT”; the second component shall have values of A01, A04 or A05 as appropriate. The third component is optional; however, if present, it shall have a value of ADT_01.

4.1.4.1.2.1.2 EVN Segment (HL7 v2.3.1)

Table 4.1-1 identifies required and optional fields of the EVN segment.

Table 4.1-1: IHE Profile - EVN segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	3	ID	O	0003	00099	Event Type Code
2	26	TS	R		00100	Recorded Date/Time
3	26	TS	O		00101	Date/Time Planned Event
4	3	IS	O	0062	00102	Event Reason Code
5	60	XCN	O	0188	00103	Operator ID
6	26	TS	R2		01278	Event Occurred

Adapted from the HL7 Standard, version 2.3.1

Field *EVN-1 Event Type Code* is optional; however, if present, its value shall be equal to the second component of the field *MSH-9 Message Type*.

4.1.4.1.2.1.3 PID Segment (HL7 v2.3.1)

Table 4.1-2 identifies required and optional fields of the PID segment.

Table 4.1-2: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	O		00104	Set ID - Patient ID
2	20	CX	O		00105	Patient ID
3	20	CX	R		00106	Patient Identifier List
4	20	CX	O		00107	Alternate Patient ID
5	48	XPN	R		00108	Patient Name
6	48	XPN	O		00109	Mother’s Maiden Name
7	26	TS	R2		00110	Date/Time of Birth
8	1	IS	R	0001	00111	Sex
9	48	XPN	O		00112	Patient Alias
10	80	CE	R2	0005	00113	Race
11	106	XAD	R2		00114	Patient Address
12	4	IS	O		00115	County Code
13	40	XTN	O		00116	Phone Number - Home

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SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
14	40	XTN	O		00117	Phone Number - Business
15	60	CE	O	0296	00118	Primary Language
16	1	IS	O	0002	00119	Marital Status
17	80	CE	O	0006	00120	Religion
18	20	CX	C		00121	Patient Account Number
19	16	ST	O		00122	SSN Number – Patient
20	25	DLN	O		00123	Driver's License Number - Patient
21	20	CX	O		00124	Mother's Identifier
22	80	CE	O	0189	00125	Ethnic Group
23	60	ST	O		00126	Birth Place
24	1	ID	O	0136	00127	Multiple Birth Indicator
25	2	NM	O		00128	Birth Order
26	80	CE	O	0171	00129	Citizenship
27	60	CE	O	0172	00130	Veterans Military Status
28	80	CE	O		00739	Nationality
29	26	TS	O		00740	Patient Death Date and Time
30	1	ID	O	0136	00741	Patient Death Indicator

Adapted from the HL7 standard, version 2.3.1

Additional requirements for the presence of a value in these PID fields may be documented in regional or national extensions to the IHE Technical Framework (see RAD TF-4).

Field *PID-3 Patient Identifier List* - Patient IDs included in the PID-3 field shall include Assigning Authority (Component 4). The first subcomponent (namespace ID) of Assigning Authority shall be populated. If the second and third subcomponents (universal ID and universal ID type) are also populated, they shall reference the same entity as is referenced in the first subcomponent. See RAD TF-2x: Appendix B and Appendix D for further discussion of the use of PID-3 in transactions and its mapping from HL7 messages to DICOM Patient ID (0010,0020).

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued.

4.1.4.1.2.1.4 PV1 Segment (HL7 v2.3.1)

Table 4.1-3: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	O		00131	Set ID - PV1
2	1	IS	R	0004	00132	Patient Class
3	80	PL	C		00133	Assigned Patient Location
4	2	IS	O	0007	00134	Admission Type
5	20	CX	O		00135	Preadmit Number
6	80	PL	O		00136	Prior Patient Location

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SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
7	60	XCN	C	0010	00137	Attending Doctor
8	60	XCN	C	0010	00138	Referring Doctor
9	60	XCN	R2	0010	00139	Consulting Doctor
10	3	IS	C	0069	00140	Hospital Service
11	80	PL	O		00141	Temporary Location
12	2	IS	O	0087	00142	Preadmit Test Indicator
13	2	IS	O	0092	00143	Readmission Indicator
14	3	IS	O	0023	00144	Admit Source
15	2	IS	C	0009	00145	Ambulatory Status
16	2	IS	O	0099	00146	VIP Indicator
17	60	XCN	C	0010	00147	Admitting Doctor
18	2	IS	O	0018	00148	Patient Type
19	20	CX	C		00149	Visit Number
20	50	FC	O	0064	00150	Financial Class
21	2	IS	O	0032	00151	Charge Price Indicator
22	2	IS	O	0045	00152	Courtesy Code
23	2	IS	O	0046	00153	Credit Rating
24	2	IS	O	0044	00154	Contract Code
25	8	DT	O		00155	Contract Effective Date
26	12	NM	O		00156	Contract Amount
27	3	NM	O		00157	Contract Period
28	2	IS	O	0073	00158	Interest Code
29	1	IS	O	0110	00159	Transfer to Bad Debt Code
30	8	DT	O		00160	Transfer to Bad Debt Date
31	10	IS	O	0021	00161	Bad Debt Agency Code
32	12	NM	O		00162	Bad Debt Transfer Amount
33	12	NM	O		00163	Bad Debt Recovery Amount
34	1	IS	O	0111	00164	Delete Account Indicator
35	8	DT	O		00165	Delete Account Date
36	3	IS	O	0112	00166	Discharge Disposition
37	25	CM	O	0113	00167	Discharged to Location
38	80	CE	O	0114	00168	Diet Type
39	2	IS	O	0115	00169	Servicing Facility
40	1	IS	O	0116	00170	Bed Status
41	2	IS	O	0117	00171	Account Status
42	80	PL	O		00172	Pending Location
43	80	PL	O		00173	Prior Temporary Location
44	26	TS	O		00174	Admit Date/Time
45	26	TS	O		00175	Discharge Date/Time
46	12	NM	O		00176	Current Patient Balance

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SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
47	12	NM	O		00177	Total Charges
48	12	NM	O		00178	Total Adjustments
49	12	NM	O		00179	Total Payments
50	20	CX	O	0203	00180	Alternate Visit ID
51	1	IS	C	0326	01226	Visit Indicator
52	60	XCN	O	0010	01224	Other Healthcare Provider

Adapted from the HL7 standard, version 2.3.1

Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Technical Framework (see RAD TF-4).

Fields *PV1-3 Assigned Patient Location, PV1-7 Attending Doctor, PV1-10 Hospital Service, PV1-17 Admitting Doctor* shall be valued only when admitting in-patient, i.e., when the *MSH-9 Message Type* is ADT^A01.

Field *PV1-8 Referring Doctor* shall be valued when registering an outpatient (MSH-9 Message Type is ADT^A04) or when pre-registering a patient (MSH-9 Message Type is ADT^A05).

Field *PV1-15 Ambulatory Status* shall be valued when patient status indicates certain conditions such as pregnancy. May be omitted if none of the defined statuses are applicable to a patient.

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued.

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

4.1.4.1.2.1.5 AL1 Segment (HL7 v2.3.1)

Table 4.1-4: IHE Profile – AL1 segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	R		00203	Set ID - AL1
2	2	IS	O	0127	00204	Allergy Type
3	60	CE	R		00205	Allergy Code/Mnemonic/Description
4	2	IS	O	0128	00206	Allergy Severity
5	15	ST	O		00207	Allergy Reaction
6	8	DT	O		00208	Identification Date

Adapted from the HL7 standard, version 2.3.1

4.1.4.1.2.1.6 OBX Segment (HL7 v2.3.1)

The IHE Technical Framework includes the OBX segment primarily for the purposes of communicating patient height and weight. In this context, the optionality of fields *OBX-3 Observation Identifier* has been changed to "R2" and *OBX-4 Observation Result Status* has been

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changed to “O”. Please refer to RAD TF-2x: Appendix B for additional details on Patient Height and Weight mapping.

Field *OBX-6 Units* is optional. When the OBX segments are sent to transmit the height and weight, this field shall be valued.

Table 4.1-5: IHE Profile - OBX Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	O		00569	Set ID - OBX
2	3	ID	C	0125	00570	Value Type
3	80	CE	R		00571	Observation Identifier
4	20	ST	C		00572	Observation Sub-ID
5	65536	*	C		00573	Observation Value
6	60	CE	O		00574	Units
7	60	ST	O		00575	References Range
8	5	ID	O	0078	00576	Abnormal Flags
9	5	NM	O		00577	Probability
10	2	ID	O	0080	00578	Nature of Abnormal Test
11	1	ID	R	0085	00579	Observe Result Status
12	26	TS	O		00580	Date Last Obs Normal Values
13	20	ST	O		00581	User Defined Access Checks
14	26	TS	O		00582	Date/Time of the Observation
15	60	CE	O		00583	Producer's ID
16	80	XCN	O		00584	Responsible Observer
17	60	CE	O		00936	Observation Method

Adapted from the HL7 Standard, version 2.3.1

4.1.4.1.2.2 Message Semantics (HL7 v2.5.1)

Actors shall implement the message semantics of Patient Encounter Management [ITI-31] for each trigger event specified in Section 4.1.4.1.1.

The Patient Management-Admit/Register Patient messages are defined in the ITI Technical Framework as follows:

- ADT^A01 Admit Patient in ITI TF-2: 3.31.7.1 Admit/Visit Notification (ADT^A01^ADT_A01)
- ADT^A04 Register Patient in ITI TF-2: 3.31.7.3 Register a Patient (ADT^A04^ADT_A01)
- ADT^A05 Pre-Admit Patient in ITI TF-2: 3.31.7.7 Pre-Admit (ADT^A05^ADT_A05)

Required and conditional segments are defined below. Other segments are optional.

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Segment	Meaning	Usage	Card.	HL7 chapter
MSH	Message Header	R	[1..1]	2
EVN	Event Type	R	[1..1]	3
PID	Patient Identification	R	[1..1]	3
PV1	Patient Visit	R	[1..1]	3
ROL	Role	R2	[0..*]	15
OBX	Observation/Result	C	[0..*]	7
AL1	Allergy Information	C	[0..*]	3

The allergy segment AL1 shall be present if allergy information is added/updated. OBX segment(s) shall be present if patient weight and/or height is updated.

4.1.4.1.2.2.1 MSH Segment (HL7 v2.5.1)

The MSH segment shall be constructed as defined in ITI TF-2: 3.30.5.1 MSH – Header Segment. Additional specifications for actors complying with the IHE Radiology Technical Framework are defined in Section 2.4.

Field *MSH-9-Message Type* shall have three components. The first component shall have a value of ADT; the second component shall have values of A01, A04 or A05 as appropriate. The third component shall have a value of ADT_A01 for the A01 and A04 trigger events, or ADT_A05 for the A05 trigger event.

4.1.4.1.2.2.2 EVN Segment (HL7 v2.5.1)

The EVN segment shall be constructed as defined in ITI TF-2: 3.30.5.2 EVN – Event Type Segment.

4.1.4.1.2.2.3 PID Segment (HL7 v2.5.1)

The PID Segment shall be constructed as defined in ITI TF-2: 3.30.5.3 PID – Patient Identification Segment. Additional required and conditionally required fields are specified in Table 4.1-6.

Table 4.1-6: IHE Profile - PID Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
7	26	TS	R2		00110	Date/Time of Birth
8	1	IS	R	0001	00111	Administrative Sex
10	250	CE	R2	0005	00113	Race
11	250	XAD	R2		00114	Patient Address
18	250	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.5.1

Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Technical Framework (see RAD TF-4).

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Field *PID-3 Patient Identifier List* - Patient IDs in the PID-3 field shall include Assigning Authority (Component 4) and Identifier Type Code (Component 5). The first subcomponent (namespace ID) of Assigning Authority shall be populated. If the second and third subcomponents (universal ID and universal ID type) are also populated, they shall reference the same entity as is referenced in the first subcomponent. ITI TF-2: 3.30.5.3 "PID – Patient Identification Segment" provides additional details for implementing the PID-3 components. See RAD TF-2x: Appendix D for further discussion of the use of PID-3 in transactions and its mapping from HL7 messages to DICOM Patient ID (0010, 0020).

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued. At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued.

4.1.4.1.2.2.4 PV1 Segment (HL7 v2.5.1)

The PV1 Segment shall be constructed as defined in ITI TF-2: 3.30.5.4 PV1 - Patient Visit Segment.

Additional optional, prohibited and conditionally required fields are specified in Table 4.1-7

Table 4.1-7: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
6	80	PL	O		00136	Prior Patient Location
7	250	XCN	C	0010	00137	Attending Doctor
8	250	XCN	C	0010	00138	Referring Doctor
9	250	XCN	X	0010	00139	Consulting Doctor
10	3	IS	C	0069	00140	Hospital Service
11	80	PL	O		00141	Temporary Location
15	2	IS	C	0009	00145	Ambulatory Status
17	250	XCN	C	0010	00147	Admitting Doctor
19	20	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.5.1

Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Technical Framework (see RAD TF-4).

Fields *PV1-3-Assigned Patient Location*, *PV1-7-Attending Doctor*, *PV1-10-Hospital Service*, *PV1-17-Admitting Doctor* shall be valued only when admitting an inpatient, i.e., when the value of *MSH-9-Message Type* is ADT^A01^ADT_A01.

Field *PV1-8-Referring Doctor* shall be valued when registering an outpatient (*MSH-9- Message Type* is ADT^A04^ADT_A01) or when pre-registering a patient (*MSH-9-Message Type* is ADT^A05^ADT_A05).

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The PV1 segment shall be followed for each of the attending doctor, admitting doctor, and referring doctor, by a ROL segment.

Field *PV1-9-Consulting Doctor* shall not be present. The consulting doctor(s) are required and entirely described in the ROL segments.

Field *PV1-15-Ambulatory Status* shall be valued when patient status indicates pregnancy (patient is pregnant). It may be omitted otherwise.

At least one of the *fields PID-18-Patient Account Number or PV1-19-Visit Number* shall be valued.

Field *PV1-51-Visit Indicator* shall be valued with value "V" if the field *PV1-19-Visit Number* is valued. It may be omitted otherwise.

4.1.4.1.2.2.5 ROL Segment (HL7 v2.5.1)

One ROL segment shall be included for each attending doctor, admitting doctor, referring doctor and consulting doctor, if any. Note that some Provider Role codes in the ROL Segment use the word "Provider" rather than "Doctor".

The ROL Segment shall be constructed as defined in ITI TF-2: 3.30.5.6 ROL- Role Segment.

4.1.4.1.2.2.6 OBX Segment (HL7 v2.5.1)

The OBX Segment shall be constructed as defined in ITI TF-2: 3.30.5.7 OBX – Observation/Result Segment.

Additional optional, required and conditionally required fields are specified in Table 4.1-8.

Table 4.1-8: IHE Profile - OBX Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
2	2	ID	C	0125	00570	Value Type
3	250	CE	R2		00571	Observation Identifier
4	20	ST	C		00572	Observation Sub-ID
5	99999	varies	C		00573	Observation Value
6	250	CE	C		00574	Units
11	1	ID	R	0085	00579	Observe Result Status

Adapted from the HL7 Standard, version 2.5.1

Refer to RAD TF-2x: Appendix B for additional details on Patient Height and Weight mapping.

Field *OBX-6-Units* is required if the OBX segments are sent to transmit the height and weight.

4.1.4.1.2.2.7 AL1 Segment (HL7 v2.5.1)

The AL1 Segment shall be constructed as defined in ITI TF-2: 3.30.5.8 AL1 - Patient Allergy Information Segment.

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4.1.4.1.3 Expected Actions

The receiver of the ADT Patient Registration transaction message shall create a new patient record for the patient identified if there is no current record for the Patient ID (defined by the field *PID-3*). Interpretation of A01, A04 and A05 messages after the patient record was created is beyond the scope of the IHE Technical Framework; however, the ADT Patient Registration [RAD-1] transaction shall not be used to update information in an existing patient record. The Patient Update [RAD-12] transaction shall be used instead.

The interpretation of A01, A04 and A05 messages after the patient record was created is described in the ITI Technical Framework in the following sections:

- ITI TF-2: 3.31.7.1.4 Expected Actions for Admit/Visit Notification
- ITI TF-2: 3.31.7.3.4 Expected Actions for Register a Patient
- ITI TF-2: 3.31.7.7.4 Expected Actions for Pre-Admit

4.1.4.2 Patient Management – Cancel Admit/Register Patient

4.1.4.2.1 Trigger Events

The following events will trigger one of the Admit/Register messages:

- A11 – Admission of an in-patient into a facility or registration of an outpatient for a visit of the facility has been cancelled due to error in the information or the decision not to admit/register patient after all.
- A38 – Pre-admission of an in-patient (i.e., registration of patient information ahead of actual admission) has been cancelled due to error in the information or the decision not to admit/register patient after all.

4.1.4.2.2 Message Semantics

Message semantics are defined for both HL7 v2.3.1 and HL7 v2.5.1. The Profile and/or Options being claimed that incorporate this transaction will specify whether actors are required to support one, the other, or both sets of semantics.

4.1.4.2.2.1 Message Semantics (HL7 v2.3.1)

Patient Registration conveyed by the HL7 ADT^A01, ADT^A04 or ADT^A05 may have to be revoked due to the errors in the information or the decision of not admitting/registering patient. The cancellation transaction is conveyed by the HL7 ADT^A11 or ADT^A38 messages. ADT^A11 shall be used to revoke the transaction conveyed by the ADT^A01 or ADT^A04 message. ADT^A38 shall be used to revoke transaction conveyed by the ADT^A05 message.

Cancellation messages shall be used only if no other transactions were performed by the ADT on the patient record after the admit/registration transaction was conveyed.

The segments of the message listed below are required, and their detailed descriptions are provided in subsections below. All other segments are optional.

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Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.3.

ADT	Patient Administration Message	Chapter in HL7 2.3.1
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
PV1	Patient Visit	3

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of ADT message to its sender. See Section 2.4.3 “Acknowledgement Modes” for definition and discussion of the ACK message.

4.1.4.2.2.1.1 MSH Segment (HL7 v2.3.1)

MSH segment shall be constructed as defined in the Section 2.4.2.2 “Message Control”.

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of “ADT”; the second component shall have values of A11 or A38 as appropriate. The third component is optional; however, if present, it shall have a value of ADT_A09 (for the A11 message) or ADT_A38 (for A38 message).

4.1.4.2.2.1.2 EVN Segment (HL7 v2.3.1)

See Section 4.1.4.1.2.1.2 for required and optional fields of the EVN segment.

4.1.4.2.2.1.3 PID Segment (HL7 v2.3.1)

All of the fields in PID segment are optional, except those listed in Table 4.1-9. See Section 4.1.4.1.2.1.3 for the list of all fields of the PID segment.

Table 4.1-9: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	20	CX	R		00106	Patient Identifier List
5	48	XPN	R		00108	Patient Name
18	20	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.3.1

4.1.4.2.2.1.4 PV1 Segment (HL7 v2.3.1)

All of the fields in PV1 segment are optional, except those listed in Table 4.1-10. See Section 4.1.4.1.2.1.4 for the list of all fields of the PV1 segment.

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Table 4.1-10: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	20	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.3.1

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued. Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4). It is required if it has been present in the registration message A01, A04 or A05 that is being cancelled by this transaction.

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

4.1.4.2.2.2 Message Semantics (HL7 v2.5.1)

The Patient Management-Cancel Admit/Register Patient [RAD-1] transaction is implemented by the Patient Encounter Management [ITI-31] transaction triggers events and related messages:

- ADT^A11 Cancel Admit Patient
- ADT^A38 Cancel Pre-Admit Patient

The above messages are described in the following sections:

- ITI TF-2: 3.31.7.2 Cancel Admit/Visit Notification (ADT^A11^ADT_A09)
- ITI TF-2: 3.31.7.8 Cancel Pre-Admit (ADT^A38^ADT_A38)

4.1.4.2.2.2.1 MSH Segment (HL7 v2.5.1)

The MSH segment shall be constructed as defined in ITI TF-2: 3.30.5.1 MSH – Header Segment. Additional specifications for actors complying with the IHE Radiology Technical Framework are defined in Section 2.4.

Field *MSH-9-Message Type* shall have three components. The first component shall have a value of ADT; the second component shall have values of A11 or A38 as appropriate. The third component shall have a value of ADT_A09 (for the A11 message) or ADT_A38 (for the A38 message).

4.1.4.2.2.2.2 EVN Segment (HL7 v2.5.1)

The EVN segment shall be constructed as defined in ITI TF-2: 3.30.5.2 EVN – Event Type Segment.

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4.1.4.2.2.2.3 PID Segment (HL7 v2.5.1)

All of the fields in the PID segment are optional, except those listed in Table 4.1-11. See Section 4.1.4.1.2.2.3 for a full discussion of the PID segment.

Table 4.1-11: IHE Profile - PID Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	250	CX	R		00106	Patient Identifier List
5	250	XPN	R		00108	Patient Name
18	250	CX	C		00121	Patient Account Number

*Adapted from the HL7 standard, version 2.*5.1

4.1.4.2.2.2.4 PV1 Segment (HL7 v2.5.1)

All of the fields in the PV1 segment are optional, except those listed in Table 4.1-12. See Section 4.1.4.1.2.2.4 for a full discussion of the PV1 segment.

Table 4.1-12: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	250	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.5.1

Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Technical Framework (see RAD TF-4).

At least one of the fields *PID-18-Patient Account Number* or *PV1-19-Visit Number* shall be valued. It is required if it has been present in the registration message A01, A04 or A05 that is being cancelled by this transaction.

Field *PV1-51-Visit Indicator* shall be valued with value "V" if the field *PV1-19-Visit Number* is valued. It may be omitted otherwise.

4.1.4.2.3 Expected Actions

If the patient record was created as a result of a Patient Registration transaction, such record shall be discarded. If the Patient Registration transaction was sent for an existing patient record, the corresponding operations shall be "rewound" to restore the record condition existing before Patient Transaction was sent.

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4.2 Placer Order Management [RAD-2]

4.2.1 Scope

This transaction is used by the Order Placer to place a new order with the Order Filler. It also allows the Order Placer to cancel the order. For the Order Placer asserting compliance with HL7 Version 2.5.1, this transaction is used to change an order with the Order. For the Order Placer asserting compliance to HL7 Version 2.3.1, to change order information, the Order Placer would cancel the initial order and place the new one. The Order Placer and Department System Scheduler/Order Filler must agree on the support of recurring orders and panel orders, if used.

Recurring order: An order with a performance frequency greater than one. For example, portable chest x-ray at 6:00 AM for the next seven days.

Panel order: A service item with more than one observation component. For example, a nuclear cardiac study that has a cardiology component and a radiology component that are usually reported on separately.

For an illustration of mapping between transactions [RAD-2], [RAD-3], [RAD-5], [RAD-6] and [RAD-7], see the IHE white paper "Code Mapping in IHE Radiology Profiles", https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE_RAD_White-Paper_Codes.pdf.

4.2.2 Actor Roles

Actor: Order Placer

Role: Places orders. Cancels orders as necessary.

Actor: Department System Scheduler/Order Filler

Role: Receives and processes (fills) orders. Receives order cancellations.

4.2.3 Referenced Standards

HL7 v2.3.1 Chapter 4

HL7 v2.5.1 Chapter 4

4.2.4 Messages

The following diagram illustrates interactions between actors within systems implementing HL7 v2.3.1:

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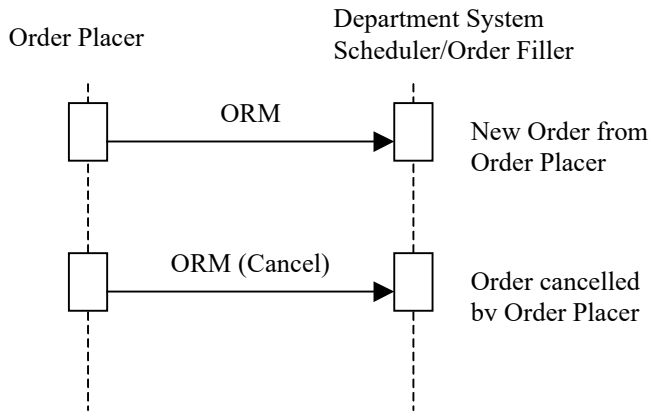

Figure 4.2.4-1: Interactions between actors within systems implementing HL7 v2.3.1

The following diagram illustrates interactions between actors within systems implementing HL7 v2.5.1:

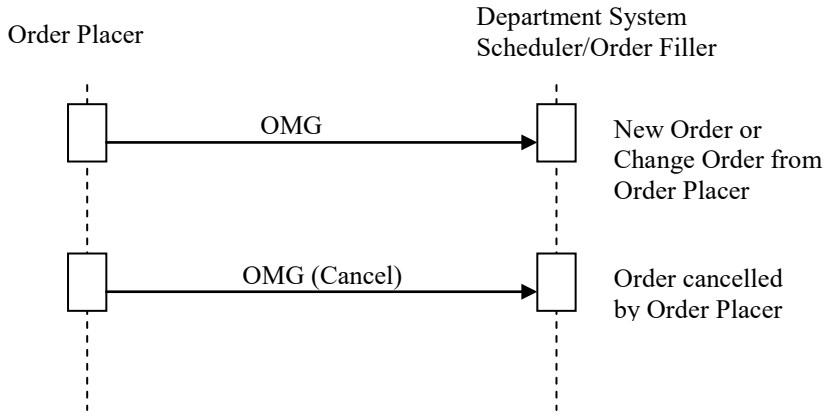

Figure 4.2.4-2: Interactions between actors within systems implementing HL7 v2.5.1

4.2.4.1 Order Management – New Order from Order Placer

4.2.4.1.1 Trigger Events

The following event will trigger the ORM messages within systems implementing HL7 v2.3.1:

ORM – The Order Placer places a new order for the Department System Scheduler/Order Filler.

The following event will trigger the OMG messages within systems implementing HL7 v2.5.1:

OMG – The Order Placer places a new order for the Department System Scheduler/Order Filler.

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4.2.4.1.2 Message Semantics

Message semantics are defined for both HL7 v2.3.1 and HL7 v2.5.1. The Profile and/or Options being claimed that incorporate this transaction will specify whether actors are required to support one, the other, or both sets of semantics.

4.2.4.1.2.1 Message Semantics (HL7 v2.3.1)

HL7 2.3.1 Chapter 4 ORM message. Refer to HL7 Standard for general message semantics.

The order start date/time or exam date/time is required in the "Quantity/Timing" field of both the ORC and OBR segments (ORC-7.4; OBR-27.4).

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.3.

Required segments are listed below. Other segments are optional.

ORM	General Order Message	Chapter in HL7 2.3.1
MSH	Message Header	2
PID	Patient Identification	3
PV1	Patient Visit	3
ORC	Common Order	4
OBR	Order Detail	4

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of ADT message to its sender. See Section 2.4.3 "Acknowledgement Modes" for definition and discussion of the ACK message.

4.2.4.1.2.1.1 MSH Segment (HL7 v2.3.1)

MSH segment shall be constructed as defined in the Section 2.4.2.2 "Message Control".

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of "ORM"; the second component shall have value of O01. The third component is optional; however, if present, it shall have a value of ORM_O01.

4.2.4.1.2.1.2 PID Segment (HL7 v2.3.1)

All of the fields in PID segment are optional, except those listed in Table 4.2-1. See Section 4.1.4.1.2.1.3 for the list of all fields of the PID segment.

Table 4.2-1: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	20	CX	R		00106	Patient Identifier List
5	48	XPN	R		00108	Patient Name
18	20	CX	C		00121	Patient Account Number

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Adapted from the HL7 standard, version 2.3.1

4.2.4.1.2.1.3 PV1 Segment (HL7 v2.3.1)

All of the fields in PV1 segment are optional, except those listed in Table 4.2-2. See Section 4.1.4.1.2.1.4 for the list of all fields of the PV1 segment.

Table 4.2-2: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
8	60	XCN	R2	0010	00138	Referring Doctor
19	20	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.3.1

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued. Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

4.2.4.1.2.1.4 ORC Segment (HL7 v2.3.1)

ORC segment conveys common order information.

Table 4.2-3: IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	R		00216	Placer Order Number
3	22	EI	O		00217	Filler Order Number
4	22	EI	C		00218	Placer Group Number
5	2	ID	O	0038	00219	Order Status
6	1	ID	O	0121	00220	Response Flag
7	200	TQ	R		00221	Quantity/Timing
8	200	CM	C		00222	Parent
9	26	TS	R		00223	Date/Time of Transaction
10	120	XCN	R2		00224	Entered By
11	120	XCN	O		00225	Verified By
12	120	XCN	R		00226	Ordering Provider
13	80	PL	O		00227	Enterer's Location
14	40	XTN	R2		00228	Call Back Phone Number
15	26	TS	O		00229	Order Effective Date/Time

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SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
16	200	CE	O		00230	Order Control Code Reason
17	60	CE	R		00231	Entering Organization
18	60	CE	O		00232	Entering Device
19	120	XCN	O		00233	Action By

Adapted from the HL7 Standard, version 2.3.1

Field *ORC-3 Filler Order Number* shall not be present.

Field *ORC-4 Placer Group Number* shall be valued only if the Order Placer and Order Filler utilize concept of Order Groups. Shall not be present otherwise.

Field *ORC-8 Parent* shall be valued only if the current order is a child order (i.e., if the field *ORC-1 Order Control* has a value of CH).

The action to be performed in the ORM message is defined by the Order Control code passed as part of the message. HL7 defines a number of Order Control codes.

The order control codes below shall be supported.

Supported Order Control Codes

Value	Description
NW [R]	New order
PA [O]	Parent order
CH [O]	Child order

Adapted from the HL7 Standard, version 2.3.1

[R]=Required; [O]=Optional

Note: The use of Required/Optional superscripts in the Value column is an IHE extension and is not part of the HL7 Standard.

4.2.4.1.2.1.5 OBR Segment (HL7 v2.3.1)

Table 4.2-4: IHE Profile - OBR Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	4	SI	O		00237	Set ID - OBR
2	75	EI	R		00216	Placer Order Number
3	75	EI	O		00217	Filler Order Number
4	200	CE	R		00238	Universal Service ID
5	2	ID	O		00239	Priority
6	26	TS	O		00240	Requested Date/time
7	26	TS	O		00241	Observation Date/Time

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SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
8	26	TS	O		00242	Observation End Date/Time
9	20	CQ	O		00243	Collection Volume
10	60	XCN	O		00244	Collector Identifier
11	1	ID	O	0065	00245	Specimen Action Code
12	60	CE	R2		00246	Danger Code
13	300	ST	C		00247	Relevant Clinical Info.
14	26	TS	O		00248	Specimen Received Date/Time
15	300	CM	C	0070	00249	Specimen Source
16	80	XCN	R		00226	Ordering Provider
17	40	XTN	O		00250	Order Callback Phone Number
18	60	ST	O		00251	Placer field 1
19	60	ST	O		00252	Placer field 2
20	60	ST	O		00253	Filler Field 1
21	60	ST	O		00254	Filler Field 2
22	26	TS	O		00255	Results Rpt/Status Chng - Date/Time
23	40	CM	O		00256	Charge to Practice
24	10	ID	O	0074	00257	Diagnostic Serv Sect ID
25	1	ID	O	0123	00258	Result Status
26	400	CM	O		00259	Parent Result
27	200	TQ	R		00221	Quantity/Timing
28	150	XCN	O		00260	Result Copies To
29	150	CM	C		00261	Parent
30	20	ID	R2	0124	00262	Transportation Mode
31	300	CE	R2		00263	Reason for Study
32	200	CM	O		00264	Principal Result Interpreter
33	200	CM	O		00265	Assistant Result Interpreter
34	200	CM	O		00266	Technician
35	200	CM	O		00267	Transcriptionist
36	26	TS	O		00268	Scheduled Date/Time
37	4	NM	O		01028	Number of Sample Containers
38	60	CE	O		01029	Transport Logistics of Collected Sample
39	200	CE	O		01030	Collector’s Comment
40	60	CE	O		01031	Transport Arrangement Responsibility
41	30	ID	R2	0224	01032	Transport Arranged
42	1	ID	O	0225	01033	Escort Required
43	200	CE	O		01034	Planned Patient Transport Comment

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SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
44	80	CE	O	0088	00393	Procedure Code
45	80	CE	O	0340	01036	Procedure Code Modifier

Adapted from the HL7 Standard, version 2.3.1

Field *OBR-13 Relevant Clinical Info* shall be populated if patient record contains any medical alerts that may be relevant to the order and, in particular, need to be communicated to the technologist.

Field *OBR-15 Specimen Source* holds the laterality (Left/Right) indicator (when used) in the <site modifier (CE)> component. See RAD TF-2x: Appendix B for details.

Per the HL7 Standard, IHE recommends that the fields in ORC and OBR segments given in the following table contain the same information.

Identical Element Mappings between ORC and OBR Segments

Element Name	ORC Segment Element	OBR Segment Element
Placer Order Number	ORC-2	OBR-2
Filler Order Number	ORC-3	OBR-3
Quantity/Timing	ORC-7	OBR-27
Parent	ORC-8	OBR-29

4.2.4.1.2.2 Message Semantics (HL7 v2.5.1)

The HL7 v2.5.1 Message Semantics implements the Chapter 4 OMG message. Refer to the HL7 Standard for general message semantics.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.3.

Required and conditional segments are listed below. Other segments are optional.

Segment	Meaning	Usage	Card.	HL7 chapter
MSH	Message Header	R	[1..1]	2
PID	Patient Identification	R	[1..1]	3
PV1	Patient Visit	R	[1..1]	3
AL1	Allergy Information	C	[0..*]	3
ORC	Common Order	R	[1..*]	4
TQ1	Timing/Quantity	R	[1..1]	4
OBR	Order Detail	R	[1..1]	4
OBX	Observation/Result	C	[0..*]	7

The allergy segment AL1 shall be present if allergy information is added/updated. The OBX segment(s) shall be present if patient weight and/or height is updated.

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Each message shall be acknowledged by the HL7 ACK message sent by the receiver of the OMG message to its sender. See Section 2.4.4 for definition and discussion of the ACK message.

4.2.4.1.2.2.1 MSH Segment (HL7 v2.5.1)

The MSH segment shall be constructed as defined in ITI TF-2: 3.30.5.1 MSH – Header Segment. Additional specifications for actors complying with the IHE Radiology Technical Framework are defined in Section 2.4.

Field *MSH-9-Message Type* shall have three components. The first component shall have a value of OMG; the second component shall have a value of O19; the third component shall have a value of OMG_O19.

4.2.4.1.2.2.2 PID Segment (HL7 v2.5.1)

All of the fields in the PID segment are optional, except those listed in Table 4.2-5. See Section 4.1.4.1.2.2.3 for further discussion of the PID segment.

Table 4.2-5: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	250	CX	R		00106	Patient Identifier List
5	250	XPN	R		00108	Patient Name
18	250	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.5.1

4.2.4.1.2.2.3 PV1 Segment (HL7 v2.5.1)

All of the fields in the PV1 segment are optional, except those listed in Table 4.2-6. See Section 4.1.4.1.2.2.4 for a full discussion of the PV1 segment.

Table 4.2-6: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
8	250	XCN	R2	0010	00138	Referring Doctor
19	250	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.5.1

Additional usage requirements for these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

At least one of the fields *PID-18-Patient Account Number* or *PV1-19-Visit Number* shall be valued.

Field *PV1-51-Visit Indicator* shall be valued with value "V" if the field *PV1-19-Visit Number* is valued. It may be omitted otherwise.

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4.2.4.1.2.2.4 ORC Segment (HL7 v2.5.1)

The ORC segment conveys common order information.

Table 4.2-7: IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	R		00216	Placer Order Number
3	22	EI	X		00217	Filler Order Number
4	22	EI	C		00218	Placer Group Number
5	2	ID	O	0038	00219	Order Status
6	1	ID	O	0121	00220	Response Flag
7	200	TQ	X		00221	Quantity/Timing
8	200	EIP	C		00222	Parent
9	26	TS	R		00223	Date/Time of Transaction
10	250	XCN	R2		00224	Entered By
11	250	XCN	O		00225	Verified By
12	250	XCN	R		00226	Ordering Provider
13	80	PL	O		00227	Enterer's Location
14	250	XTN	R2		00228	Call Back Phone Number
15	26	TS	O		00229	Order Effective Date/Time
16	250	CE	O		00230	Order Control Code Reason
17	250	CE	R		00231	Entering Organization
18	250	CE	O		00232	Entering Device
19	250	XCN	O		00233	Action By
20	250	CE	O	0339	01310	Advanced Beneficiary Notice Code
21	250	XON	O		01311	Ordering Facility Name
22	250	XAD	O		01312	Ordering Facility Address
23	250	XTN	O		01313	Ordering Facility Phone Number
24	250	XAD	O		01314	Ordering Provider Address
25	250	CWE	O		01473	Order Status Modifier
26	60	CWE	C	0552	01641	Advanced Beneficiary Notice Override Reason
27	26	TS	O		01642	Filler's Expected Availability Date/Time
28	250	CWE	O	0177	00615	Confidentiality Code
29	250	CWE	O	0482	01643	Order Type
30	250	CNE	O	0483	01644	Enterer Authorization Mode
31	250	CWE	O		02286	Parent Universal Service Identifier

Adapted from the HL7 Standard, version 2.5.1

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Field *ORC-3-Filler Order Number* shall not be present.

Field *ORC-4-Placer Group Number* shall be valued only if the Order Placer and Order Filler utilize the concept of Order Groups. It shall not be present otherwise.

Field ORC-7-Quantity/Timing is not populated. It has been superseded by the TQ1 segment.

Field *ORC-8-Parent* shall be valued only if the current order is a child order (i.e., if the field *ORC-1-Order Control* has a value of CH).

The action to be performed in the OMG message is defined by *ORC-1-Order Control Code.* HL7 defines a number of order control codes.

The following Order Control Codes are supported:

Supported Order Control Codes

Value	Description
NW [R]	New order
PA [O]	Parent order
CH [O]	Child order
XO [R]	Change order

Adapted from the HL7 Standard, version 2.5.1

[R]=Required; [O]=Optional

Note: The use of Required/Optional superscripts in the Value column is an IHE extension and is not part of the HL7 Standard.

4.2.4.1.2.2.5 TQ1 Segment (HL7 v2.5.1)

Deprecated components *ORC-7.4-Start Date/Time* or *OBR-27.4-Start Date/Time* shall not be populated but instead the TQ1 segment shall be used to carry the start date and time of the procedure.

Table 4.2-8: IHE Profile – TQ1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	4	SI	O		01627	Set ID – TQ1
2	20	CQ	O		01628	Quantity
3	540	RPT	O	0335	01629	Repeat Pattern
4	20	TM	O		01630	Explicit Time
5	20	CQ	O		01631	Relative Time and Units
6	20	CQ	O		01632	Service Duration
7	26	TS	R		01633	Start Date/Time
8	26	TS	O		01634	End Date/Time
9	250	CWE	O	0485	01635	Priority
10	250	TX	O		01636	Condition Text

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SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
11	250	TX	O	0065	01637	Text Instruction
12	10	ID	C	0472	01638	Conjunction
13	20	CQ	O		01639	Occurrence Duration
14	10	NM	O		01640	Total Occurrences

Adapted from the HL7 Standard, version 2.5.1

Field *TQ1-7-Start Date/Time* shall contain the date and time of the exam.

4.2.4.1.2.2.6 OBR Segment (HL7 v2.5.1)

Table 4.2-9: IHE Profile - OBR Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	4	SI	O		00237	Set ID – OBR
2	22	EI	R		00216	Placer Order Number
3	22	EI	O		00217	Filler Order Number
4	250	CE	R		00238	Universal Service ID
5	2	ID	O		00239	Priority
6	26	TS	O		00240	Requested Date/time
7	26	TS	O		00241	Observation Date/Time
8	26	TS	O		00242	Observation End Date/Time
9	20	CQ	O		00243	Collection Volume
10	250	XCN	O		00244	Collector Identifier
11	1	ID	O	0065	00245	Specimen Action Code
12	250	CE	R2		00246	Danger Code
13	300	ST	C		00247	Relevant Clinical Info.
14	26	TS	X		00248	Specimen Received Date/Time
15	300	SPS	X	0070	00249	Specimen Source
16	250	XCN	R		00226	Ordering Provider
17	250	XTN	O		00250	Order Callback Phone Number
18	60	ST	O		00251	Placer field 1
19	60	ST	O		00252	Placer field 2
20	60	ST	O		00253	Filler Field 1
21	60	ST	O		00254	Filler Field 2
22	26	TS	O		00255	Results Rpt/Status Chng - Date/Time
23	40	MOC	O		00256	Charge to Practice
24	10	ID	O	0074	00257	Diagnostic Serv Sect ID
25	1	ID	O	0123	00258	Result Status
26	400	PRL	O		00259	Parent Result

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SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
27	200	TQ	X		00221	Quantity/Timing
28	250	XCN	O		00260	Result Copies To
29	200	EIP	C		00261	Parent
30	20	ID	R2	0124	00262	Transportation Mode
31	250	CE	R2		00263	Reason for Study
32	200	NDL	O		00264	Principal Result Interpreter
33	200	NDL	O		00265	Assistant Result Interpreter
34	200	NDL	O		00266	Technician
35	200	NDL	O		00267	Transcriptionist
36	26	TS	O		00268	Scheduled Date/Time
37	4	NM	O		01028	Number of Sample Containers
38	250	CE	O		01029	Transport Logistics of Collected Sample
39	250	CE	O		01030	Collector's Comment
40	250	CE	O		01031	Transport Arrangement Responsibility
41	30	ID	R2	0224	01032	Transport Arranged
42	1	ID	O	0225	01033	Escort Required
43	250	CE	O		01034	Planned Patient Transport Comment
44	250	CE	O	0088	00393	Procedure Code
45	250	CE	O	0340	01036	Procedure Code Modifier
46	250	CE	R2	0411	01474	Placer Supplemental Service Information
47	250	CE	R2	0411	01475	Filler Supplemental Service Information
48	250	CWE	R2	0476	01646	Medically Necessary Duplicate Procedure Reason
49	2	IS	O	0507	01647	Result Handling
50	250	CWE	O		02286	Parent Universal Service Identifier

Adapted from the HL7 Standard, version 2.5.1

Field *OBR-13-Relevant Clinical Info* shall be populated if the patient record contains any medical alerts that may be relevant to the order and, in particular, need to be communicated to the technologist.

Field *OBR-27-Quantity/Timing* shall not be present. The date and time of the exam shall be carried in field *TQ1-7-Start Date/Time*.

Field *OBR-46-Placer Supplemental Service Information* holds the laterality (Left/Right) indicator (when used). This element shall be populated if the procedure has laterality and the Universal Service ID code in OBR-4 does not encode laterality. This element shall be empty otherwise. Field OBR-15-Specimen Source, which had formerly been adapted for this use by the

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IHE Technical Framework and has been deprecated in HL7 Version 2.5.1, shall not be present. See RAD TF-2x: Appendix B for details.

Per the HL7 Standard, IHE recommends that the fields in ORC and OBR segments given in the following table contain the same information.

Identical Element Mappings between ORC and OBR Segments

Element Name	ORC Segment Element	OBR Segment Element
Placer Order Number	ORC-2	OBR-2
Filler Order Number	ORC-3	OBR-3
Parent	ORC-8	OBR-29

4.2.4.1.3 Expected Actions

Department System Scheduler/Order Filler shall accept the order information for fulfillment. If error in data prevents it from fulfilling the order, it shall notify the Order Placer by returning proper information in the ACK message.

For actors implementing the HL7 v2.5.1 Message Semantics, the Order Placer shall not change an order that has already been started, e.g., one for which Order Filler has transmitted an "In-Progress" status in the Order Status message in the [RAD-3] transaction (see Section 4.3.4.2). However, if the Order Filler receives the change order message after it has sent the Order Status Update message (for example, in a case of a race condition between two messages), Order Filler shall accept the change order and perform transaction Procedure Update [RAD-13] to notify Image Manager.

4.2.4.2 Order Management - Order Cancelled by Order Placer

4.2.4.2.1 Trigger Events

The following event will trigger the ORM messages within systems implementing HL7 v2.3.1:

ORM – Order Placer cancels an order (control code = CA).

ORM – Order Placer discontinues (attempts to stop) an ongoing order (control code = DC).

The following event will trigger the OMG messages within systems implementing HL7 v2.5.1:

OMG – Order Placer cancels an order (control code = CA).

OMG – Order Placer discontinues (attempts to stop) an ongoing order (control code = DC).

4.2.4.2.2 Message Semantics

Message semantics are defined for both HL7 v2.3.1 and HL7 v2.5.1. The Profile and/or Options being claimed that incorporate this transaction will specify whether actors are required to support one, the other, or both sets of semantics.

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4.2.4.2.2.1 Message Semantics (HL7 v.2.3.1)

HL7 2.3.1 Chapter 4 ORM message. Refer to HL7 standard for general message semantics. Refer to Section 4.2.4.1.2.1 above for detailed requirements of the ORM message.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.3.

Required segments are listed below. Other segments are optional.

ORM	General Order Message	Chapter in HL7 2.3.1
MSH	Message Header	2
PID	Patient Identification	3
PV1	Patient Visit	3
ORC	Common Order	4

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of ADT message to its sender. See Section 2.4.3 “Acknowledgement Modes” for definition and discussion of the ACK message.

4.2.4.2.2.1.1 MSH Segment (HL7 v2.3.1)

MSH segment shall be constructed as defined in the Section 2.4.2.2 “Message Control”.

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of “ORM”; the second component shall have a value of O01. The third component is optional; however, if present, it shall have a value of ORM_O01.

4.2.4.2.2.1.2 PID Segment (HL7 v2.3.1)

All of the fields in PID segment are optional, except those listed in Table 4.2-10. See Section 4.1.4.1.2.1.3 for the list of all fields of the PID segment.

Table 4.2-10: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	20	CX	R		00106	Patient Identifier List
5	48	XPN	R		00108	Patient Name
18	20	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.3.1

4.2.4.2.2.1.3 PV1 Segment (HL7 v2.3.1)

All of the fields in PV1 segment are optional, except those listed in Table 4.2-11. See Section 4.1.4.1.2.1.4 for the list of all fields of the PV1 segment.

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Table 4.2-11: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	20	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.3.1

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued. Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

4.2.4.2.2.1.4 ORC Segment (HL7 v2.3.1)

All of the fields in ORC segment are optional, except those listed in Table 4.2-12. See Section 4.2.4.1.2.1.4 for the list of all fields of the ORC segment.

Table 4.2-12: IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	R		00216	Placer Order Number

Adapted from the HL7 Standard, version 2.3.1

The action to be performed in the ORM message is defined by the Order Control code passed as part of the message. HL7 defines a number of Order Control codes.

The order control codes below shall be supported.

IHE Profile - Supported Order Control Codes

Value	Description
CA	Cancel order request
DC	Discontinue Order request

4.2.4.2.2.2 Message Semantics (HL7 v2.5.1)

The HL7 v2.5.1 Message Semantics implement the Chapter 4 OMG message. Refer to the HL7 standard for general message semantics. Refer to Section 4.2.4.1.2.2 above for detailed requirements of the OMG message.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.3.

Required segments are listed below. Other segments are optional.

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OMG	General Clinical Order Message	Chapter in HL7 v2.5.1
MSH	Message Header	2
PID	Patient Identification	3
PV1	Patient Visit	3
ORC	Common Order	4

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of the OMG message to its sender. See Section 2.4.4.3 “Acknowledgement Modes” for definition and discussion of the ACK message.

4.2.4.2.2.2.1 MSH Segment (HL7 v2.5.1)

The MSH segment shall be constructed as defined in ITI TF-2: 3.30.5.1 MSH – Header Segment. Additional specifications for actors complying with the IHE Radiology Technical Framework are defined in Section 2.4.

Field *MSH-9-Message Type* shall have three components. The first component shall have a value of OMG; the second component shall have a value of O19; the third component shall have a value of OMG_O19.

4.2.4.2.2.2.2 PID Segment (HL7 v2.5.1)

All of the fields in the PID segment are optional, except those listed in Table 4.2-13. See Section 4.1.4.1.2.2.3 for further discussion of the PID segment.

Table 4.2-13: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	250	CX	R		00106	Patient Identifier List
5	250	XPN	R		00108	Patient Name
18	250	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.5.1

4.2.4.2.2.2.3 PV1 Segment (HL7 v2.5.1)

All of the fields in the PV1 segment are optional, except those listed in Table 4.2-14. See Section 4.1.4.1.2.2.4 for a full discussion of the PV1 segment.

Table 4.2-14: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	250	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.5.1

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At least one of the fields *PID-18-Patient Account Number* or *PV1-19-Visit Number* shall be valued. Additional usage requirements for these fields may be documented in regional or national extensions to the IHE Technical Framework (see RAD TF-4).

Field *PV1-51-Visit Indicator* shall be valued with value "V" if the field *PV1-19-Visit Number* is valued. It may be omitted otherwise.

4.2.4.2.2.2.4 ORC Segment (HL7 v2.5.1)

All of the fields in ORC segment are optional, except those listed in Table 4.2-15. See Section 4.2.4.1.2.2.4 for the list of all fields of the ORC segment.

Table 4.2-15: IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	R		00216	Placer Order Number

Adapted from the HL7 Standard, version 2.5.1

The action to be performed in the OMG message is defined by the Order Control code passed as part of the message. HL7 defines a number of Order Control codes.

The order control codes below shall be supported.

IHE Profile - Supported Order Control Codes

Value	Description
CA	Cancel order request
DC	Discontinue Order request

4.2.4.2.3 Expected Actions

After receiving the Order Management message with the control code CA, DSS/Order Filler shall discard the record of the order and shall not attempt to schedule or otherwise to fulfill it. If the DSS/Order Filler has already scheduled the procedures corresponding to the order, it has to perform transaction Procedure Update [RAD-13] (see Section 4.13) to notify the Image Manager of order cancellation.

Order Placer shall not cancel order that has already been started, i.e., the one for which Order Filler transmitted the "In-Progress" status (see Section 4.3.4.2). However, if the Order Filler receives the cancellation message after it has sent the Status Update message (for example, in a case of a race condition between two messages), Order Filler shall accept order cancellation and perform transaction Procedure Update [RAD-13] to notify Image Manager.

It is expected that in most cases Order Placer will utilize the Order Management message with the control code of CA. However, in some cases (such as with recurring orders – to stop the order fulfillment before all its parts were completed), Order Placer and Order Filler may agree on a use of the Order Management message with the control code DC. Upon receiving such Order

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Management message, DSS/Order Filler shall perform transaction Procedure Update [RAD-13] (see Section 4.13) to notify the Image Manager of order discontinuation

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4.3 Filler Order Management [RAD-3]

4.3.1 Scope

This transaction is used by the Order Filler to inform the Order Placer about the orders it creates and cancels, including the status of the orders it is fulfilling.

A 1:1 relationship between Placer Order and Filler Order shall be maintained.

For an illustration of mapping between transactions [RAD-2], [RAD-3], [RAD-5], [RAD-6] and [RAD-7], see the IHE white paper "Code Mapping in IHE Radiology Profiles", https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE_RAD_White-Paper_Codes.pdf.

4.3.2 Actor Roles

Actor: Order Placer

Role: Receives new order, order change (HL7 v2.5.1 Message Semantics) and order cancellation requests from Order Filler. Receives Order Status updates from Order Filler.

Actor: Department System Scheduler/Order Filler

Role: Creates new or cancels existing orders; sends notifications of order status to the Order Placer.

4.3.3 Referenced Standards

HL7 v2.3.1 Chapter 4

HL7 v2.5.1 Chapter 4

4.3.4 Messages

The following diagram illustrates interactions between actors implementing HL7 v2.3.1

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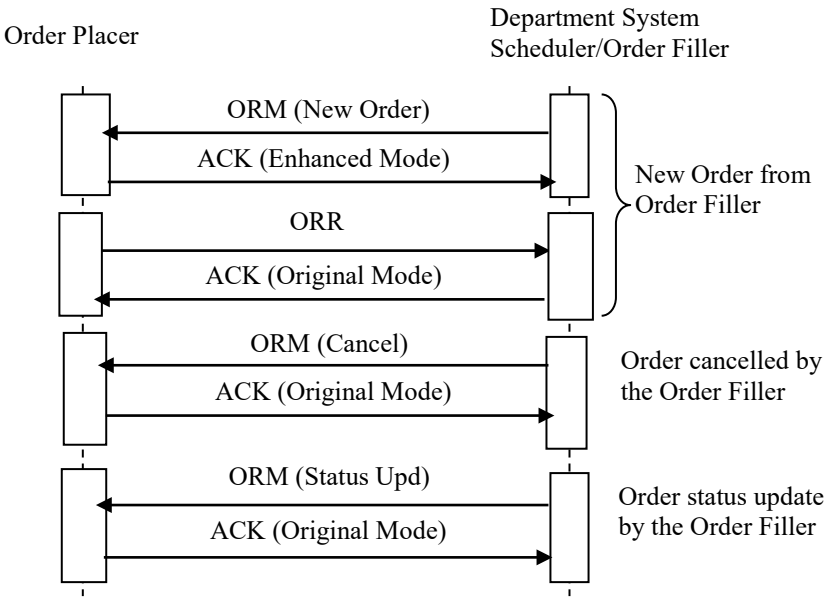

Figure 4.3.4-1: Interactions between actors implementing HL7 v2.3.1

The following diagram illustrates interactions between actors implementing HL7 v2.5.1:

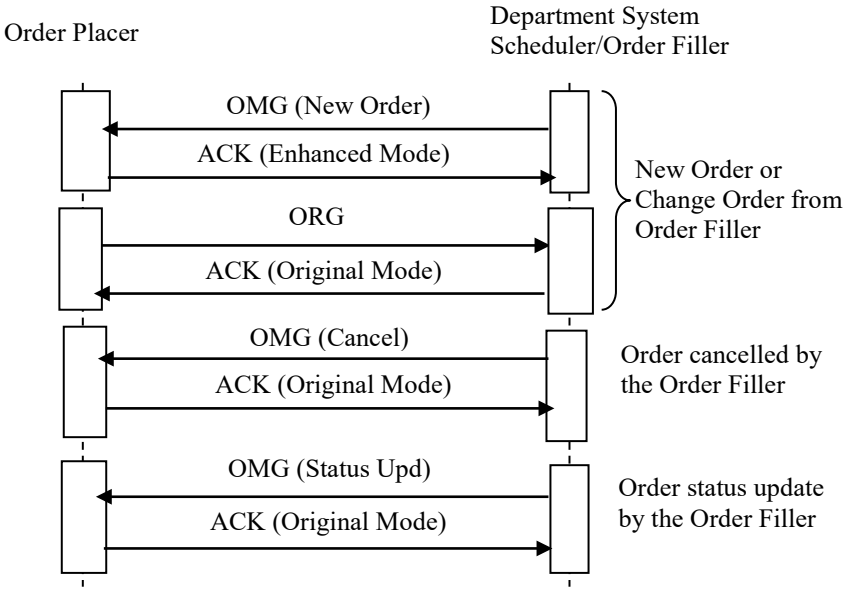

Figure 4.3.4-2: Interactions between actors implementing HL7 v2.5.1

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4.3.4.1 Filler Order Management – New Order from Order Filler or Change Order from Order Filler

4.3.4.1.1 Trigger Events

Actors implementing the HL7 v2.3.1 Message Semantics shall implement the following:

ORM - Department System Scheduler/Order Filler creates a new order or cancels an order (control code = SN).

ORR – Order Placer replies (control code = NA).

Actors implementing the HL7 v2.5.1 Message Semantics shall implement the following:

OMG - Department System Scheduler/Order Filler creates a new order or cancels an order (control code = SN).

OMG – Department. System Scheduler/Order Filler changes an order (control code = XX).

ORG – Order Placer replies (control code = NA).

The ORR (HL7 v2.3.1) or ORG (HL7 v2.5.1) messages are sent by the Order Placer as application acknowledgements to convey the Order Placer Number in those cases where the DSS/Order Filler creates a new Order or changes an existing Order. Enhanced acknowledgement mode shall not be used in Order Cancel or Order Status Update messages.

4.3.4.1.2 Message Semantics

Message semantics are defined for both HL7 v2.3.1 and HL7 v2.5.1. The Profile and/or Options being claimed that incorporate this transaction will specify whether actors are required to support one, the other, or both sets of semantics.

4.3.4.1.2.1 Message Semantics (HL7 v2.3.1)

HL7 v2.3.1 Chapter 4 ORM message. Refer to HL7 Standard for general message semantics. Refer to Section 4.2.4.1.2.1 above for detailed requirements for the ORM message.

See Section 2.4.2.2 of this document for MSH segment definition.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.3.

Required segments are listed below. Other segments are optional.

ORM	General Order Message	Chapter in HL7 2.3.1
MSH	Message Header	2
PID	Patient Identification	3
PV1	Patient Visit	3
ORC	Common Order	4
OBR	Order Detail	4

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When the Order Placer receives an ORM message, it shall send an HL7 ACK message to the DSS/Order Filler. See Section 2.4.2.1 Acknowledgement Message for definition of the ACK message.

When the Order Placer receives an ORM for a New Order, the Order Placer shall also place a corresponding order and then send an ORR message for the placed order to the DSS/Order Filler (see Figure 4.3.4-1).

See HL7 v2.3.1 Chapter 4 ORR message. Refer to the HL7 Standard for general message semantics.

ORR (Success)	General Order Message	Chapter in HL7 2.3.1
MSH	Message Header	2
MSA	Message Acknowledgement	2
ORC	Common Order	4
OBR	Order Detail	4

ORR (Error)	General Order Message	Chapter in HL7 2.3.1
MSH	Message Header	2
MSA	Message Acknowledgement	2
ERR	Error	2

Field *MSA-1 Acknowledgement Code* shall contain a code according to the Original Acknowledge Mode.

When the DSS/Order Filler receives an ORR message, it shall send an HL7 ACK message to the Order Placer. See Section 2.4.2.1 Acknowledgement Message for definition of the ACK message.

4.3.4.1.2.1.1 MSH Segment (HL7 v2.3.1)

MSH segment shall be constructed as defined in Section 2.4.2.2 “Message Control”.

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of “ORM” for ORM message and “ORR” for ORR message; the second component shall have value of O01 or O02, respectively. The third component is optional; however, if present, it shall have a value of ORM_O01 or ORR_O02, respectively.

Field *MSH-15 Accept Acknowledgement Type* shall be populated with the value “AL” if MSH-16 is populated; otherwise it shall be left empty.

Field *MSH-16 Application Acknowledgement Type* shall be populated with the value “AL” to request an application acknowledgement if the ORM message is for New Order message; otherwise it shall be left empty.

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4.3.4.1.2.1.2 MSA Segment (HL7 v2.3.1)

MSA segment in the ACK, ORR (Success), or ORR (Error) message shall be constructed as defined in the Section 2.4.3 “Acknowledgement Modes”.

Field *MSA-1 Acknowledgement Code* shall:

- contain a code according to the Original Acknowledge Mode if it is the acknowledgement message for the Order Cancelled or Order Status Update message, or for the ORR message.
- contain a code according to the Enhanced Acknowledgement Mode if it is the acknowledgement message for the New Order message.

Field *MSA-6 Error condition* in ORR (Error) shall have the Error code value of 204 (Unknown Key Identifier)

4.3.4.1.2.1.3 PID Segment (HL7 v2.3.1)

All of the fields in PID segment are optional, except those listed in Table 4.3-1. See Section 4.1.4.1.2.1.3 for the list of all fields of the PID segment.

Table 4.3-1: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	20	CX	R		00106	Patient Identifier List
5	48	XPN	R		00108	Patient Name
18	20	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.3.1

4.3.4.1.2.1.4 PV1 Segment (HL7 v2.3.1)

All of the fields in PV1 segment are optional, except those listed in Table 4.3-2. See Section 4.1.4.1.2.1.4 for the list of all fields of the PV1 segment.

Table 4.3-2: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	20	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.3.1

Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued.

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Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

4.3.4.1.2.1.5 ORC Segment (HL7 v2.3.1)

All of the fields in ORC segment are optional, except those listed in Table 4.3-3. See Section 4.2.4.1.2.1.4 for the list of all fields of the ORC segment.

Table 4.3-3: IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	C		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number
4	22	EI	C		00218	Placer Group Number
7	200	TQ	R		00221	Quantity/Timing
9	26	TS	R		00223	Date/Time of Transaction
10	120	XCN	R2		00224	Entered By
12	120	XCN	R		00226	Ordering Provider
14	40	XTN	R2		00228	Call Back Phone Number
17	60	CE	R		00231	Entering Organization

Adapted from the HL7 Standard, version 2.3.1

Field ORC-1 Order Control shall have the value of SN in the ORM message and the value NA in the ORR message.

Field *ORC-2 Placer Order Number* shall be valued only in the ORR message and omitted in the ORM message.

Field *ORC-4 Placer Group Number* shall be valued only if the Order Placer and Order Filler utilize concept of Order Groups. Shall not be present otherwise.

4.3.4.1.2.1.6 OBR Segment (HL7 v2.3.1)

All of the fields in OBR segment are optional, except those listed in Table 4.3-4. See Section 4.2.4.1.2.1.5 for the list of all fields of the OBR segment.

Table 4.3-4: IHE Profile - OBR Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
2	75	EI	C		00216	Placer Order Number
3	75	EI	R		00217	Filler Order Number
4	200	CE	R		00238	Universal Service ID
12	60	CE	R2		00246	Danger Code
13	300	ST	C		00247	Relevant Clinical Info.

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SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
15	300	CM	C	0070	00249	Specimen Source
16	80	XCN	R		00226	Ordering Provider
27	200	TQ	R		00221	Quantity/Timing
30	20	ID	R2	0124	00262	Transportation Mode
31	300	CE	R2		00263	Reason for Study
41	30	ID	R2	0224	01032	Transport Arranged

Adapted from the HL7 Standard, version 2.3.1

Field *OBR-13 Relevant Clinical Info* shall be populated if patient record contains any medical alerts that may be relevant to the order and, in particular, need to be communicated to the technologist.

Field *OBR-15 Specimen Source* holds the laterality (Left/Right) indicator (when used) in the <site modifier (CE)> component. See RAD TF-2x: Appendix B for details.

Per the HL7 Standard, IHE recommends that some fields in ORC and OBR segments contain the same information, as described in Section 4.2.4.1.2.1.5.

For the ORR message, all required fields in the OBR segment, except *OBR-2 Placer Order Number,* shall be copied by Order Placer from the ORM message received from the Order Filler. Value of the field *OBR-2 Placer Order Number* shall be generated by the Order Placer.

4.3.4.1.2.1.7 ERR Segment (HL7 v2.3.1)

ERR segment in the ORR (Error) message shall be constructed as defined in Section 2.4.3 “Acknowledgement Modes”.

Field *ERR-1 Error code and location* in ORR (Error) shall have the Error code value of 204 (Unknown Key Identifier).

4.3.4.1.2.2 Message Semantics (HL7 v2.5.1)

The HL7 v2.5.1 Message Semantics implement the Chapter 4 OMG message. Refer to the HL7 Standard for general message semantics. Refer to Section 4.2.4.1.2.2 above for detailed requirements for the OMG message.

See Section 2.4 and Section 4.2 for the MSH segment definition.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.3 above.

Required segments are listed below. Other segments are optional.

OMG	General Clinical Order Message	Chapter in HL7 v2.5.1
MSH	Message Header	2
PID	Patient Identification	3

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OMG	General Clinical Order Message	Chapter in HL7 v2.5.1
PV1	Patient Visit	3
ORC	Common Order	4
TQ1	Timing / Quantity	4
OBR	Order Detail	4

When the Order Placer receives an OMG message, it shall send an HL7 ACK message to the DSS/Order Filler. See Section 2.4.2.1 Acknowledgement Message for definition of the ACK message.

When the Order Placer receives an OMG for a New Order or Change Order, the Order Placer shall also place a corresponding order and then send an ORG message for the placed order to the DSS/Order Filler (see Figure 4.3.4-2).

HL7 v2.5.1 Chapter 4 ORG message. Refer to HL7 Standard for general message semantics.

ORG (Success)	General Clinical Order Message Acknowledgment	Chapter in HL7 v2.5.1
MSH	Message Header	2
MSA	Message Acknowledgement	2
ORC	Common Order	4
TQ1	Timing / Quantity	4
OBR	Order Detail	4

ORG (Error)	General Clinical Order Message Acknowledgment	Chapter in HL7 v2.5.1
MSH	Message Header	2
MSA	Message Acknowledgement	2
[{ ERR }]	Error	2

Field *MSA-1 Acknowledgement Code* shall contain a code according to the Original Acknowledge Mode.

Each ORG message shall be acknowledged by an HL7 ACK message sent by the DSS/OF to the Order Placer. See Section 2.4.2.1 Acknowledgement Message for definition of the ACK message.

4.3.4.1.2.2.1 MSH Segment (HL7 v2.5.1)

The MSH segment shall be constructed as defined in ITI TF-2: 3.30.5.1 MSH – Header Segment. Additional specifications for actors complying with the IHE Radiology Technical Framework are defined in Section 2.4.

Field MSH-9-Message Type shall have three components.

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For the order message, the first component shall have a value of OMG; the second component shall have a value of O19; the third component shall have a value of OMG_O19.

For the order acknowledgment message, the first component shall have a value of ORG; the second component shall have value of O20; the third component shall have a value of ORG_O20.

Field *MSH-15 Accept Acknowledgement Type* shall be populated with the value "AL" if MSH-16 is populated, otherwise shall be left empty.

Field *MSH-16 Application Acknowledgement Type* shall be populated with the value "AL" to request for application acknowledgement if the OMG message is for New Order or Change Order message, otherwise shall be left empty.

4.3.4.1.2.2.2 MSA Segment (HL7 v2.5.1)

The MSA segment in the ACK, ORG (Success), or ORG (Error) message shall be constructed as defined in Section 2.4.4.3 "Acknowledgement Modes".

Field *MSA-1 Acknowledgement Code* shall:

- contain a code according to the Original Acknowledge Mode if it is the acknowledgement message for the Order Cancelled or Order Status Update message, or the ORR message.
- contain a code according to the Enhanced Acknowledgement Mode if it is the acknowledgement message for the New Order or Change Order message.

Field *MSA-6-Error condition* in an ACK (Error) or ORG (Error) shall have the error code value of 204 (Unknown Key Identifier) in case of an error.

4.3.4.1.2.2.3 PID Segment (HL7 v2.5.1)

All of the fields in the PID segment are optional, except those listed in Table 4.3-5. See Section 4.1.4.1.2.2.3 for further discussion of the PID segment.

Table 4.3-5: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	250	CX	R		00106	Patient Identifier List
5	250	XPN	R		00108	Patient Name
18	250	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.5.1

4.3.4.1.2.2.4 PV1 Segment (HL7 v2.5.1)

All of the fields in the PV1 segment are optional, except those listed in Table 4.3-6. See Section 4.1.4.1.2.2.4 for a full discussion of the PV1 segment.

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Table 4.3-6: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	250	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.5.1

Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued. PID-18 and/or PV1-19 is required if it was present in the registration message (trigger event A01, A04 or A05) that is being cancelled by this transaction.

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is valued. It may be omitted otherwise.

4.3.4.1.2.2.5 ORC Segment (HL7 v2.5.1)

All of the fields in ORC segment are optional, except those listed in Table 4.3-7. See Section 4.2.4.1.2.2.4 for the list of all fields of the ORC segment.

Table 4.3-7: IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	C		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number
4	22	EI	C		00218	Placer Group Number
7	200	TQ	X		00221	Quantity/Timing
9	26	TS	R		00223	Date/Time of Transaction
10	250	XCN	R2		00224	Entered By
12	250	XCN	R		00226	Ordering Provider
14	250	XTN	R2		00228	Call Back Phone Number
17	250	CE	R		00231	Entering Organization

Adapted from the HL7 Standard, version 2.5.1

Field *ORC-1-Order Control* shall have the value of SN for "New Order" or XX for "Change Order" in the OMG message and the value NA in the ORG message.

Field *ORC-2-Placer Order Number*

- shall be empty in the OMG message for the "New Order" workflow
- shall be valued, if known, in the OMG message for the "Order Cancelled" and "Order Status Update" workflows

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- shall be valued in the ORG message

Note: Depending on when the DSS/OF receives the ORG message from the Order Placer, DSS/OF may not yet be aware of the Placer Order Number when it sent an Order Cancelled or Order Status Update.

Field *ORC-4-Placer Group Number* shall be valued only if the Order Placer and Order Filler utilize concept of Order Groups. They shall not be present otherwise.

Field *ORC-7-Quantity/Timing* shall not be present. The date and time of the exam shall be carried in field *TQ1-7-Start Date/Time*.

4.3.4.1.2.2.6 TQ1 Segment (HL7 v2.5.1)

Implementations that support the HL7 v2.5.1 Message Semantics shall not populate deprecated components ORC-7.4-Start Date/Time or OBR-27.4-Start Date/Time but instead shall use the TQ1 segment to carry the start date and time of the procedure.

Table 4.3-8: IHE Profile – TQ1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	4	SI	O		01627	Set ID – TQ1
2	20	CQ	O		01628	Quantity
3	540	RPT	O	0335	01629	Repeat Pattern
4	20	TM	O		01630	Explicit Time
5	20	CQ	O		01631	Relative Time and Units
6	20	CQ	O		01632	Service Duration
7	26	TS	R		01633	Start Date/Time
8	26	TS	O		01634	End Date/Time
9	250	CWE	O	0485	01635	Priority
10	250	TX	O		01636	Condition Text
11	250	TX	O	0065	01637	Text Instruction
12	10	ID	C	0427	01638	Conjunction
13	20	CQ	O		01639	Occurrence Duration
14	10	NM	O		01640	Total Occurrences

Adapted from the HL7 Standard, version 2.5.1

Field *TQ1-7-Start Date/Time* shall contain the date and time of the exam.

4.3.4.1.2.2.7 OBR Segment (HL7 v2.5.1)

All of the fields in the OBR segment are optional, except those listed in Table 4.3-9. See Section 4.2.4.1.2.2.6 for the list of all fields of the OBR segment.

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Table 4.3-9: IHE Profile - OBR Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
2	22	EI	C		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number
4	250	CE	R		00238	Universal Service ID
12	250	CE	R2		00246	Danger Code
13	300	ST	C		00247	Relevant Clinical Info.
15	300	SPS	X	0070	00249	Specimen Source
16	80	XCN	R		00226	Ordering Provider
27	200	TQ	X		00221	Quantity/Timing
30	20	ID	R2	0124	00262	Transportation Mode
31	250	CE	R2		00263	Reason for Study
41	30	ID	R2	0224	01032	Transport Arranged
46	250	CE	C	0411	01474	Placer Supplemental Service Information

Adapted from the HL7 Standard, version 2.5.1

Field *OBR-13-Relevant Clinical Info* shall be populated if patient record contains any medical alerts that may be relevant to the order and, in particular, need to be communicated to the technologist.

Field *OBR-27-Quantity/Timing* shall not be present. The date and time of the exam shall be carried in field *TQ1-7-Start Date/Time*.

Field *OBR-46-Placer Supplemental Service Information* holds the laterality (Left/Right) indicator (when used). This element shall be populated if the procedure has laterality and the Universal Service ID code in OBR-4 does not encode laterality. This element shall be empty otherwise. Field OBR-15-Specimen Source, which had formerly been adapted for this use by the IHE Technical Framework and has been deprecated in HL7 Version 2.5.1, shall not be present. See RAD TF-2x: Appendix B for details.

Per the HL7 Standard, IHE recommends that some fields in the ORC and OBR segments contain the same information, as described in Section 4.2.4.1.2.2.6.

For the ORG message, all required fields in the OBR segment, except *OBR-2-Placer Order Number*, shall be copied by Order Placer from the OMG message received from the Order Filler. The value of the field *OBR-2-Placer Order Number* shall be generated by the Order Placer.

4.3.4.1.2.2.8 ERR Segment (HL7 v2.5.1 Option)

The ERR segment in the ORG (Error) message shall be constructed as defined in Section 2.4.

The first component of Field *ERR-1-Error code* and location in the ORG (Error) message shall have the error code value of 204 (Unknown Key Identifier).

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4.3.4.1.3 Expected Actions

If the Order Placer accepts and registers order information transmitted from the Order Filler in the Order Management message, it shall assign its unique number to it and convey that number to order Filler in the ORR (Success) message for HL7 v2.3.1 and the ORG (Success) message for HL7 v2.5.1. In turn, the Order Filler shall register received Order Placer number and include it into the subsequent communication of order status with Order Placer, as well as procedure-related information to the Image Manager and Acquisition Modality (see Sections 4.4 and 4.5).

If the Order Placer cannot accept order information transmitted from the Order Filler in the Order Management message (e.g., Patient ID does not exist anymore due to a Patient Update-Cancel registration the Order Placer just received), it shall convey the rejection by returning an ORR (Error) message for HL7 v2.3.1 and the ORG (Error) message for HL7 v2.5.1.

4.3.4.2 Filler Order Management - Order Status Update

The Order Status Update Message is used by the DSS/Order Filler to notify Order Placer about changes in the status of the order as it is being fulfilled by the DSS/Order Filler.

4.3.4.2.1 Trigger Events

Actors implementing the HL7 v2.3.1 Message Semantics shall implement the following:

ORM - Department System Scheduler/Order Filler updates an order status (control code = SC).

Actors implementing the HL7 v2.5.1 Message Semantics shall implement the following:

OMG - Department System Scheduler/Order Filler updates an order status (control code = SC).

4.3.4.2.2 Message Semantics

4.3.4.2.2.1 Message Semantics (HL7 v2.3.1)

HL7 2.3.1 Chapter 4 ORM message. Refer to HL7 Standard for general message semantics.

See Section 4.1 of this document for MSH segment definition.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.

Required segments are listed below. Other segments are optional.

ORM	General Order Message	Chapter in HL7 2.3.1
MSH	Message Header	2
ORC	Common Order	4

4.3.4.2.2.1.1 MSH Segment (HL7 v2.3.1)

MSH segment shall be constructed as defined in the Section 2.4.2.2 “Message Control”.

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Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of "ORM"; the second component shall have value of O01. The third component is optional; however, if present, it shall have a value of ORM_O01.

4.3.4.2.2.1.2 ORC Segment (HL7 v2.3.1)

All of the fields in ORC segment are optional, except those listed in Table 4.3-10. See Section 4.2.4.1.2.1.4 for the list of all fields of the ORC segment.

Table 4.3-10: IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	R		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number
5	2	ID	R	0038	00219	Order Status

Adapted from the HL7 Standard, version 2.3.1

When an Order Status Update (control code = SC) message is received at the Order Placer, the element ORC-5 "Order Status" will contain the reason for the status change. The reason shall be one of the following:

Order Status Codes

Value	Description
CM	Order is completed
DC	Order was discontinued
IP	Order is in progress

Adapted from the HL7 Standard, version 2.3.1

4.3.4.2.2.2 Message Semantics (HL7 v2.5.1)

The HL7 v2.5.1 Message Semantics implement the Chapter 4 OMG message. Refer to HL7 Standard for general message semantics.

See Section 2.4 of this document for MSH segment definition.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.

Required segments are listed below. Other segments are optional.

OMG	General Clinical Order Message	Chapter in HL7 v2.5.1
MSH	Message Header	2
ORC	Common Order	4
TQ1	Timing/Quantity	4

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OMG	General Clinical Order Message	Chapter in HL7 v2.5.1
OBR	Observation Request	4

4.3.4.2.2.2.1 MSH Segment (HL7 v2.5.1)

The MSH segment shall be constructed as defined in ITI TF-2: 3.30.5.1 MSH – Header Segment. Additional specifications for actors complying with the IHE Radiology Technical Framework are defined in Section 2.4.

Field MSH-9-Message Type shall have three components. The first component shall have a value of OMG; the second component shall have a value of O19; the third component shall have a value of OMG_O19.

4.3.4.2.2.2.2 ORC Segment (HL7 v2.5.1)

All of the fields in the ORC segment are optional, except those listed in Table 4.3-11. See Section 4.2.4.1.2.2.4 for the list of all fields of the ORC segment.

Table 4.3-11: IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	R		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number
5	2	ID	R	0038	00219	Order Status
7	200	TQ	X		00221	Quantity/Timing

Adapted from the HL7 Standard, version 2.5.1

Deprecated component ORC-7.4-Start Date/Time shall not be populated. The TQ1 segment shall be used to carry the start date and time of the procedure.

When an Order Status Update (control code = SC) message is received at the Order Placer, the element *ORC-5-Order Status* will contain the reason for the status change. The reason shall be one of the following:

Order Status Codes

Value	Description
CM	Order is completed
DC	Order was discontinued
IP	Order is in progress

Adapted from the HL7 Standard, version 2.5.1

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4.3.4.2.2.2.3 TQ1 Segment (HL7 v2.5.1)

Deprecated components ORC-7.4-Start Date/Time or OBR-27.4-Start Date/Time shall not be populated. The TQ1 segment shall be used to carry the start date and time of the procedure.

Table 4.3-12: IHE Profile – TQ1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	4	SI	O		01627	Set ID – TQ1
2	20	CQ	O		01628	Quantity
3	540	RPT	O	0335	01629	Repeat Pattern
4	20	TM	O		01630	Explicit Time
5	20	CQ	O		01631	Relative Time and Units
6	20	CQ	O		01632	Service Duration
7	26	TS	R		01633	Start Date/Time
8	26	TS	O		01634	End Date/Time
9	250	CWE	O	0485	01635	Priority
10	250	TX	O		01636	Condition Text
11	250	TX	O	0065	01637	Text Instruction
12	10	ID	C	0427	01638	Conjunction
13	20	CQ	O		01639	Occurrence Duration
14	10	NM	O		01640	Total Occurrences

Adapted from the HL7 Standard, version 2.5.1

Field *TQ1-7-Start Date/Time* shall contain the date and time of the exam.

4.3.4.2.2.2.4 OBR Segment (HL7 v2.5.1)

All of the fields in the OBR segment are optional, except those listed in Table 4.3-13. See Section 4.2.4.1.2.2.6 for the list of all fields of the OBR segment.

Table 4.3-13: IHE Profile - OBR Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
2	22	EI	C		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number

Adapted from the HL7 Standard, version 2.5.1

Deprecated component OBR-27.4-Start Date/Time shall not be populated. The TQ1 segment shall be used to carry the start date and time of the procedure.

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4.3.4.2.3 Expected Actions

DSS/Order Filler shall provide Order Placer with status updates on the order. At least the following events shall be noted:

- In Progress – when the first Performed Procedure Step corresponding to the Order has been created;
- Discontinued – when a cancellation request was received from Order Placer, after an Order has been set to "In-Progress". A discontinuation applied instead.
- Completed – when the complete, verified report is available for the given order.

Order Filler shall send at least one Order Status Update message with the Order Status code of "CM". Determination of exact timing of such a message shall be at the discretion of the Order Filler; however, it may not occur before the final, verified report for all requested procedures within the order is available.

Order Filler shall use the Order Status Update message with the Order Status code of "IP", to facilitate synchronization of order handling with the Order Placer, for example, to prevent cancellation/discontinuation of an order in progress. In this case, at least one message shall be sent after the Order Filler/Department System Scheduler has processed the first Modality Procedure Step In Progress [RAD-6] transaction associated with the order. Note, that Order Placer may still issue the cancellation request, for example, because of race condition between two messages. In such case, Order Filler shall process cancellation of the order as a discontinuation and return an Order Status Update message with the Order Status Code of "OD".

Order Status Update message cannot be used to request an action, for example, cancellation or discontinuation of an order.

If an order is being created by the Order Filler (for example, in a case of unidentified patient, see RAD TF-1: 4.4), the Order Status Update message shall not be issued until New Order message has been sent by the Order Filler.

4.3.4.3 Filler Order Management - Order Cancelled by the Order Filler

4.3.4.3.1 Trigger Events

Actors claiming the HL7 v2.3.1 Message Semantics shall implement the following trigger event:

ORM – Department System Scheduler/Order Filler cancels the order previously received from Order Placer (control code = OC).

Actors claiming the HL7 v2.5.1 Message Semantics shall implement the following trigger event:

OMG – Department System Scheduler/Order Filler cancels the order previously received from Order Placer (control code = OC).

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4.3.4.3.2 Message Semantics

4.3.4.3.2.1 Message Semantics (HL7 v2.3.1)

HL7 2.3.1 Chapter 4 ORM message. Refer to HL7 standard for general message semantics. Required segments listed below. Other segments are optional.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.3.

ORM	General Order Message	Chapter in HL7 2.3.1
MSH	Message Header	2
PID	Patient Identification	3
PV1	Patient Visit	3
ORC	Common Order	4

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of ADT message to its sender. See Section 2.4.3 “Acknowledgement Modes” for definition and discussion of the ACK message.

4.3.4.3.2.1.1 MSH Segment (HL7 v2.3.1)

MSH segment shall be constructed as defined in the Section 2.4.2.2 “Message Control”.

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of “ORM”; the second component shall have value of O01. The third component is optional; however, if present, it shall have a value of ORM_O01.

4.3.4.3.2.1.2 PID Segment (HL7 v2.3.1)

All of the fields in PID segment are optional, except those listed in Table 4.3-14. See Section 4.1.4.1.2.1.3 for the list of all fields of the PID segment.

Table 4.3-14: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	20	CX	R		00106	Patient Identifier List
5	48	XPN	R		00108	Patient Name
18	20	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.3.1

4.3.4.3.2.1.3 PV1 Segment (HL7 v2.3.1)

All of the fields in PV1 segment are optional, except those listed in Table 4.3-15. See Section 4.1.4.1.2.1.4 for the list of all fields of the PV1 segment.

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Table 4.3-15: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	20	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.3.1

Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued.

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

4.3.4.3.2.1.4 ORC Segment (HL7 v2.3.1)

All of the fields in ORC segment are optional, except those listed in Table 4.3-16. See Section 4.2.4.1.2.1.4 for the list of all fields of the ORC segment.

Table 4.3-16: IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	R		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number

*Adapted from the HL7 Standard, version 2.3.*1

The action to be performed in the ORM message is defined by the Order Control code passed as part of the message. The order control code below shall be supported.

Table 4.3-17: IHE Profile - Supported Order Control Codes

Value	Description	Originator
OC	Order Cancelled	F

4.3.4.3.2.2Message Semantics (HL7 v2.5.1)

The HL7 v2.5.1 Message Semantics implement the OMG message. Refer to the HL7 standard for general message semantics. Required segments are listed below. Other segments are optional.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.3.

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OMG	General Clinical Order Message	Chapter in HL7 v2.5.1
MSH	Message Header	2
PID	Patient Identification	3
PV1	Patient Visit	3
ORC	Common Order	4
OBR	Order Detail	4

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of the OMG message to its sender. See Section 2.4 for definition and discussion of the ACK message.

4.3.4.3.2.2.1 MSH Segment (HL7 v2.5.1)

The MSH segment shall be constructed as defined in ITI TF-2: 3.30.5.1 MSH – Header Segment. Additional specifications for actors complying with the IHE Radiology Technical Framework are defined in Section 2.4.

Field *MSH-9-Message Type* shall have three components. The first component shall have a value of OMG; the second component shall have a value of O19; the third component shall have a value of OMG_O19.

4.3.4.3.2.2.2 PID Segment (HL7 v2.5.1)

All of the fields in the PID segment are optional, except those listed in Table 4.3-18. See Section 4.1.4.1.2.2.3 for further discussion of the PID segment.

Table 4.3-18: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	250	CX	R		00106	Patient Identifier List
5	250	XPN	R		00108	Patient Name
18	250	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.5.1

4.3.4.3.2.2.3 PV1 Segment (HL7 v2.5.1)

All of the fields in the PV1 segment are optional, except those listed in Table 4.3-19. See Section 4.1.4.1.2.2.4 for a full discussion of the PV1 segment.

Table 4.3-19: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	250	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.5.1

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Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

At least one of the fields *PID-18-Patient Account Number* or *PV1-19-Visit Number* shall be valued.

Field *PV1-51-Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is valued. It may be omitted otherwise.

4.3.4.3.2.2.4 ORC Segment (HL7 v2.5.1)

All of the fields in the ORC segment are optional, except those listed in Table 4.3-20. See Section 4.2.4.1.2.2.4 for the list of all fields of the ORC segment.

Table 4.3-20: IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	R		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number

Adapted from the HL7 Standard, version 2.5.1

The action to be performed in the OMG message is defined by the Order Control code passed as part of the message. The order control code below shall be supported.

Table 4.3-21: IHE Profile - Supported Order Control Codes

Value	Description	Originator
OC	Order Cancelled	F

4.3.4.3.2.2.5 OBR Segment (HL7 v2.5.1)

All of the fields in the OBR segment are optional, except those listed in Table 4.3-22. See Section 4.2.4.1.2.2.6 for the list of all fields of the OBR segment.

Table 4.3-22: IHE Profile - OBR Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
2	22	EI	C		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number

Adapted from the HL7 Standard, version 2.5.1

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4.3.4.3.3 Expected Actions

After receiving the ORM message (or OMG message if implementing the HL7 v2.5.1 Message Semantics) with the control code OC, Order Placer shall process the order the same way as if it was cancelled/discontinued by the Order Placer.

If DSS/Order Filler has already scheduled the procedures corresponding to the order, it shall perform transaction Procedure Update [RAD-13] (see Section 4.13) to notify the Image Manager of order cancellation.

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4.4 Procedure Scheduled [RAD-4]

4.4.1 Scope

This transaction specifies a message from the Department System Scheduler/Order Filler to the Image Manager and the Report Manager notifying them that a procedure has been scheduled.

Scheduling does not necessarily mean precise time assignment for the particular procedures. For example, inpatient procedures are not necessarily scheduled for a specific time slot, but rather for "today" or "as soon as possible". However, the Department System Scheduler/Order Filler shall handle all orders in such a way that it is capable of informing the Image Manager and the Report Manager about procedure timing and resources used to perform a procedure. It must provide the date and time when the procedure is to be performed, although precision of the time portion of that information is allowed to be implementation dependent.

This message serves as a trigger event for the Image Manager and the Report Manager, informing it to obtain necessary information and apply rules to ensure the availability of relevant information to the end user. The Image Manager and the Report Manager may need the information to create the Requested Procedure context for its purposes. The Procedure Scheduled transaction includes the initial scheduling message. The Procedure Scheduled message is also used to provide additional information from the Department System Scheduler to the Image Manager and the Report Manager for unscheduled cases. In the event that a procedure is performed prior to ordering (as in some of the use cases in RAD TF-1: 4.4 for SWF and in RAD TF-1: 34.4.2 for SWF.b), this message is used "after the fact" for the Department System Schedule to inform the Image Manager and the Report Manager of critical information such as Accession Number and Requested Procedure ID. This is described in more detail within this section.

The Department System Scheduler/Order Filler will need to communicate with multiple Image Managers. The Department System Scheduler/Order Filler shall broadcast these scheduling messages to all Image Managers and the Report Manager. An Image Manager shall be able to receive and process these messages with the understanding that the images and MPPS events for these procedures may be sent to a different Image Manager.

The organization operating the DSS/OF and the Image Manager/Image Archive is responsible for synchronizing Procedure and Protocol Codes between all the systems that use such codes. IHE does not yet define a common mechanism for code synchronization or access.

4.4.2 Actor Roles

Actor: Department System Scheduler/Order Filler

Role: Enters, modifies and stores information about patients, receives orders, schedules Procedures (exams), modifies information about them (rescheduling, cancellations, code changes, etc.).

Actor: Image Manager

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Role: Receives information about Patients, Orders, and schedules, and uses this information to assist in image management.

Actor: Report Manager

Role: Receives information about Patients, Orders, and schedules, and uses this information to assist in Report management.

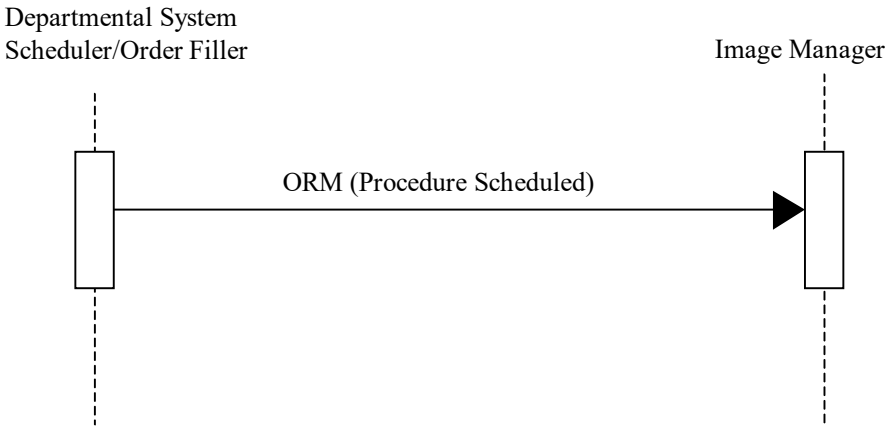
4.4.3 Referenced Standards

HL7 v2.3.1 Chapters 2-4

HL7 v2.5.1 Chapters 2-4

4.4.4 Messages

The following diagram illustrates interactions between actors within systems implementing HL7 v2.3.1:



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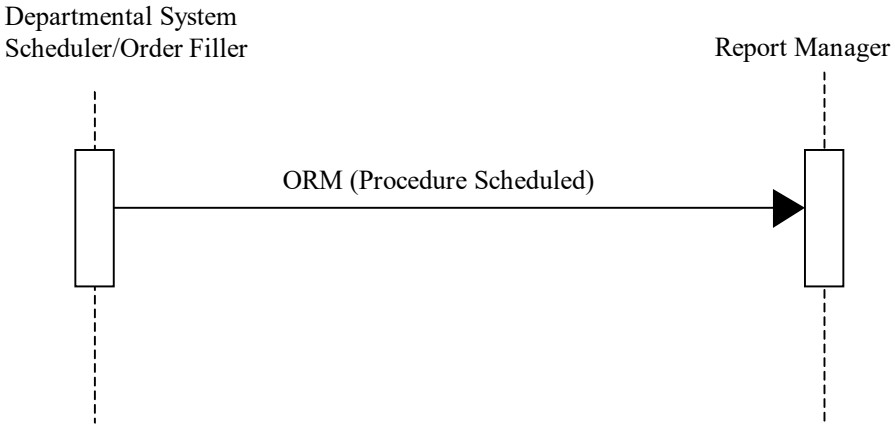

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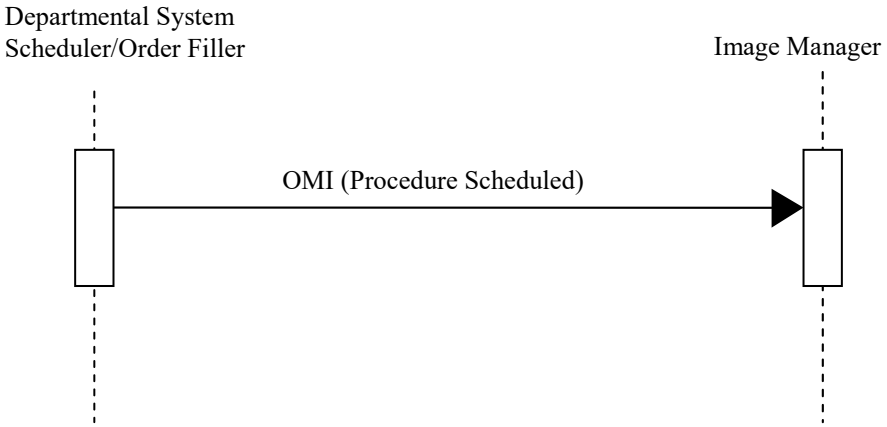
Figure 4.4.4-1: Interactions between actors implementing HL7 v2.3.1

The following diagram illustrates interactions between actors within systems implementing HL7 v2.5.1:



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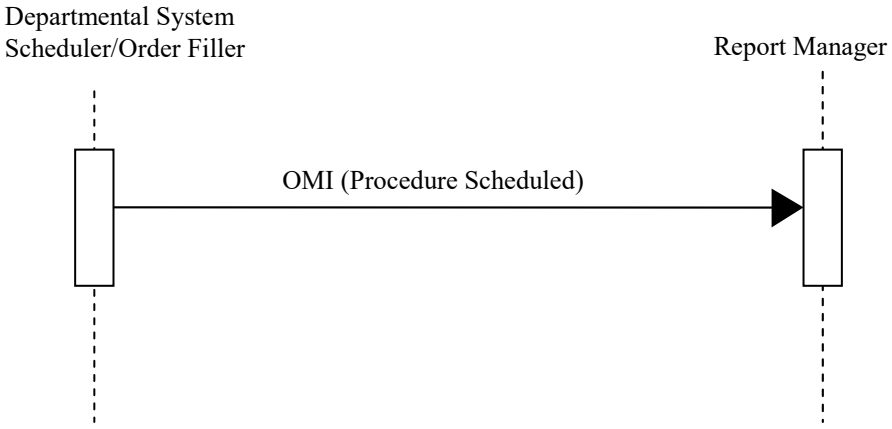

Figure 4.4.4-2: Interactions between actors implementing HL7 v2.5.1

4.4.4.1 Procedure Scheduled Message

4.4.4.1.1 Trigger Events

The Department System Scheduler/Order Filler determines procedures which need to be performed to fill the order, what Procedure Steps need to be performed for each Procedure, and timing and necessary resources.

Note: This transaction shall be used the first time a particular Study Instance UID is sent from the Department System Scheduler/Order Filler to the Image Manager or Report Manager. If the Study Instance UID has been sent previously, then Procedure Updated [RAD-13] shall be used.

4.4.4.1.2 Message Semantics

Message semantics are defined for both HL7 v2.3.1 and HL7 v2.5.1. The Profile and/or Options being claimed that incorporate this transaction will specify whether actors are required to support one, the other, or both sets of semantics.

4.4.4.1.2.1 Message Semantics (HL7 v2.3.1)

The Department System Scheduler/Order Filler uses an ORM message to convey necessary procedure and scheduling information.

The Procedure Scheduled Transaction will perform the additional task of providing Patient Demographic information to the Image Manager and the Report Manager. The Image Manager and the Report Manager do not receive all Patient Registration events from the ADT System because it is not necessary for the Image Manager and Report Manager to be aware of all patients in the enterprise (since most will never have an imaging procedure). The Image Manager and the Report Manager shall obtain the Patient Demographic information from the Procedure Schedule ORM, specifically the PID and PV1 segments. For this reason, the Department System

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Scheduler/Order Filler must complete these segments as described in Section 4.1, Patient Registration.

Note: Additional information regarding HL7 conventions, profiling, and implementation considerations is given in Section 2.3.

The segments listed below are required. All other segments are optional.

ORM	General Order Message	Chapter in HL7 2.3
MSH	Message Header	2
PID	Patient Identification	3
PV1	Patient Visit	3
{ORC	Common Order	4
OBR}	Order Detail	4
ZDS	Additional identification information (custom for IHE)	

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of the ORM message to its sender. See Section 2.4.3 “Acknowledgement Modes” for definition and discussion of the ACK message.

4.4.4.1.2.1.1 MSH Segment (HL7 v2.3.1)

MSH segment shall be constructed as defined in the Section 2.4.2.2 “Message Control”.

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of “ORM”; the second component shall have value of O01. The third component is optional; however, if present, it shall have a value of ORM_O01.

4.4.4.1.2.1.2 PID Segment (HL7 v2.3.1)

See Section 4.1.4.1.2.1.3 for the specification of the PID segment.

4.4.4.1.2.1.3 PV1 Segment (HL7 v2.3.1)

All of the fields in PV1 segment are optional, except those listed in Table 4.4-2. See Section 4.1.4.1.2.1.4 for the list of all fields of the PV1 segment.

Table 4.4-2: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
3	80	PL	C		00133	Assigned Patient Location
7	60	XCN	C	0010	00137	Attending Doctor
8	60	XCN	C	0010	00138	Referring Doctor
9	60	XCN	R2	0010	00139	Consulting Doctor
10	3	IS	C	0069	00140	Hospital Service

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SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
15	2	IS	C	0009	00145	Ambulatory Status
17	60	XCN	C	0010	00147	Admitting Doctor
19	20	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.3.1

Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

Fields *PV1-3 Assigned Patient Location, PV1-7 Attending Doctor, PV1-10 Hospital Service, PV1-17 Admitting Doctor* shall be valued only when a procedure is scheduled for the admitted in-patient.

Field *PV1-8 Referring Doctor* shall be valued when a procedure is scheduled for an outpatient. May be omitted otherwise.

Field *PV1-15 Ambulatory Status* shall be valued when patient status indicates certain conditions such as pregnancy. May be omitted if none of the defined statuses are applicable to a patient.

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued.

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

4.4.4.1.2.1.4 ORC Segment (HL7 v2.3.1)

All of the fields in ORC segment are optional, except those listed in Table 4.4-3. See Section 4.2.4.1.2.1.4 for the list of all fields of the ORC segment

Table 4.4-3: IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	R2		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number
5	2	ID	R	0038	00219	Order Status
7	200	TQ	R		00221	Quantity/Timing
10	120	XCN	R2		00224	Entered By
12	120	XCN	R2		00226	Ordering Provider
13	80	PL	R2		00227	Enterer's Location
14	40	XTN	R2		00228	Call Back Phone Number
17	60	CE	R2		00231	Entering Organization

Adapted from the HL7 Standard, version 2.3.1

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The Department System Scheduler uses the ORM message in a context different from the context existing between Order Placer and Order Filler. The Department System Scheduler/Order Filler shall send as many ORM messages as there are Requested Procedures identified to fill a single order. Each ORM message shall contain as many ORC/OBR pairs as there are Protocol Codes in all Scheduled Procedure Steps for that Requested Procedure.

It is actually common for the Department System Scheduler/Order Filler to receive a single ORM from the Order Placer system, but choose to expand that order into multiple Requested Procedures, therefore sending multiple ORMs to the Image Manager or Report Manager. Taking this into account, the Department System Scheduler will consider itself an "order placer" in relation to the Image Manager or Report Manager.

Required fields in the ORC segment shall be filled by the Department System Scheduler as given in the following table.

Table 4.4-4: DSS Mappings of the ORC Segment

Element Name	Seq.	Element Shall Contain:	Notes
Order Control Code	ORC-1	"NW"	New order
Placer Order Number	ORC-2	Placer Order Number received from Order Placer	In the event that the Order Filler places the order, the Order Filler shall not send the scheduling ORM message until it has received the Placer Order Number from the Order Placer (through an ORR message). If the Order Filler schedules a procedure for unidentified patient without an order (see case 4), this field shall be empty.
Filler Order Number	ORC-3	Filler Order Number	Number generated internally by the Department System Scheduler
Order Status	ORC-5	"SC"	Scheduled
Quantity/Timing	ORC-7	Date and time of the Scheduled Procedure Step (in the fourth component)	

4.4.4.1.2.1.5 OBR Segment (HL7 v2.3.1)

All of the fields in OBR segment are optional, except those listed in Table 4.4-5. See Section 4.2.4.1.2.1.5 for the list of all fields of the OBR segment.

Table 4.4-5: IHE Profile - OBR Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	4	SI	R		00237	Set ID – OBR
2	22	EI	R2		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number

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SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
4	200	CE	R		00238	Universal Service ID
5	2	ID	R2		00239	Priority
12	60	CE	R2		00246	Danger Code
13	300	ST	R2		00247	Relevant Clinical Info.
15	300	CM	C	0070	00249	Specimen Source
16	120	XCN	R2		00226	Ordering Provider
17	40	XTN	R2		00250	Order Callback Phone Number
18	60	ST	R		00251	Placer field 1
19	60	ST	R		00252	Placer field 2
20	60	ST	R		00253	Filler Field 1
24	10	ID	R	0074	00257	Diagnostic Serv Sect ID
27	200	TQ	R		00221	Quantity/Timing
30	20	ID	R2	0124	00262	Transportation Mode
31	300	CE	R2		00263	Reason for Study
44	80	CE	O	0088	00393	Procedure Code

Adapted from the HL7 Standard, version 2.3.1

Field *OBR-15 Specimen Source* holds the laterality (Left/Right) indicator (when used) in the <site modifier (CE)> component. This element shall be present if the procedure has laterality and the Universal Service ID code in OBR-4 does not encode laterality. This element shall not be present otherwise.

Per the HL7 Standard, IHE recommends that some fields in ORC and OBR segments contain the same information, as described in Section 4.2.4.1.2.1.5.

Required fields in the OBR segment that are not identical to those from the ORC segment shall be filled by the Department System Scheduler as defined in the following table.

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Table 4.4-6: DSS mappings of the OBR Segment

Element Name	Seq.	Shall Contain:	Notes
Placer Field 1	OBR-18	Accession Number	Length of the value in this field shall not exceed 16 characters
Placer Field 2	OBR-19	Requested Procedure ID	All OBR segments within a single ORM message shall have the same value in this field.
Filler Field 1	OBR-20	Scheduled Procedure Step ID	If a Scheduled Procedure Step has multiple Protocol Codes associated with it, several ORC segments within a single ORM message may have the same value in this field.
Universal Service ID	OBR-4	Both the Universal Service ID of the Order and a Scheduled Protocol Code of the Scheduled Procedure Step (see OBR-20).	Components 1-3 of OBR-4 shall be copied by the Order Filler from the components 1-3 of OBR-4 it obtains from the ORM message (OBR segment) conveyed to it by the Order Placer. Components 1-3 of OBR-4 in all OBR segments of an ORM message shall have the same value. Components 4-6 shall be filled with the Scheduled Protocol Code. (See Section 4.4.4.1.2.1.4 for multiple Scheduled Protocol Codes.) The related Requested Procedure Code/ Description is sent in OBR-44.
Specimen Source	OBR-15	Laterality of the procedure. The value shall be appended to the Requested Procedure Description (0032,1060).	See note below Table 4.4-5.
Diagnostic Service Section ID	OBR-24	DICOM Modality	The Modality attribute of DICOM consists of Defined Terms that shall be used in this element.
Procedure Code	OBR-44	Requested Procedure Code and Requested Procedure Description.	Components 1-3 shall contain the Requested Procedure Code for this ORM message. Optionally, component 5 may contain the Requested Procedure Description. As the Order Filler may expand a single order into multiple Requested Procedures, multiple ORM messages may be sent for a single Order (with the same value for Components 1-3 of OBR-4).

A custom ZDS Segment is defined to convey information generated by the Order Filler and not currently defined in the HL7 standard and is given in the following table.

Table 4.4-7: IHE Profile - ZDS Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	200	RP	R		Z0001	Study Instance UID

Components of the Study Instance UID field shall be encoded as given in the Table 4.4-8.

Table 4.4-8: Z Segment Study Instance UID Element Components

Component Number	Component Name	Shall Contain:
1	Reference Pointer	DICOM compliant Study Instance UID value

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Component Number	Component Name	Shall Contain:
2	Application ID	Implementation specific
3	Type of Data	"Application"
4	Subtype	"DICOM"

4.4.4.1.2.2 Message Semantics (HL7 v2.5.1)

The HL7 2.5.1 Message Semantics implement the OMI message. Refer to the HL7 Standard for general message semantics. This section contains additional requirements for the OMI message.

The Department System Scheduler/Order Filler uses an OMI message to convey necessary procedure and scheduling information.

The Procedure Scheduled Transaction will perform the additional task of providing Patient Demographic information to the Image Manager and the Report Manager. The Image Manager and the Report Manager do not receive all Patient Registration events from the ADT System because it is not necessary for the Image Manager and Report Manager to be aware of all patients in the enterprise (since most will never have an imaging procedure). The Image Manager and the Report Manager shall obtain the Patient Demographic information from the Procedure Scheduled OMI message, specifically the PID and, PV1 segments. For this reason, the Department System Scheduler/Order Filler must complete these segments as described in Section 4.1, Patient Registration.

Note: Additional information regarding HL7 conventions, profiling, and implementation considerations is given in Section 2.3.

The segments listed below are required or conditionally required. All other segments are optional.

Segment	Meaning	Usage	Card.	HL7 chapter
MSH	Message Header	R	[1..1]	2
PID	Patient Identification	R	[1..1]	3
PV1	Patient Visit	R	[1..1]	3
AL1	Allergy Information	C	[0..*]	3
ORC	Common Order	R	[1..*]	4
TQ1	Timing/Quantity	R	[1..1]	4
OBR	Order Detail	R	[1..1]	4
OBX	Observation/Result	C	[0..*]	7
IPC	Imaging Procedure Control	R	[1..*]	4

The allergy segment AL1 shall be present if allergy information is added/updated. The OBX segment(s) shall be present if patient weight and/or height is updated.

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of the ORM message to its sender. See Section 2.4.4.3 "Acknowledgement Modes" for definition and discussion of the ACK message.

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4.4.4.1.2.2.1 MSH Segment (HL7 v2.5.1)

The MSH segment shall be constructed as defined in ITI TF-2: 3.30.5.1 MSH – Header Segment. Additional specifications for actors complying with the IHE Radiology Technical Framework are in Section 2.4.

Field MSH-9-Message Type shall have three components. The first component shall have a value of OMI; the second component shall have a value of O23; the third component shall have a value of OMI_O23.

4.4.4.1.2.2.2 PID Segment (HL7 v2.5.1)

See Section 4.1.4.1.2.2.3 for the specification of the PID segment.

4.4.4.1.2.2.3 PV1 Segment (HL7 v2.5.1)

All of the fields in the PV1 segment are optional, except those listed in Table 4.4-10. See Section 4.1.4.1.2.2.4 for a full discussion of the PV1 segment.

Table 4.4-10: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
3	80	PL	C		00133	Assigned Patient Location
7	60	XCN	C	0010	00137	Attending Doctor
8	60	XCN	C	0010	00138	Referring Doctor
9	60	XCN	X	0010	00139	Consulting Doctor
10	3	IS	C	0069	00140	Hospital Service
15	2	IS	C	0009	00145	Ambulatory Status
17	60	XCN	C	0010	00147	Admitting Doctor
19	20	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.5.1

Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

Fields *PV1-3-Assigned Patient Location, PV1-7-Attending Doctor, PV1-10-Hospital Service, PV1-17-Admitting Doctor* shall be valued only when a procedure is scheduled for an admitted in-patient.

Field *PV1-8-Referring Doctor* shall be valued when registering an outpatient (*MSH-9- Message Type* is ADT^A04^ADT_A01) or when pre-registering a patient (*MSH-9-Message Type* is ADT^A05^ADT_A05).

Field *PV1-9-Consulting Doctor* shall not be present.

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Field *PV1-15-Ambulatory Status* shall be valued when patient status indicates certain conditions such as pregnancy. It may be omitted if none of the defined statuses are applicable to a patient.

At least one of the fields *PID-18-Patient Account Number* or *PV1-19-Visit Number* shall be valued.

Field *PV1-51-Visit Indicator* shall be valued with value "V" if the field *PV1-19-Visit Number* is valued. It may be omitted otherwise.

4.4.4.1.2.2.4 Intentionally Left Blank

4.4.4.1.2.2.5 ORC Segment (HL7 v2.5.1)

All of the fields in the ORC segment are optional, except those listed in Table 4.4-11. See Section 4.2.4.1.2.2.4 for the list of all fields of the ORC segment.

Table 4.4-11: IHE Profile - ORC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	2	ID	R	0119	00215	Order Control
2	22	EI	R2		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number
5	2	ID	R	0038	00219	Order Status
7	200	TQ	X		00221	Quantity/Timing
10	250	XCN	R2		00224	Entered By
12	250	XCN	R2		00226	Ordering Provider
13	80	PL	R2		00227	Enterer's Location
14	250	XTN	R2		00228	Call Back Phone Number
17	250	CE	R2		00231	Entering Organization

Adapted from the HL7 Standard, version 2.5.1

The Department System Scheduler uses the OMI message in a context different from the context existing between Order Placer and Order Filler. The Department System Scheduler/Order Filler shall send as many OMI messages as there are Requested Procedures identified to fill a single order.

It is actually common for the Department System Scheduler/Order Filler to receive a single ORM from the Order Placer system, but choose to expand that order into multiple Requested Procedures, therefore sending multiple OMIs to the Image Manager or Report Manager. Taking this into account, the Department System Scheduler will consider itself an "order placer" in relation to the Image Manager or Report Manager.

Required fields in the ORC segment shall be filled by the Department System Scheduler as given in the following table.

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Table 4.4-12: DSS Mappings of the ORC Segment

Element Name	Seq.	Element Shall Contain:	Notes
Order Control Code	ORC-1	"NW"	New order
Placer Order Number	ORC-2	Placer Order Number received from Order Placer	In the event that the Order Filler places the order, the Order Filler shall not send the scheduling OMI message until it has received the Placer Order Number from the Order Placer (through an ORG message). If the Order Filler schedules a procedure for unidentified patient without an order (see case 4), this field shall be empty.
Filler Order Number	ORC-3	Filler Order Number	Number generated internally by the Department System Scheduler
Order Status	ORC-5	"SC"	Scheduled
Quantity/Timing	ORC-7	Shall not be valued: Date and time of the Scheduled Procedure Step shall be carried in the immediately following TQ1 segment.	

4.4.4.1.2.2.6 TQ1 Segment (HL7 v2.5.1)

Deprecated components ORC-7.4-Start Date/Time or OBR-27.4-Start Date/Time shall not be populated but instead the TQ1 segment shall be used to carry the start date and time of the procedure.

Table 4.4-13: IHE Profile – TQ1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	4	SI	O		01627	Set ID – TQ1
2	20	CQ	O		01628	Quantity
3	540	RPT	O	0335	01629	Repeat Pattern
4	20	TM	O		01630	Explicit Time
5	20	CQ	O		01631	Relative Time and Units
6	20	CQ	O		01632	Service Duration
7	26	TS	R		01633	Start Date/Time
8	26	TS	O		01634	End Date/Time
9	250	CWE	O	0485	01635	Priority
10	250	TX	O		01636	Condition Text
11	250	TX	O	0065	01637	Text Instruction
12	10	ID	C	0427	01638	Conjunction
13	20	CQ	O		01639	Occurrence Duration

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SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
14	10	NM	O		01640	Total Occurrences

Adapted from the HL7 Standard, version 2.5.1

Field *TQ1-7-Start Date/Time* shall contain the date and time of the exam.

4.4.4.1.2.2.7 OBR Segment (HL7 v2.5.1)

All of the fields in the OBR segment are optional, except those listed in Table 4.4-14. See Section 4.2.4.1.2.2.6 for the list of all fields of the OBR segment.

Table 4.4-14: IHE Profile - OBR Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	R		00237	Set ID – OBR
2	22	EI	R2		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number
4	200	CE	R		00238	Universal Service ID
5	2	ID	R2		00239	Priority
12	60	CE	R2		00246	Danger Code
13	300	ST	R2		00247	Relevant Clinical Info.
16	120	XCN	R2		00226	Ordering Provider
17	40	XTN	R2		00250	Order Callback Phone Number
27	200	TQ	X		00221	Quantity/Timing
30	20	ID	R2	0124	00262	Transportation Mode
31	300	CE	R2		00263	Reason for Study
46	250	CE	R2	0411	01474	Placer Supplemental Service Information

Adapted from the HL7 Standard, version 2.5.1

One ORC-TQ1-OBR-IPC segment group shall correspond to each Requested Procedure. If a Requested Procedure is comprised of multiple Scheduled Procedure Steps and/or if a Scheduled Procedure Step is comprised of multiple Protocol Codes, each applicable Scheduled Procedure Step / Protocol Code combination shall be included in a separate IPC segment following the ORC-TQ1-OBR segment group that contains the Requested Procedure.

- Field OBR-46-Placer Supplemental Service Information holds the laterality (Left/Right) indicator (when used). This element shall be populated if the procedure has laterality and the Universal Service ID code in OBR-4 does not encode laterality. This element shall be empty otherwise. Field OBR-15-Specimen Source, which had formerly been adapted for this use by the IHE Technical Framework and has been deprecated in HL7 Version 2.5.1, shall not be present. See RAD TF-2x: Appendix B for details.
- Per the HL7 Standard, IHE recommends that some fields in the ORC and OBR segments contain the same information, as described in Section 4.2.4.1.2.6.6.

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- Non-optional fields in the OBR segment that are not identical to those from the ORC segment shall be filled by the Department System Scheduler as defined in the following table.

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Table 4.4-15: DSS mappings of the OBR Segment

Element Name	Seq.	Shall Contain:	Notes
Universal Service ID	OBR-4	The Universal Service ID of the Order.	Components 1-3 of OBR-4 shall be copied by the Order Filler from the components 1-3 of OBR-4 it obtains from the ORM message (OBR segment) conveyed to it by the Order Placer. Components 1-3 of OBR-4 in all OBR segments of an OMI or legacy ORM message shall have the same value. The related Requested Procedure Code/ Description are sent in OBR-44. As the Order Filler may expand a single order into multiple Requested Procedures, multiple OMI messages may be sent for a single Order (with the same value for Components 1-3 of OBR-4).
Reason for Study	OBR-31	The reason or clinical indication for which the study was ordered.	Components 1-3 of OBR-31 shall be copied by the Order Filler from the components 1-3 of OBR-31 it obtains from the ORM message (OBR segment) conveyed to it by the Order Placer. Component 5 (Alternate Text) shall be copied from the Component 5 of the OBR-31 conveyed by the Order Placer if present. Otherwise, the value of Component 5 may be generated by the DSS/Order Filler. Components 2 and 5 may or may not have the same value. Procedure codes may have both short and long names, either may be used in either component. As the Order Filler may expand a single order into multiple Requested Procedures, multiple OMI messages may be sent for a single Order (with the same value for Components 1-3 and 5 of OBR-31).
Procedure Code	OBR-44	Requested Procedure Code and Requested Procedure Description.	Components 1-3 shall contain the Requested Procedure Code for this OMI message. Optionally, component 5 may contain the Requested Procedure Description.
Placer Supplemental Service Information	OBR-46	Laterality of the procedure. The value shall be appended to the Requested Procedure Description (0032,1060).	See note below Table 4.4-14.

4.4.4.1.2.2.8 IPC Segment (HL7 v2.5.1)

All of the fields in the IPC segment are optional, except those listed in Table 4.4-16.

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Table 4.4-16: IHE Profile –IPC Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	80	EI	R		00237	Accession Identifier
2	22	EI	R		00216	Requested Procedure ID
3	70	EI	R		00217	Study Instance UID
4	22	EI	R		00238	Scheduled Procedure Step ID
5	16	CE	R+		00239	Modality
6	250	CE	R2		00246	Protocol Code

Adapted from the HL7 Standard, version 2.5.1

The Department System Scheduler uses the OMI message in a context different from the context of the ORM message sent between the Order Placer and Order Filler. As provided by the HL7 Standard, each OMI message shall convey information about Requested Procedure(s) pertaining to one order.

The value of the IPC-1 field shall be identical in all IPC segments. Because the Accession Identifier is later mapped to Accession Number (0008,0050), which has a DICOM value representation of Short Text, the length of the value in IPC-1 shall not exceed 16 characters. See the HL7 Standard for further explanation of the use of the IPC segment within the OMI message.

4.4.4.1.2.2.9 Enterprise Identity Option

A DSS/Order Filler supporting the Enterprise Identity Option shall send Assigning Authority values for the Patient Identifier and for the Accession Number sent in the OMI message.

The DSS/OF shall provide a value for the Patient Identifier Assigning authority in PID-3.

The DSS/Order Filler shall specify the Assigning Authority of the Accession Number in IPC-1.

It shall provide values for all components of the Accession Identifier. The second component (namespace ID) shall reference the same entity as is referenced by the third and fourth components (universal ID and universal ID type).

Table 4.4-17: DSS/Order Filler requirements for the IPC Segment for Enterprise Identity Option

Element Name	Seq.	Shall Contain:	Notes
Accession Identifier	IPC-1	Accession Number and its assigning authority	Values shall be provided for all components: <entity identifier (ST)> ^ <namespace ID (IS)> ^ <universal ID (ST)> ^ <universal ID type (ID)>

For example, a DSS/Order Filler at the Metropolitan Medical Center sends an Image Manager/Archive the following values in a Procedure Scheduled OMI message:

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Table 4.4-18: Example Accession Number Assigning Authority in OMI Message

Element Name	Seq.	Value
Filler Order Number	OBR-3	35732^99MMC^1.2.mm.nnnnn.444.888888^ISO
Accession Identifier	IPC-1	A35732-1^99MMC^1.2.mm.nnnnn.444.888888^ISO

Typically, the Accession Identifier value in IPC-1 will be the same value as the entity identifier value of the Filler Order Number in OBR-3; however, in this example they are not. Regardless, the same Assigning Authority is providing both of these values so the Image Manager/Archive shall still obtain the Accession Number Assigning Authority from OBR-3 or IPC-1. So, in this example, the Image Manager would map the following values to their corresponding DICOM attributes:

Table 4.4-19: Example Mapping to DICOM Accession Number Attributes

DICOM Attribute	DICOM Tag	Value
Accession Number	(0008,0050)	A35732-1
Issuer of Accession Number Sequence	(0008,0051)	
>Local Namespace Entity ID	(0040,0031)	99MMC
>Universal Entity ID	(0040,0032)	1.2.mm.nnnnn.444.888888
>Universal Entity ID Type	(0040,0033)	ISO

4.4.4.2 Expected Actions

4.4.4.2.1 Use Cases

The intent of this section is to illustrate through use cases how key information is used in a Procedure Scheduled transaction.

See RAD TF-1: 3.3 (Typical Process Flow) for illustrations of the following discussions:

- RAD TF-1: 3.3.2.1: In the case where the patient demographics are updated or patients are merged prior to placer order creation, this transaction occurs normally using the updated patient and visit information.
- RAD TF-1: 3.3.2.2: In the case where the patient demographics are updated or patients are merged after a procedure has been scheduled, only a Patient Update transaction is required, and this transaction is not used.
- RAD TF-1: 3.3.3: In the case where an order is cancelled at the Order Placer or Order Filler and a new order is generated, the previously scheduled order transaction sent to the Image Manager or Report Manager shall be cancelled (Section 4.13) and a new Procedure Scheduled transaction shall be initiated for the “new” order.

See RAD TF-1: 4.3 (Unidentified Patient Image Acquisition) for illustrations of the following discussions:

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- Case 1: In the case where a Temporary Patient Name and ID are assigned by an ADT system and an order is placed at the Order Placer, a Procedure Update transaction is not necessary (only a Patient Update transaction is necessary).
- Case 2: In the case where a Temporary Patient Name and ID are assigned by an ADT system but the order is placed at the Department System Scheduler, a Procedure Update transaction is not necessary (only a Patient Update transaction is necessary).

In both cases 1 and 2, the DICOM attribute information mapping given in the Procedure Scheduled Transaction remains the same. That is, the Study Instance UID, Requested Procedure ID, Accession Number, etc., are supplied by the Department System Scheduler, are used by the modality and Image Manager or Report Manager, and are not changed.

- Case 3: In this case a Temporary Patient Name and ID are assigned by an ADT system, no order is placed prior to image acquisition, but rather an order is placed after the exam is completed, the Study Instance UID is generated by the acquisition modality, and a Modality Performed Procedure Step is sent to the Image Manager, Report Manager and Department System Scheduler (containing the modality generated Study Instance UID). As always, the Study Instance UID contained within an object set remains the "master" key.

  At this point, a Procedure Scheduled transaction (Control Code = NW) must be sent to the Image Manager and Report Manager using the Study Instance UID contained in the MPPS message from the acquisition device. In this case, the information given in Table 4.4-20 must be altered by the Image Manager, Report Manager using the information received in the Procedure Update transaction by changing the DICOM objects.

Table 4.4-20: Data Mapping from ORM by Image Manager and Report Manager after Procedure Scheduled

Attributes Overwritten in DICOM Instances Based on Procedure Scheduled information
Placer Order Number + Issuer
Filler Order Number + Issuer
Accession Number
Requested Procedure ID

Note: In Case 3, the reconciliation of Scheduled Procedure Steps which are identified by the Department System Scheduler and contained in the Procedure Scheduled message with the Performed Procedure Steps that are actually contained in the DICOM objects (MPPS object) may not be consistent and do not need to be coerced. At this point, the number and identification of the Scheduled Procedure Steps is irrelevant because the procedure has already been performed.

If a race condition should occur such that the Department System Scheduler has just created a Procedure Scheduled Transaction (and generated a Study Instance UID) and the Modality has generated DICOM objects (and generated a different Study Instance UID), it is the responsibility of the Department System Scheduler to reconcile these transactions by canceling the order (and Study Instance UID) that it generated internally and create a new Procedure Scheduled transaction using the Study Instance UID generated by the modality and provided in the Modality Performed Procedure Step transaction. In cases where this is a multi-modality study

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with multiple Study Instance UIDs, multiple Procedure Scheduled transactions must be generated by the Department System Scheduler. The studies may still be reported as one Requested Procedure (see Sections 4.24 - 4.27).

In case 3, Patient Update [RAD-12] transaction(s) must still be sent to the Image Manager and Report Manager to update the patient demographic, visit information, and ID.

- Case 4: In the case where the Departmental System Scheduler assigns a Department Temporary Patient Name and ID and the procedure is scheduled, a Procedure Scheduled transaction is necessary and adequately provides the Study Instance UID and other information given in Table 4.4-20. Subsequently, a Patient Update [RAD-12] transaction(s) is necessary.

- Case 5: In the case where no Temporary Patient Name nor ID are assigned by an ADT system, no order is placed in advance, but rather the patient is registered at the Department System Scheduler and the order is placed after the exam is complete a Procedure Scheduled transaction (Control Code = NW) must be sent to the Image Manager and the Report Manager. Similar to case 3, the Study Instance UID obtained in the Modality Performed Procedure Step message shall be used as the key by both the Department System Scheduler the Image Manager and the Report Manager. The Image Manager and the Report Manager must alter the information given in Table 4.4-11 using the information received in the Procedure Scheduled [RAD-4] transaction.
  In Case 5, a Patient Update [RAD-12] transaction(s) must still be sent to the Image Manager and Report Manager to update the patient demographic, visit information and ID.

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4.5 Query Modality Worklist [RAD-5]

4.5.1 Scope

This transaction takes place under two circumstances. The first is for the scheduling of an acquisition, the second is for the scheduling of an importation of existing Evidence Objects or Hardcopy. This transaction takes place at the Acquisition Modality at the point of scan/acquisition, or at the Radiopharmaceutical Activity Supplier (RAS) at the point of radiopharmaceutical administration, by a technologist. When a patient arrives for the scheduled procedure, the technologist performing the procedure must examine key information elements as they relate to the procedure, the correctness of the procedure that has been ordered, and comments that may have been entered by the referring physician and/or radiologist, among others. The technologist at the Acquisition Modality or RAS uses the DICOM Modality Worklist to query the Department System Scheduler/Order Filler for Scheduled Procedure Steps. The list is downloaded to the Acquisition Modality or RAS and the technologist verifies the information on the Acquisition Modality or RAS console. In the Modality Images Stored transaction this information will be included in the header of the generated images (see Section 4.8 and RAD TF-2x: Appendix A).

An importation may occur with existing DICOM Objects or the creation of DICOM Objects as part of the importation (e.g., the digitization of films into DICOM Objects). The actual scheduling of the importation may vary. For example, the importation may be scheduled as part of an externally referred acquisition, or upon the receipt of a physical PDI media containing patient images required for an upcoming consultation. The User at the Importer uses the DICOM Modality Worklist to query the Department System Scheduler/Order Filler for Scheduled Procedure Steps. The User must be able to verify that Evidence Objects or the Hardcopy data to be imported as DICOM Composite Objects are for the correct Patient and Scheduled Procedure Step. In the Imported Objects Stored transaction this information will be included in the header of the imported Evidence Documents (see Section 4.61 and RAD TF-2x: Appendix A.5).

For an illustration of mapping between transactions [RAD-2], [RAD-3], [RAD-5], [RAD-6] and [RAD-7], see the IHE white paper “Code Mapping in IHE Radiology Profiles”, https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE_RAD_White-Paper_Codes.pdf.

4.5.2 Actor Roles

Actor: Acquisition Modality

Role: Responsible for requesting and receiving data from the Department System Scheduler/Order Filler.

Actor: Importer

Role: Responsible for requesting and receiving data from the Department System Scheduler/Order Filler.

Actor: Department System Scheduler/Order Filler

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Role: Responsible for accepting requests for MWL from an acquisition modality, performing the query, and sending the response back.

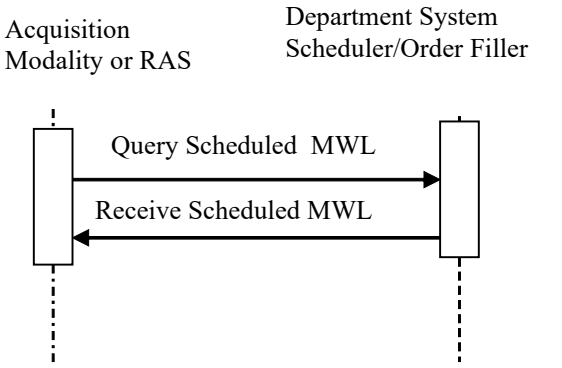
Actor: Radiopharmaceutical Activity Supplier

Role: Responsible for requesting and receiving data from the Department System Scheduler/Order Filler.

4.5.3 Referenced Standards

DICOM PS3.4 Annex K: Basic Worklist Management Service

4.5.4 Messages



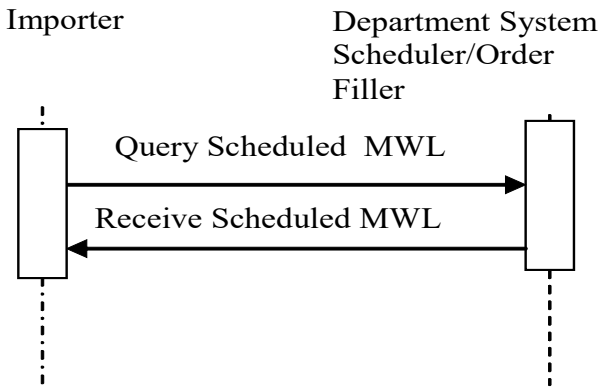


Figure 4.5.4-1: Interaction Diagram

4.5.4.1 Query Scheduled MWL Message

This is the worklist query request message sent to the Department System Scheduler/Order Filler.

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4.5.4.1.1 Trigger Events

The patient arrives at the Acquisition Modality or Radiopharmaceutical Activity Supplier (RAS) for a procedure (scan/acquisition).

The trigger event for an importation is a User that wants to perform a scheduled importation. The actual trigger for scheduling the importation is site specific, but may be triggered by such events as:

- Arrival of films as a result of a request for a scheduled consult.
- Patient with a scheduled procedure brings prior Evidence Objects on a PDI Media.
- Other communications not specified further by the IHE Radiology Technical Framework which result in the scheduling of an import.

4.5.4.1.2 Message Semantics

The Acquisition Modality, RAS, or Importer uses the C-FIND Request of the DICOM Modality Worklist SOP Class to query for the worklist from the DSS/Order Filler. The Acquisition Modality, RAS, or Importer performs the SCU role, and the DSS/Order Filler the SCP role.

An **Acquisition Modality** or a **RAS**:

- shall support the required matching keys listed in Table 4.5-3 - Matching and Return Keys For Modality Worklist
- shall support at least one of the following:
  - all combinations of the matching keys in Table 4.5-1: MWL Keys for Query by Patient
  - all combinations of the matching keys in Table 5.4-2: MWL Keys for Broad Worklist Queries

An **Importer**:

- shall support the required matching keys listed in Table 4.5-3 - Matching and Return Keys For Modality Worklist
- shall support all combinations of matching keys in Table 4.5-1: MWL Keys for Query by Patient

1. **The Patient Based Query:** Query for a worklist specific for a particular patient. The SCU shall support all (15) combinations of the matching key attributes listed in Table 4.5-1 by including 1 or more keys.

Table 4.5-1: MWL Keys for Query by Patient

Matching Key Attributes	Tag
Patient's Name	(0010,0010)

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Matching Key Attributes	Tag
Patient ID	(0010,0020)
Accession Number	(0008,0050)
Requested Procedure ID	(0040,1001)

2. The Broad Query: Query for a broad worklist. The SCU shall support all (7) combinations of the matching key attributes listed in Table 4.5-2 by including 1 or more keys.

Table 4.5-2: MWL Keys for Broad Worklist Queries

Matching Key Attributes	Tag
Scheduled Procedure Step Start Date	(0040,0002)
Modality	(0008,0060)
Scheduled Station AE Title	(0040,0001)

4.5.4.1.2.1 Examples for the Use of Matching Key Attributes

- Using the Scheduled Procedure Step Start Date: query for all the procedures in my department that are scheduled for the start date specified.
- Using the Modality key: query for all the procedures that are scheduled on this type of modality (e.g., all CT exams).
- Using AE Title key: query for all the procedures that are scheduled on the modality with the specified AE Title.
- Using the Scheduled Procedure Step Start Date and Modality keys: query for all the CT procedures that are scheduled for today.
- Using the Patient Name, Patient Birth Date and Patient Sex query for all the procedures that are scheduled for a patient.
- Using the Patient Name and AE Title query for all procedures to be imported for a Patient.

Note: DICOM defines that dates and times are matched by their meaning, not as literal strings. If an application is concerned about how a single value matching of dates and times is performed by another application, it may consider using range matching instead (e.g., "<today>-<today>"), which is always performed by meaning.

Note: Applications are recommended to append a wildcard "*", if one was not previously entered by the user, at the end of each component of the structured Patient Name.

4.5.4.1.2.2 Matching Keys and Return Keys

Table 4.5-3 contains both the matching key requirements and the return key requirements.

Attributes with R+ or R+* highlight additions to the DICOM Standard requirements for Modality Worklist SOP Class. See Section 2.2 for more information.

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An **Acquisition Modality**:

- shall be able to request specific attributes (return keys)
- shall be able to display in the user interface the returned value of attributes specified as R or R+
- shall map returned values into stored images as defined in Section 4.8 and RAD TF-2x: Appendix A
- may request additional return key attributes that might be displayed but not be inserted into the composite image object

A **Radiopharmaceutical Activity Supplier** (RAS):

- shall be able to query for specific attributes (return keys)
- shall be able to display in the user interface the returned value of attributes specified as R or R+
- shall map returned values into RRDSR objects. The requirements for the attributes in the stored Dose Reports are defined in RAD TF-2: Table 4.110.4.1.2-1.

An **Importer**:

- shall be able to request specific attributes (return keys)
- shall be able to display in the user interface the returned value of attributes specified as R or R+
- shall use returned values to modify imported objects as defined in RAD TF-2: 4.61.4.1.2.1 and RAD TF-2x: Appendix A.5

Table 4.5-3: Return and Matching Keys for Modality Worklist

Attribute Name	Tag	Matching Keys		Return Keys	
		SCU	SCP	SCU	SCP
Scheduled Procedure Step					
Scheduled Procedure Step Sequence	(0040,0100)			[IHE-1]	[IHE-2]
>Scheduled Station AE Title	(0040,0001)	R+	R	R+*	R
>Scheduled Procedure Step Start Date	(0040,0002)	R+	R	R+	R
>Scheduled Procedure Step Start Time	(0040,0003)	O	R	R+	R
> Scheduled Procedure Step Location	(0040,0011)	O	O	O	O
>Modality	(0008,0060)	R+	R	R+	R
>Scheduled Performing Physician's Name	(0040,0006)	O	R	O	R
>Scheduled Procedure Step ID	(0040,0009)	O	O	R+*	R

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Attribute Name	Tag	Matching Keys		Return Keys	
		SCU	SCP	SCU	SCP
>Scheduled Protocol Code Sequence	(0040,0008)				
>>Code Value	(0008,0100)	O	O	R+*	R
>>Coding Scheme Version	(0008,0103)	O	O	O	O
>>Coding Scheme Designator	(0008,0102)	O	O	R+*	R
>>Code Meaning	(0008,0104)	O	O	R+	R+
>Scheduled Procedure Step Description	(0040,0007)	O	O	R+	R
Requested Procedure					
Requested Procedure Comments	(0040,1400)	O	O	O	O
Requested Procedure Description	(0032,1060)	O	O	R+	R
Requested Procedure Code Sequence	(0032,1064)				
>Code Value	(0008,0100)	O	O	R+*	R
>Coding Scheme Version	(0008,0103)	O	O	O	O
>Coding Scheme Designator	(0008,0102)	O	O	R+*	R
>Code Meaning	(0008,0104)	O	O	R+	R+
Requested Procedure ID	(0040,1001)	R+ (Note 1)	R+ (Note 1)	R+	R
Names of Intended recipients of results	(0040,1010)	O	O	O	O
Reason for the Requested Procedure [IHE-7]	(0040,1002)	O	O	R+*	R+
Reason for Requested Procedure Code Sequence [IHE-7]	(0040,100A)	O	O	R+*	R+
>Code Value	(0008,0100)	O	O	R+*	R+
>Coding Scheme Version	(0008,0103)	O	O	O	O
>Coding Scheme Designator	(0008,0102)	O	O	R+*	R+
>Code Meaning	(0008,0104)	O	O	R+*	R+
Study Instance UID	(0020,000D)	O	O	R+*	R
Referenced Study Sequence [IHE-3], [IHE-6]	(0008,1110)				
>Referenced SOP Class UID	(0008,1150)	O	O	R+*	R
>Referenced SOP Instance UID	(0008,1155)	O	O	R+*	R
Reason for the Requested Procedure	(0040,1002)	O	O	O	O
Reason for Requested Procedure Code Sequence	(0040,100A)				
>Code Value	(0008,0100)	O	O	O	O
>Coding Scheme Designator	(0008,0102)	O	O	O	O

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Attribute Name	Tag	Matching Keys		Return Keys	
		SCU	SCP	SCU	SCP
>Coding Scheme Version	(0008,0103)	O	O	O	O
>Code Meaning	(0008,0104)	O	O	O	R+
Imaging Service Request					
Imaging Service Request Comments	(0040,2400)	O	O	O	O
Accession Number	(0008,0050)	R+ (Note 1)	R+ (Note 1)	R+	R+ [IHE-3]
Requesting Physician	(0032,1032)	O	O	O	R
Issuer of Accession Number Sequence	(0008,0051)				
>Local Namespace Entity ID	(0040,0031)	O	O	O [IHE-4]	O [IHE-5]
>Universal Entity ID	(0040,0032)	O	O	O [IHE-4]	O [IHE-5]
>Universal Entity ID Type	(0040,0033)	O	O	O [IHE-4]	O [IHE-5]
Requesting Service	(0032,1033)	O	O	O	O
Referring Physician's Name	(0008,0090)	O	O	R+	R
Visit Identification					
Institution Name	(0008,0080)	O	O	O [IHE-4]	O [IHE-5]
Institution Address	(0008,0081)	O	O	O [IHE-4]	O [IHE-5]
Institution Code Sequence	(0008,0082)	O	O	O [IHE-4]	O [IHE-5]
>Code Value	(0008,0100)	O	O	O [IHE-4]	O [IHE-5]
>Coding Scheme Designator	(0008,0102)	O	O	O [IHE-4]	O [IHE-5]
>Code Meaning	(0008,0104)	O	O	O [IHE-4]	O [IHE-5]
Admission ID	(0038,00100	O	O	O	R
Visit Status					
Current Patient Location	(0038,0300)	O	O	O	R
Visit Relationship					
Referenced Patient Sequence	(0008,1120)				
>Referenced SOP Class UID	(0008,1150)	O	O	O	R
>Referenced SOP Instance UID	(0008,1155)	O	O	O	R
Patient Identification					
Patient's Name	(0010,0010)	R+	R	R+	R
Patient ID	(0010,0020)	R+	R	R+	R
Issuer of Patient ID	(0010,0021)	O	O	O [IHE-4]	O [IHE-5]
Issuer of Patient ID Qualifiers Sequence	(0010,0024)				
>Universal Entity ID	(0040,0032)	O	O	O [IHE-4]	O [IHE-5]
>Universal Entity ID Type	(0040,0033)	O	O	O [IHE-4]	O [IHE-5]
Other Patient IDs Sequence	(0010,1002)				
>Patient ID	(0010,0020)	O	O	O [IHE-4]	O [IHE-5]
>Issuer of Patient ID	(0010,0021)	O	O	O [IHE-4]	O [IHE-5]

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Attribute Name	Tag	Matching Keys		Return Keys	
		SCU	SCP	SCU	SCP
>Type of Patient ID	(0010,0022)	O	O	O [IHE-4]	O [IHE-5]
>Issuer of Patient ID Qualifiers Sequence	(0010,0024)				
>>Universal Entity ID	(0040,0032)	O	O	O [IHE-4]	O [IHE-5]
>>Universal Entity ID Type	(0040,0033)	O	O	O [IHE-4]	O [IHE-5]
Patient Demographic					
Patients Birth Date	(0010,0030)	O	O	R+	R
Patient's Sex	(0010,0040)	O	O	R+	R
Confidentiality constraint on patient data	(0040,3001)	O	O	O	R
Ethnic Group	(0010,2160)	O	O	O	O
Patient Comment	(0010,4000)	O	O	O	O
Patient Medical					
Patient State	(0038,0500)	O	O	O	R
Pregnancy Status	(0010,21C0)	O	O	O	R
Medical Alerts	(0010,2000)	O	O	O	R
Additional Patient History	(0010,21B0)	O	O	O	O
Contrast Allergies	(0010,2110)	O	O	O	R
Patient's Age [IHE-7]	(0010,1010)	O	O	R+*	R+
Patient Size [IHE-7]	(0010,1020)	O	O	R+*	R+
Patient Weight	(0010,1030)	O	O	O	R
Special Needs	(0038,0050)	O	O	O	R
Admitting Diagnosis [IHE-7]	(0008,1080)	O	O	R+*	R+
Admitting Diagnosis Code Sequence [IHE-7]	(0008,1084)	O	O	R+*	R+
>Code Value	(0008,0100)	O	O	R+*	R+
>Coding Scheme Version	(0008,0103)	O	O	O	O
>Coding Scheme Designator	(0008,0102)	O	O	R+*	R+
>Code Meaning	(0008,0104)	O	O	R+*	R+

Note 1: The matching performed by the SCP for the Requested Procedure ID and Accession Number attributes shall be single value (SV) matching.

[IHE-1]: SCU implementations may choose to obtain the values contained in attributes that are part of the Scheduled Procedure Step sequence in either one of three ways. The first one is to request a universal match on the sequence attribute (zero length attribute). The second one is a universal sequence match (zero length item) for all attributes of the Scheduled Procedure Step sequence. The third one is to request a universal attribute match for selected attributes contained in the Scheduled Procedure Step sequence.

[IHE-2]: SCP implementations shall support, per the DICOM Standard, three ways to let the Query SCU obtain the values contained in attributes that are part of the Scheduled Procedure

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Step sequence. The first one is to support a universal match on the sequence attribute (zero length attribute), and all managed attributes will be returned. The second one is to support a universal sequence match (zero length item) for all attributes of the Scheduled Procedure Step sequence, and all managed attributes will be returned. The third one is to support a universal attribute match for selected attributes contained in the Scheduled Procedure Step sequence, and the managed attributes that were selected will be returned.

[IHE-3]: A value (Non empty field) shall be returned in the Accession Number attribute if the field was requested by the MWL SCU.

[IHE-4]: Acquisition Modalities that support the Enterprise Identity Option shall request Institution Name, Institution Address, Institution Code Sequence, Issuer of Accession Number Sequence, Other Patient IDs Sequence and Issuer of Patient ID Qualifiers Sequence. See Section 4.5.4.1.2.3. The normal DICOM rules for Sequence Matching apply.

[IHE-5]: DSS/Order Fillers that support the Enterprise Identity Option shall provide the Institution Name, Institution Address, Institution Code Sequence, Issuer of Accession Number Sequence, Other Patient IDs Sequence and Issuer of Patient ID Qualifiers Sequence upon request by an SCU. The normal DICOM rules for Sequence Matching apply. See Section 4.5.4.1.2.3.

[IHE-6]: In the Query Modality Worklist provided by an Order Filler, the Referenced Study Sequence shall contain only one Referenced SOP Class UID and one Referenced SOP Instance UID for each Scheduled Procedure Step. Furthermore, the Referenced SOP Instance UID contained in the Referenced Study Sequence shall contain the same UID value as the Study Instance UID for a Requested Procedure. Note that this UID value is also conveyed to the Image Manager in the Study Instance UID field of the Procedure Scheduled transaction.

Note: The Study Instance UID in the Referenced SOP Instance UID refers to a "non-instantiated" instance of the normalized Study SOP Class, not to a composite SOP Instance.

[IHE-7]: The requirements for the Query Return Key for this attribute apply to SCU and SCP implementations of actors in the REM-NM Profile; for actors in all other profiles, the optionality is "O".

4.5.4.1.2.3 Enterprise Identity Option

An Acquisition Modality supporting the Enterprise Identity Option shall request additional return keys in its Modality Worklist. Table 4.5-3a contains attributes for the Query Keys Return that have optionality R+* (rather than O) for the SCU in Table 4.5-3.

A DSS/Order Filler supporting the Enterprise Identity Option shall provide the additional return keys in the Modality Worklist upon request from the SCU. Table 4.5-3a contains attributes for the Query Keys Return that have an optionality R+* (rather than O) for the SCP in Table 4.5-3.

Table 4.5-3a: MWL Keys for Enterprise Identity Option

Return Key Attributes	Tag
Issuer of Accession Number Sequence	(0008,0051)
>Local Namespace Entity ID	(0040,0031)

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Return Key Attributes	Tag
>Universal Entity ID	(0040,0032)
>Universal Entity ID Type	(0040,0033)
Issuer of Patient ID	(0010,0021)
Issuer of Patient ID Qualifiers Sequence	(0010,0024)
>Universal Entity ID	(0040,0032)
>Universal Entity ID Type	(0040,0033)
Other Patient IDs Sequence	(0010,1002)
>Patient ID	(0010,0020)
>Issuer of Patient ID	(0010,0021)
>Issuer of Patient ID Qualifiers Sequence	(0010,0024)
>>Universal Entity ID	(0040,0032)
>>Universal Entity ID Type	(0040,0033)
>Type of Patient ID	(0010,0022)
Institution Name	(0008,0080)
Institution Address	(0008,0081)
Institution Code Sequence	(0008,0082)
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)
>Code Meaning	(0008,0104)

4.5.4.1.3 Expected Actions

The Departmental System Schedule/Order Filler performs the query and sends the DICOM Modality Worklist to the Acquisition Modality, Importer, or RAS.

The Importer shall make available to the Operator the information in the Scheduled Procedure Step Description (see Table 4.5-3). This information may include:

- A description of specific Evidence Objects to import (e.g., only a particular study, series or image should be imported).

4.5.4.1.3.1 Expected Actions for Mammography Acquisition Workflow

This section is currently in the Mammography Acquisition Workflow (MAWF) Trial Implementation Supplement.

4.5.4.2 Receive Scheduled MWL Message

This is the message that the Department System Scheduler sends to the modality as a reply containing DICOM Modality Worklist information.

4.5.4.2.1 Trigger Events

The Departmental System Scheduler/Order Filler had received a query for a MWL.

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4.5.4.2.2 Message Semantics

C-FIND Response from the DICOM Modality Worklist SOP Class will be used for this message. Some of the attributes queried through the MWL SOP class originate with the Order Placer and ADT, while other attributes are managed internally by the Department System Scheduler/Order Filler.

The DSS/Order Filler will determine the Requested Procedures needed to fulfill the Order, and decompose the Requested Procedures into one or more Scheduled Procedure Steps, assigning proper Scheduled Protocol Codes. The DSS/Order Filler shall support the definition of multiple Protocol Codes in a Scheduled Protocol Code Sequence contained in the Scheduled Procedure Steps for any Requested Procedure. Coded Values shall be used to specify exactly what actions are to be performed at the Acquisition Modality - the DSS/OF shall be configurable to provide such codes.

In addition to these Coded Values further instructions for the technologist may be specified. It is recommended to use the Scheduled Procedure Step Description and the Requested Procedure Description attributes for these additional specific instructions (free text).

The organization operating the DSS/OF and the Modalities is responsible for synchronizing Procedure and Protocol Codes between all the systems that use such codes. IHE does not yet define a common mechanism for code synchronization or access.

RAD TF-2x: Appendix B defines the origin and mappings of the attributes returned in a MWL query.

The details of the C-FIND Response from the DICOM MWL SOP Class are depicted in Table 4.5-3 and RAD TF-2x: Appendix A. At the time images are being created/generated, these attributes will be stored into the DICOM image instance headers. The Acquisition Modality or Importer may need additional information; however, this is beyond the scope of this document. Refer to RAD TF-1x: Appendix A for a discussion of Accession Number and Procedure ID.

An Order may be cancelled after the corresponding Requested Procedure(s) and Scheduled Procedure Steps have been scheduled, and possibly even after a Performed Procedure Step has been started. In this case the Department System Scheduler/Order Filler shall remove the Scheduled Procedure Steps of the Order from its worklist, and the absence of these Scheduled Procedure Steps in the next C-FIND response to the Acquisition Modality or Importer will indicate that the procedure has been cancelled. In this way the technologist recognizes that the previously scheduled steps no longer need to be performed.

It is the responsibility of the Department System Scheduler/Order Filler to ensure that the patient and procedure information is current in the Modality Worklist response. The Department System Scheduler/Order Filler receives patient and procedure updates through transactions [RAD-2], [RAD-3] and [RAD-12].

4.5.4.2.2.1 Scheduled Protocol Sequence for Import

The Department System Scheduler/Order Filler has the ability to provide instructions to the Importer on what should be done with the imported Evidence Objects after they are imported

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through the use of the Scheduled Protocol Sequence (0040,0008). Zero or more items may be present. Table 4.5-4 provides a list of the valid codes that may be used.

If present the codes are intended to be made available for copying into the Performed Protocol Sequence (0040,0260) in order to convey the subsequent use of the instances.

Table 4.5-4: Import Instruction Codes

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
IHERADTF	IRWF001	Import
IHERADTF	IRWF002	To be interpreted
IHERADTF	IRWF003	To be archived
IHERADTF	IRWF004	To be over read
IHERADTF	IRWF005	To be post-processed
IHERADTF	IRWF006	To be printed
IHERADTF	IRWF007	To be provided as a prior
IHERADTF	IRWF008	Destroy original media
IHERADTF	IRWF009	Return original media to patient
IHERADTF	IRWF010	Return original media to sender
IHERADTF	IRWF011	Archive original media

4.5.4.2.2.2 Codes and References in Procedures (Mammography Acquisition Workflow)

This section is currently in the Mammography Acquisition Workflow (MAWF) Trial Implementation Supplement.

4.5.4.2.3 Expected Actions

The technologist checks for the existence of the Scheduled Procedure Steps, validates the displayed patient and procedure information, and checks the given instructions.

When an Acquisition Modality supports the Assisted Acquisition Protocol Setting Option**,** it shall provide the means to use the protocol codes specified in the Scheduled Procedure Steps selected from the Modality Worklist (see Section 4.6.4.1.2.4.2 Assisted Acquisition Protocols Setting Option).

For imports, the User checks for the existence of the Scheduled Procedure Steps, validates the selected Patient Demographics with the Patient demographics of the existing Evidence Objects or the hardcopy, and checks for special instructions given in the Scheduled Procedure Step Description on what Evidence Objects are to be imported (e.g., how many PDI Media or films are associated with the Scheduled Procedure Step). In addition, the Importer shall provide the means to use the protocol codes specified in the Scheduled Procedure Step selected from the Modality Worklist (see Section 4.59.4.1.2.3.3 Import Instruction Codes).

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4.5.4.2.3.1 Expected Actions for Mammography Acquisition Workflow

This section is currently in the Mammography Acquisition Workflow (MAWF) Trial Implementation Supplement.

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4.6 Modality Procedure Step In Progress [RAD-6]

4.6.1 Scope

This transaction includes a message from the Acquisition Modality to the Performed Procedure Step Manager, which in turn issues the message to the Department System Scheduler/Order Filler, the Image Manager and the Report Manager that the Performed Procedure Step is in progress. This may be an unscheduled procedure step. The receiving Performed Procedure Step Manager is grouped with the Image Manager or the Department System Scheduler/Order Filler, and shall support forwarding messages to two other destinations besides the actor it is grouped with. It shall start issuing messages to the configured destinations immediately after it accepts the corresponding messages from the Acquisition Modality.

To allow for proper integration, the following considerations must be taken into account:

- The Performed Procedure Step Manager must maintain proper PPS objects and then store them until corresponding N-CREATE and N-SET messages are transmitted to the actor it is grouped with, and the two other Actors. If transmission to a destination fails, the Performed Procedure Step Manager shall try to repeat transmission periodically until it succeeds. The Performed Procedure Step Manager must not use failure of one or more of these transmissions as a reason for rejecting the initial transmission from the Acquisition Modality;
- Because both the Image Manager and the Department System Scheduler/Order Filler incorporate the Performed Procedure Step Manager function, an infinite redistribution of PPS messages is possible. The Image Manager and the Department System Scheduler/Order Filler systems that provide the Performed Procedure Step Manager function shall be configurable to disable this function;
- Transfer of the information to the system that the receiving Performed Procedure Step Manager is integrated with is outside the scope of the IHE Radiology Technical Framework (i.e., internal to an implementation).

For an illustration of mapping between transactions [RAD-2], [RAD-3], [RAD-5], [RAD-6] and [RAD-7], see the IHE white paper "Code Mapping in IHE Radiology Profiles", https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE_RAD_White-Paper_Codes.pdf.

4.6.2 Actor Roles

Actor: Department System Scheduler/Order Filler

Role: Receives the PPS information forwarded by the PPS Manager

Actor: Image Manager

Role: Receives the PPS information forwarded by the PPS Manager

Actor: Report Manager

Role: Receives the PPS information forwarded by the PPS Manager

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Actor: Acquisition Modality

Role: Informs the Performed Procedure Step Manager that a particular Performed Procedure Step has started

Actor: Performed Procedure Step Manager

Role: Accepts Performed Procedure Step information from an Acquisition Modality and transmits it to the Department System Scheduler/Order Filler, Image Manager and Report Manager

4.6.3 Referenced Standards

DICOM PS3.4 Section F.7: Modality Performed Procedure Step SOP Class.

4.6.4 Messages

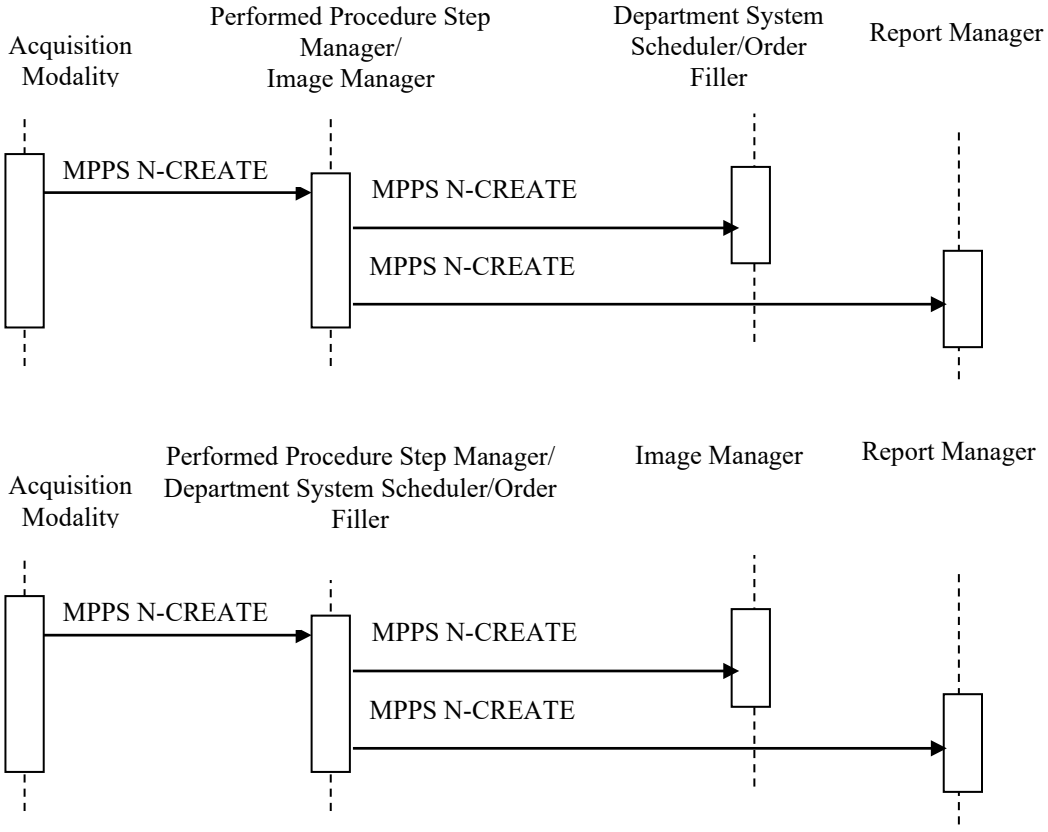

Figure 4.6.4-1: Interaction Diagram

4.6.4.1 Procedure Step In Progress Message

4.6.4.1.1 Trigger Event

Technologist begins procedure step from the Acquisition Modality console.

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4.6.4.1.2 Message Semantics

The Acquisition Modality uses the Modality Performed Procedure Step SOP Class (N-CREATE Service) to inform the Performed Procedure Step Manager that a specific Procedure Step has been started and is in progress. In turn, the Performed Procedure Step Manager uses the N-CREATE service to forward the information to the Department System Scheduler/Order Filler Image Manager and Report Manager. The SOP Instance UID value of the Performed Procedure Step shall be conveyed in the Affected SOP Instance UID (0000,1000) during this interchange (see also corresponding notes in RAD TF-2x: Appendix A.1). The following aspects shall be taken into account during implementation of this step:

4.6.4.1.2.1 Patient/Procedure/Scheduled Procedure Step Information

The Acquisition Modality shall ensure that the Patient/Procedure/Scheduled Procedure Step information it has is valid and current.

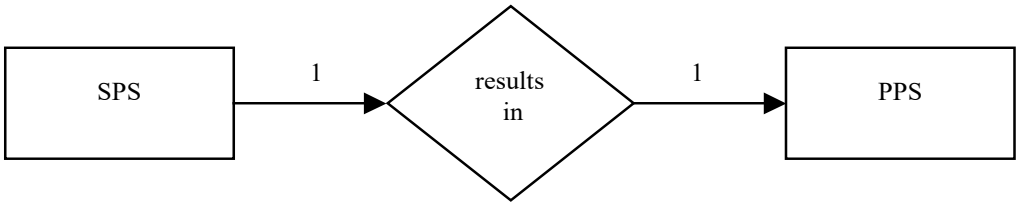
4.6.4.1.2.2 Required Attributes

RAD TF-2x: Appendix A lists a number of attributes that have to be properly handled by the Acquisition Modality to ensure consistency between the Performed Procedure Step object attributes, Scheduled Step information in the Modality Worklist, and the information included in the generated SOP instances.

4.6.4.1.2.3 Relationship between Scheduled and Performed Procedure Steps

The relationship between Scheduled and Performed Procedure Step information is shown in the following 6 cases. Refer to RAD TF-2x: Appendix A for details of forming attributes (Study Instance UID, Procedure ID, Accession Number, etc.) in each of these cases.

4.6.4.1.2.3.1 Simple Case



This case indicates a 1-to-1 relationship between SPS and PPS. Information about the Scheduled Procedure Step and Requested Procedure shall be copied from the Scheduled Procedure Step object to the Performed Procedure Step Relationship Module (see RAD TF-2x: Appendix A).

Examples: A Procedure Step was performed exactly as scheduled. It could also be that a Procedure Step was not exactly performed as scheduled, but without being rescheduled, e.g., due to a patient's allergic reaction to contrast media.

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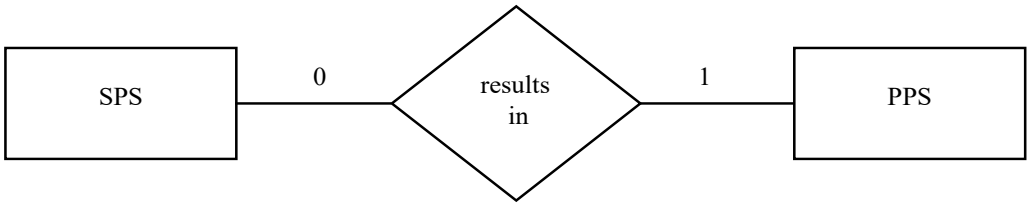
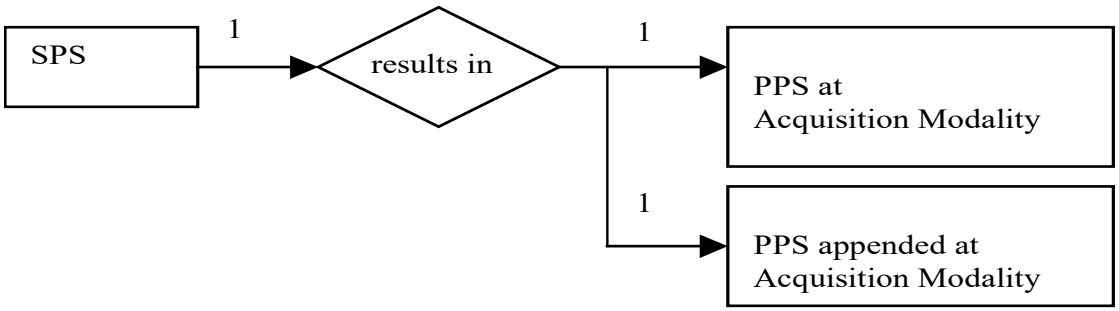
4.6.4.1.2.3.2 Unscheduled Case



This case indicates a 0-to-1 relationship between SPS and PPS. Information about the Scheduled Procedure Step and, possibly, Requested Procedure is not available to the Acquisition Modality due to different reasons (emergency procedure, Modality Worklist SCP not available, etc.).

The Patient ID entered on the Acquisition Modality by the technologist shall be the one created by the Assigning (Issuer) Authority (refer to RAD TF-2x: Appendix D).

4.6.4.1.2.3.3 Append Case



Append to a Normal Case

This is a case of 1-to-N relationship between SPS and PPS where first the PPS is generated in response to an SPS, as in the simple case. Other Performed Procedure Steps that have not been scheduled by additional SPSs are added sequentially at a later time, for instance

- due to unacceptable quality of certain images (“redo” certain images)
- because head MR images from a patient with severe headache that were just acquired are inconclusive, so that additional neck MR images are performed immediately (“add” certain images)

Note that the scheduling of the additional procedure would have resulted in two simple cases.

All Performed Procedure Steps shall refer back to the same Requested Procedure and to the original SPS. All Requested Procedure and Scheduled Procedure Step attributes shall be copied from the Scheduled Procedure Step Object to the Performed Procedure Step Relationship Module and the image Request Attribute Sequence (see RAD TF-2x: Appendix A).

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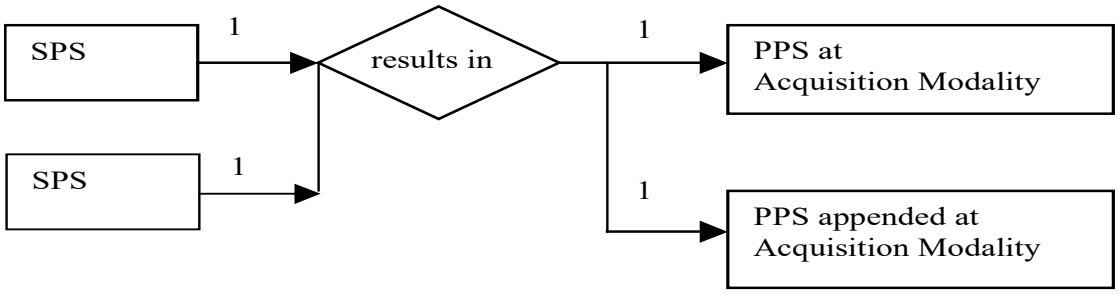
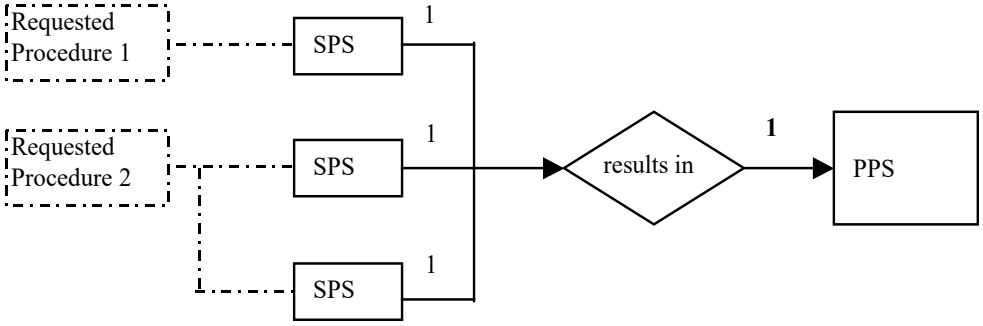


Append to a Group Case

When the first PPS generated at the Acquisition Modality results from a Group Case (see Section 4.6.4.1.2.3.4 or 4.6.4.1.2.3.6), the Performed Procedure Step appended by the Acquisition Modality may refer back to any one or all of the original SPSs and related Requested Procedure(s), using information from the Request Attribute Sequence in the original images. The corresponding attributes shall be copied to the Performed Procedure Step Relationship Module and the image Request Attribute Sequence (see RAD TF-2x: Appendix A).

Note: For example, following a PPS performed on an MR Modality in response to the grouping of a "neck" SPS and a "head" SPS, a 3D analysis on the MR head images is performed on the modality. This modality application may choose to link the appended PPS associated with the 3D secondary captures images resulting from the 3D analysis with both the head and the neck SPS.

4.6.4.1.2.3.4 Group Case



This case indicates an N-to-1 relationship between SPS and PPS. The following sub-cases shall be supported and fulfilled by a single Performed Procedure Step:

- Grouped SPSs belonging to a single Requested procedure
- Grouped SPSs belonging to multiple Requested Procedures
- A combination of Grouped SPSs belonging to multiple Requested procedures and Grouped SPSs belonging to a single Requested Procedure.

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If all grouped SPSs belong to the same Requested Procedure, then the Study Instance UID and Accession Number from the MWL shall be copied to the corresponding attributes of the grouped images and in the grouped PPS.

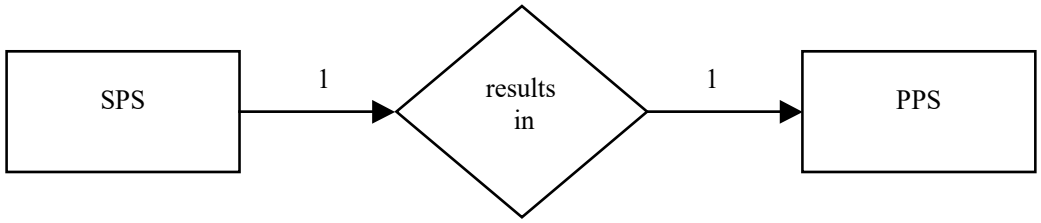
If the grouped SPSs belong to different Requested Procedures sharing the same Accession Number (i.e., same Order), the Modality shall generate a new Study Instance UID and the Accession Number from the MWL shall be copied to the corresponding attributes of the grouped images and the grouped PPS (see RAD TF-2x: Appendix A.1-4 for mapping details). If the grouped SPSs belong to different Requested Procedures with different Accession Numbers (i.e., different Orders), the Modality shall generate a new Study Instance UID, leave the Accession Number empty in grouped Images and copy the Accession Number from the MWL to the corresponding attributes in grouped PPS (see RAD TF-2x: Appendix A.1-4 for mapping details).

All Requested Procedure and Scheduled Procedure Step attributes shall be copied from the multiple Scheduled Procedure Step Objects (and associated Requested Procedures) to the Performed Procedure Step Relationship Module in the single Performed Procedure Step and to the Request Attribute Sequence in Images (see RAD TF-2x: Appendix A for proper mappings to MPPS and Images).

Support for the group case by the Acquisition Modality is required in the Presentation of Grouped Procedures Integration Profile. In the Scheduled Workflow and Charge Posting Integration Profiles, a Modality may claim the support of the MODALITY GROUP CASE Option. When supported, this option implies that sub-cases a), b), and c) above shall be supported.

The DSS/Order Filler, Image Manager Report Manager and Performed Procedure Step Manager are always required to accept Performed Procedure Steps containing attributes from multiple Scheduled Procedure Steps and Requested Procedures in Integration Profiles where those actors accept Modality Performed Procedure Step Transactions.

4.6.4.1.2.3.5 Abandoned Case



This case indicates a 1-to-1 relationship between SPS and PPS, even though the PPS may or may not create images. A procedure step may have to be abandoned for clinical reasons before it is complete. If SOP instances are sent by the Acquisition Modality to the Image Archive, then they shall be identified in the PPS N-SET. This is a means to explicitly communicate this information to the Image Manager or Department System Scheduler/Order Filler. In addition, one may choose to use this abandoned case to remove Scheduled Procedure Steps from the worklist, by starting the corresponding Performed Procedure Step and immediately discontinuing it using the

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N-SET service with the status value DISCONTINUED. All Requested Procedure and Scheduled Procedure Step attributes shall be copied from the Scheduled Procedure Step Object to the Performed Procedure Step Relationship Module (see RAD TF-2x: Appendix A).

4.6.4.1.2.3.6 Group Case with Presentation of Grouped Procedures

This case applies only in the context of the Presentation of Grouped Procedures Integration Profile. It applies to the subcases b) and c) of the Group Case (Section 4.6.4.1.2.3.4) and to the Append Case (Section 4.6.4.1.2.3.3) along with the rules specified in this section. Refer to RAD TF-1:6 for the use cases associated with the Presentation of Grouped Procedures. Presentation of Grouped Procedures in the a) subcase is equivalent to the use of the CPI Integration Profile. It is therefore out of scope for this section.

First, this case indicates an N-to-1 relationship between SPS and a first PPS. SPSs belong to two or more different Requested Procedures, and are fulfilled by a single Performed Procedure Step. This Performed Procedure Step is related to the images (and possibly presentation states, key image notes, etc.) acquired in a single acquisition. All Requested Procedure and Scheduled Procedure Step attributes shall be copied from the multiple Scheduled Procedure Step Objects to the Performed Procedure Step Relationship Module in the single Performed Procedure Step (see RAD TF-2x: Appendix A) and to the Request Attribute Sequence in Images (see RAD TF-2x: Appendix A). This is a proper subset of the Group Case specified in Section 4.6.4.1.2.3.4.

Second, this case indicates a 1-to-1 relationship between the SPSs of each Requested Procedure and an additional corresponding PPS. All SPSs belonging to the same Requested Procedure are fulfilled by a corresponding Performed Procedure Step. The Requested Procedure and Scheduled Procedure Step attributes shall only be copied from the related Scheduled Procedure Step Object(s) to the Performed Procedure Step Relationship Module in the Performed Procedure Step (see RAD TF-2x: Appendix A) related to the specific Presentation State(s) intended to present the corresponding subset of images for the Requested Procedure. This is a proper subset of the Append Case specified in Section 4.6.4.1.2.3.3, with the exception that the Study Instance UID used for the Presentation States shall be the same as the one created for the image set acquired as part of the first PPS (see RAD TF-2x: Appendix A, Table A.1-4).

The Presentation of Grouped Procedure operates at the Requested Procedure level whereas grouping operates at the level of Scheduled Procedure Steps.

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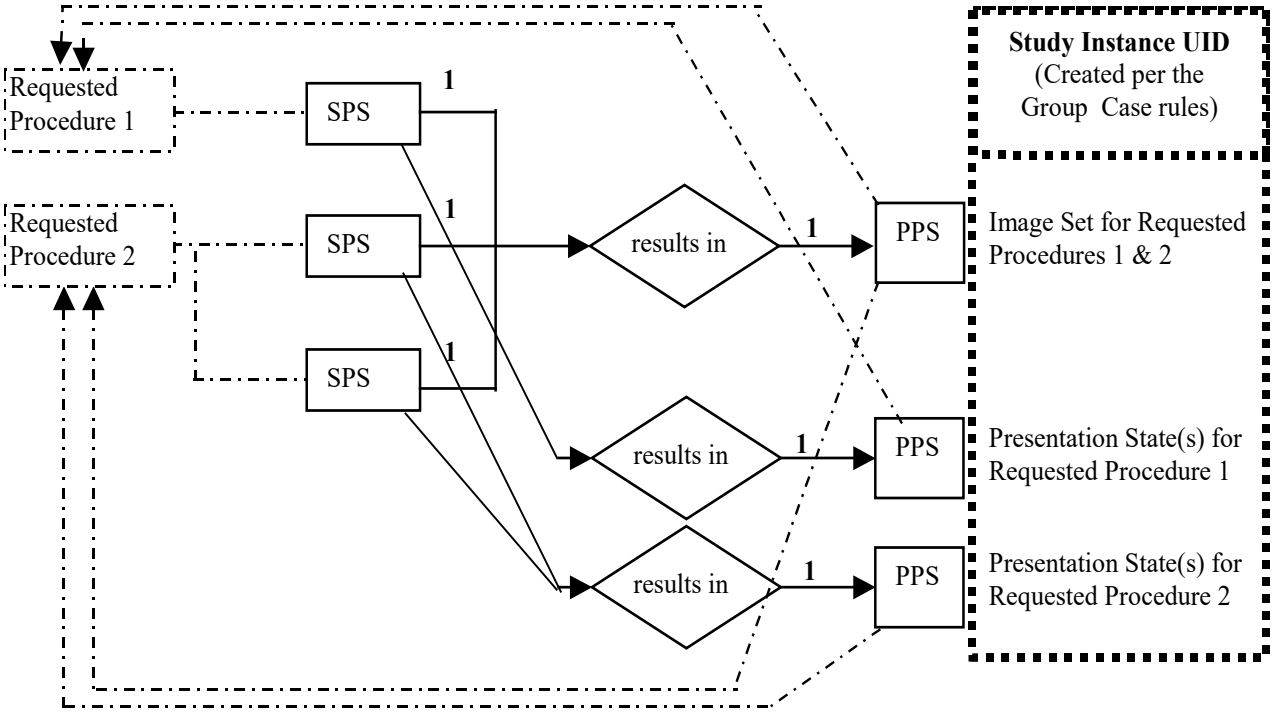

4.6.4.1.2.4 Protocol Handling

The protocol (a specific combination of modality settings or a method) used in performing a procedure step shall be determined on the Acquisition Modality at this time. Two cases/options are defined: Manual Modality Setting and Assisted Modality Setting. The first case is the one that is currently most commonly used while the second case introduces new functionality and is optional for the IHE Technical Framework.

The Acquisition Modality shall not change the Requested Procedure Code it obtains through the MWL. If the Requested Procedure Code is not correct or needs to be changed at the time the procedure is being performed, one of the following two methods shall be used:

- Department System Scheduler Method: The Procedure Information shall be corrected on the Department System Scheduler/Order Filler, and updated information shall be downloaded to the Acquisition Modality, OR
- Acquisition Modality Method: The Acquisition Modality redefines Protocol Code(s) for the Procedure Steps it actually performs and sets the Procedure Code Sequence (0008,1032) to zero length.

The specification for which methods are required or optional is found in the Scheduled Workflow Integration Profile (RAD TF-1: 3.3.4) and in Scheduled Workflow.b (RAD TF-1: 34.4.2.4 – 34.4.2.5).

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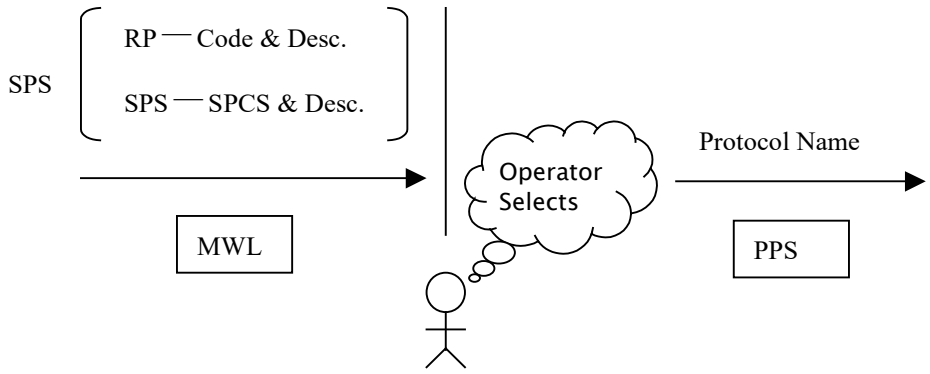
4.6.4.1.2.4.1 Manual Modality Setting

An operator selects and sets a protocol based on manual interpretation/evaluation of the Requested Procedure (RP) code and/or the Scheduled Procedure Step description and content of the Scheduled Protocol Code Sequence (SPCS). Note that the Scheduled Protocol Code Sequence, if present, may contain multiple items, however, they describe a single Protocol.

Note: Scheduled Action Item Code Sequence was redefined in 2001 by the DICOM standard as Scheduled Protocol Code Sequence.

This approach may also be used in cases when the protocol identifies more of a method used in performing the acquisition (such as in ultrasound), rather than a set of fixed modality settings (such as in CT/MR).



In this Manual Modality Setting, the Scheduled Protocol Code Sequence is analyzed by the Operator. The Acquisition Modality is not required to provide a value for the Performed Protocol Code Sequence. (Only the Protocol Name is required to be sent).

4.6.4.1.2.4.2 Assisted Acquisition Protocol Setting Option

When an Acquisition Modality supports the Assisted Acquisition Protocol Setting Option, it shall provide the means to use the protocol codes specified in the Scheduled Procedure Steps selected from the Modality Worklist.

According to DICOM PS3.3 Section 7.3.1.8: "A Protocol is a specification of actions prescribed by a Procedure Plan to perform a specific Procedure Step. A Scheduled Procedure Step contains only one Protocol that may be conveyed with one or more Protocol Codes." So, each Scheduled Procedure Step is performed according to a single Protocol which may be identified by one or more Protocol Codes. This option refines the semantics of the interpretation of Protocol Codes specifically in the case where more than one Protocol Code is present.

A Scheduled Procedure Step may contain a single Protocol Code, for example:

- A "Standard Chest X-ray" Protocol Code. This implies PA and Lateral views.
- A "Screening Mammography" Protocol Code. This implies RMLO and LMLO, RCC and LCC views.

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A Scheduled Procedure Step may also contain multiple Protocol Codes in cases where more complex SPS requires several acquisition or image processing tasks be performed in a sequential manner, for example:

- An “MRI Acquisition” Protocol Code followed by an “MRA Acquisition” Protocol Code.
- A “CT Head without contrast” Protocol Code followed by a “CT with contrast” Protocol Code.
- A “CT Lumbar Spine” Protocol Code followed by a “Reformation of the discs” Protocol Code.
- A “CT Thorax” protocol Code followed by a “Recon with lung kernel” Protocol Code.

In this option, an Acquisition Modality shall process the protocol code sequence in each Scheduled Procedure Step (SPS) selected from the Modality Worklist and return the Performed Protocol Codes in the Performed Procedure Step (PPS). Modalities shall support one or more codes in the Scheduled Protocol Code (SPC) sequence.

- Department System Schedulers will (per DICOM) support the use of more than one Protocol Code in the Scheduled Protocol Code (SPC) Sequence. The institution may decide to configure its Department System Scheduler to schedule all Scheduled Procedure Steps with a single code in the SPC or with multiple codes in the SPC.

The modality operator shall be able to either accept the protocol proposed by the set of Protocol Codes or select one or more alternative protocol defined on the Modality. The operator shall not be forced to manually enter the attributes of the acquisition protocol as in the Manual Modality Setting. The Assisted Acquisition Protocol Setting Option simplifies the operator’s work on the modality and enables a better management of the protocols used in an imaging department. This option may provide benefits for charge posting.

When multiple Scheduled Protocol Codes are present in the SPC Sequence, each Scheduled Protocol Code shall be analyzed independently (i.e., not as a compound code). It follows that:

- The modality settings resulting from the simultaneous processing of the ordered set of Protocol Codes is semantically equivalent to the sequential processing of each Protocol Code independently. In other words, no additional semantics may be inferred from the simultaneous processing of multiple Protocol Codes in the sequence, and
- Protocol Codes shall be proposed to the operator in the order defined in the sequence. The Operator may choose to perform this sequence of Protocol Codes in a different order than scheduled, omit performing some of the protocol codes or include others.

Whether the Scheduled Procedure Step includes one or several Protocol Codes, each Protocol Code shall be processed according to the Protocol Codes defined in the Modality Protocol Code Table. This table shall also be used for an interactive function that lets the user select protocols without manual text entry in the following manner:

- If a match is found, the modality settings defined in the Modality Protocol Code Table shall be proposed to the operator. The operator may then choose to:

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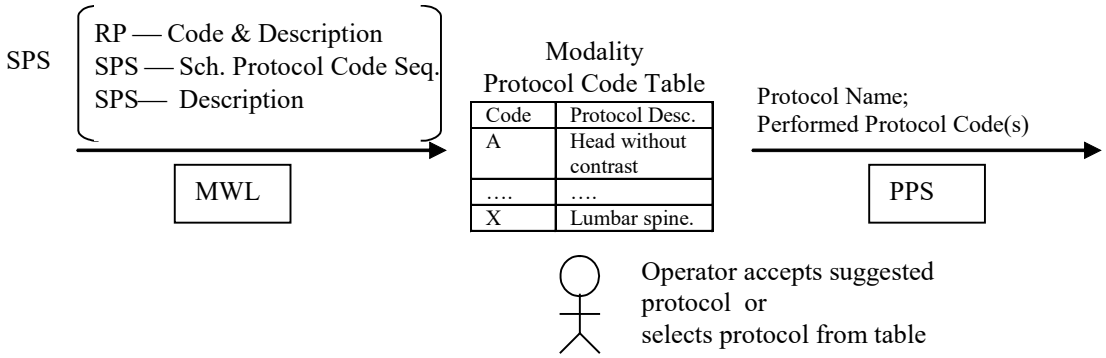
- Accept the settings (i.e., modality acquisition parameters) proposed. In this case the Performed Protocol Code will take the value of the Scheduled Protocol Code.
- Accept the settings (modality acquisition parameters) and refine them. (Local policy will determine what refinements are acceptable within a specific protocol code). In this case the Performed Protocol Code will take the value of the Scheduled Protocol Code.
- Reject the settings proposed and manually select another protocol defined in the Modality Protocol Table. In this case the Performed Protocol Code will take the value of the manually selected Protocol Code (see recommendations in RAD TF-2x: Appendix A Tables A.1-1 to A.1-5).
- If there is no identical Protocol Code defined in the Modality Protocol Table, the Acquisition Modality must alert the operator.
- A Modality Protocol Code Table shall be configurable on the Acquisition Modality.



When the Assisted Acquisition Protocol Setting Option is supported by the Acquisition Modality, one or more values for the Performed Protocol Code Sequence shall be provided in addition to the Protocol Name. If multiple Protocol Codes have been selected and the corresponding acquisitions performed, the order of the Protocol Codes in the sequence shall reflect the order in which they were performed. This order may differ from the order in which they appeared in the Scheduled Protocol Code Sequence.

The Assisted Acquisition Protocol Setting Option does not define a specific codification of acquisition protocols. The Acquisition Modality shall be configurable in order to support the codification scheme selected or defined by the healthcare enterprise.

4.6.4.1.2.5 Enterprise Identity Option

An Acquisition Modality supporting the Enterprise Identity Option shall copy values for the following Patient Context-critical attributes from the information received in the Modality Worklist, if provided, as specified in RAD TF-2x: Appendix A, to ensure consistency with the Performed Procedure Step object attributes, and the generated MPPS objects:

Patient Context-critical Attributes	Tag
Issuer of Patient ID	(0010,0021)

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Patient Context-critical Attributes	Tag
Issuer of Patient ID Qualifiers Sequence	(0010,0024)
>Universal Entity ID	(0040,0032)
>Universal Entity ID Type	(0040,0033)
Other Patient ID Sequence	(0010, 1002)
>Patient ID	(0010,0020)
>Issuer of Patient ID	(0010,0021)
>Issuer of Patient ID Qualifiers Sequence	(0010,0024)
>>Universal Entity ID	(0040,0032)
>>Universal Entity ID Type	(0040,0033)
>Type of Patient ID	(0010,0022)

In the case where Issuer of Patient ID and Issuer of Patient ID Qualifiers Sequence attributes are not explicitly supplied by the DSS/Order Filler in the Modality Worklist (e.g., in the Unscheduled Case), the Acquisition Modality shall not include values for these attributes in the generated SOP Instances.

Note: this requirement is intended to reduce complexity of information reconciliation on the Image Manager and Order Filler. An implementation that supports configuration of default values for these attributes will need to be configured, so that these defaults contain no value.

An Acquisition Modality supporting the Enterprise Identity Option shall copy values for the following Accession Context-critical attributes from the information received in the Modality Worklist, if provided, as specified in RAD TF-2x: Appendix A to ensure consistency with the Performed Procedure Step object attributes, and the information included in the generated MPPS objects.

Accession Context-critical Attributes	Tag
Issuer of Accession Number Sequence	(0008,0051)
>Local Namespace Entity ID	(0040,0031)
>Universal Entity ID	(0040,0032)
>Universal Entity ID Type	(0040,0033)

4.6.4.1.3 Expected Actions

The Department System Scheduler/Order Filler, Report Manager and the Image Manager/Image Archive receive information from the Performed Procedure Step Manager and link it with the Requested Procedure and Scheduled Procedure Step. If the Requested Procedure ID is transmitted empty (Unscheduled Performed Procedure Step case), the Department System Scheduler/Order Filler and the Image Manager shall create an exception that must be manually resolved to link the Performed Procedure Step to the appropriate procedure.

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4.6.4.1.3.1 Procedure and Protocol Changes at the Modality in Mammography Acquisition Workflow

This section is currently in the Mammography Acquisition Workflow (MAWF) Trial Implementation Supplement.

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4.7 Modality Procedure Step Completed/Discontinued [RAD-7]

4.7.1 Scope

This transaction includes a message from the Acquisition Modality to the Performed Procedure Step Manager, which in turn issues messages to the DSS/Order Filler, the Report Manager and the Image Manager that the Performed Procedure Step has been completed. Information is not being released for billing at this point but a code may be assigned. The Image Manager may need the information to co-locate images of the same study. The Modality Procedure Step Completed message does not necessarily mean that the set of images is complete or available for retrieval.

For an illustration of mapping between transactions [RAD-2], [RAD-3], [RAD-5], [RAD-6] and [RAD-7], see the IHE white paper "Code Mapping in IHE Radiology Profiles", https://www.ihe.net/uploadedFiles/Documents/Radiology/IHE_RAD_White-Paper_Codes.pdf.

4.7.2 Actor Roles

Actor: Department System Scheduler/Order Filler

Role: Receives the PPS information forwarded by the PPS Manager

Actor: Image Manager.

Role: Receives the PPS information forwarded by the PPS Manager

Actor: Report Manager

Role: Receives the PPS information forwarded by the PPS Manager

Actor: Acquisition Modality

Role: Informs the Performed Procedure Step Manager that a particular Performed Procedure Step is completed

Actor: Performed Procedure Step Manager

Role: Accepts Performed Procedure Step information from an Acquisition Modality and transmits it to the Department System Scheduler/Order Filler, Image Manager and Report Manager

4.7.3 Referenced Standards

DICOM PS3.4 Section F.7: Modality Performed Procedure Step SOP Class

DICOM PS3.16 Annex B: DCMR Context Groups

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4.7.4 Messages

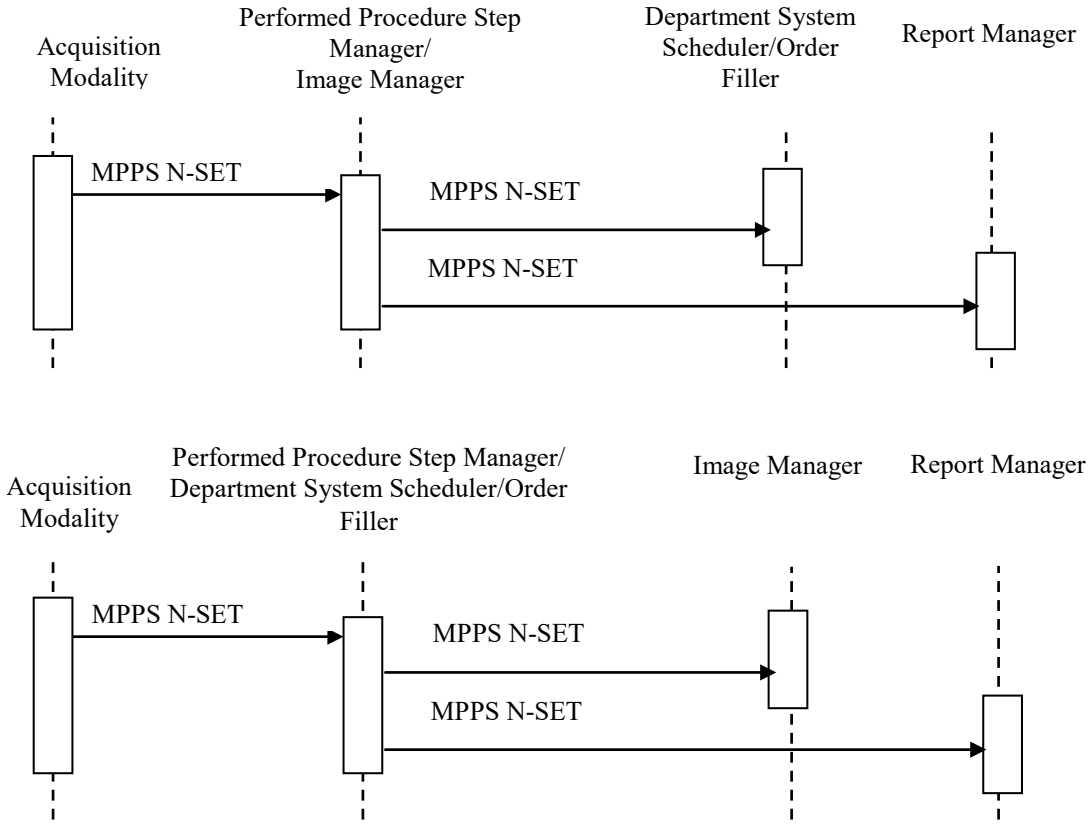

Figure 4.7.4-1: Interaction Diagram

Note: The diagram above shows the sequencing of messages for the Modality Performed Procedure Step SOP Class. Acquisition Modalities will also implement the Storage and Storage Commitment classes. The timing relationship between PPS messages and Storage and Storage Commitment messages is not specified. That is, PPS messages may occur before or after storage requests.

4.7.4.1 Procedure Step Completed/Discontinued

4.7.4.1.1 Trigger Event

Technologist completes procedure step from the Acquisition Modality console.

4.7.4.1.2 Message Semantics

The Acquisition Modality uses the Modality Performed Procedure Step SOP Class (N-SET service) to inform the Performed Procedure Step Manager that a specific Performed Procedure Step has been completed or discontinued. The Acquisition Modality may use the MPPS N-SET service to send intermediate updates of the Performed Procedure Step information.

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The final N-SET has either the MPPS status of "COMPLETED" or "DISCONTINUED". The Performed Procedure Step Manager sends corresponding N-SETs to the Department System Scheduler/Order Filler, Image Manager and Report Manager.

When an N-SET is issued with a “DISCONTINUED” status, one or more Series of Instances may be referenced, if images were created and sent. Those Instances shall be Stored and Storage Committed.

Along with other information, the Acquisition Modality shall transmit information about the protocol it used to produce the SOP instances to the recipients. See Protocol Handling in Section 4.6.4.1.2.4 for detailed discussion of this issue.

Note: DICOM specifies that when attributes are allowed to be set by an N-SET, the value provided by the last N-SET overrides any value set by an earlier N-CREATE or N-SET.

4.7.4.1.2.1 Retrieve AE Title

According to the DICOM Standard, the Acquisition Modality has the ability to include the Retrieve AE Title attribute (0008,0054) in the Performed Series Sequence (0040,0340). This is an AE Title where the referenced SOP instances for the series may be retrieved. This Retrieve AE Title will often be of zero length or be of short-term validity, due to the following situations:

- If an Acquisition Modality supports a Retrieve SOP Class in an SCP Role, the modality Retrieve AE Title may be included; however, the modality does not guarantee long-term availability.
- A Retrieve AE Title of the Image Manager can be configured on the Acquisition Modality. Otherwise, this field shall be sent zero length. Acquisition Modality implementers shall not assume that the destination AE Title used for the Storage SCP or Storage Commitment SCP is the same as that for Image Retrieval.
- An Acquisition Modality may receive the Retrieve AE Title in a Storage Commitment Message (N-EVENT REPORT). However, this information may be received well after the MPPS N-SET (Complete) was performed.

4.7.4.1.2.2 PPS Exception Management Option

When an Acquisition Modality supports the PPS Exception Management Option, it shall provide the appropriate reason codes (often selected by the operator) in the final N-SET sent with the status of DISCONTINUED.

When the Modality Procedure Step is sent with the Status DISCONTINUED, the Modality Procedure Step Discontinuation Reason Code Sequence (0040,0281) shall be sent with one of the values defined in DICOM PS3.16 Annex B CID 9301 Modality PPS Discontinuation Reasons.

The Reason Code when communicated to the DSS/Order Filler and Image Manager/Archive may imply canceling an order. It may also facilitate more accurate charge posting.

The Reason Code: “Incorrect Worklist Entry Selected’ is used by the Acquisition Modality to convey that the wrong SPS has been selected (incorrect patient or incorrect Requested procedure/order for the same patient). In this case some or all of the incorrectly acquired images

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(for example the ones assigned to the wrong patient) may already have been stored to the image manager (see Section 4.7.4.1.3.1).

Modality implementers are left free to decide how to correct the incorrectly acquired images. The Acquisition Modality shall include within the MPPS the list of images that are or will be included in the Images Stored Transaction(s).

Note: When a PPS DISCONTINUED is sent with the reason code "incorrect worklist entry selected", images referenced in this PPS DISCONTINUED are images that may have been sent to the Image Manager/Archive. The IHE Technical Framework does not specify whether or not the Acquisition Modality needs to perform a Storage Commitment for these instances.

4.7.4.1.2.3 Billing and Material Management Information

The message semantics are defined in the DICOM Service Class section of the DICOM Modality Performed Procedure Step SOP Class. It is the responsibility of the Acquisition Modality to ensure that the patient and procedure information is sent to the Department System Scheduler/Order Filler.

The Attributes defined in Table 4.7-2 provide a means to transmit procedure and material management codes from the acquisition modality to the DSS/Order Filler that uses them for calculation of charges to be posted to Charge Processor.

An Acquisition Modality that supports the Billing and Material Management Option shall be able to provide content within at least one of the Billing Procedure Step Sequence, Film Consumption Sequence and Billing Supplies and Devices Sequence.

Table 4.7-2 Billing and Material Management Code Module Attributes

Attribute name	Tag	Attribute Description
Billing Procedure Step Sequence	(0040,0320)	Contains billing codes for the Procedure Type performed within the Procedure Step. The sequence may have zero or more Items See note IHE-1, IHE-2.
> Code Value	(0008,0100)	
> Coding Scheme Designator	(0008,0102)	
> Code Meaning	(0008,0104)	
Film Consumption Sequence	(0040,0321)	Information about the film consumption for this Performed Procedure Step. The sequence may have zero or more Items. Note: This is only for films printed from this device. See note IHE-3.
>Number of Films	(2100,0170)	Number of films actually printed.
>Medium Type	(2000,0030)	Type(s) of medium on which images were printed.
>Film Size ID	(2010,0050)	Size(s) of film on which images were printed.
Billing Supplies and Devices Sequence	(0040,0324)	Contains billing codes for chemicals, supplies and devices for billing used in the Performed Procedure Step. The sequence may have one or more Items.

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Attribute name	Tag	Attribute Description
>Billing Item Sequence	(0040,0296)	Codes values of chemicals, supplies or devices required for billing. The sequence may have zero or one Items. See note IHE-4.
>> Code Value	(0008,0100)	
>> Coding Scheme Designator	(0008,0102)	
>> Code Meaning	(0008,0104)	
>Quantity Sequence	(0040,0293)	Sequence containing the quantity of used chemicals or devices. The sequence may have zero or one Items.
>>Quantity	(0040,0294)	Numerical quantity value.
>>Measuring Units Sequence	(0040,0295)	Unit of measurement. The sequence may have zero or one Items. Baseline DICOM PS3.16 CID 82
>>> Code Value	(0008,0100)	
>>> Coding Scheme Designator	(0008,0102)	
>>> Code Meaning	(0008,0104)	

- [IHE-1] Billing Procedure Step Sequence Attribute shall be present if Modality supports the Billing and Material Management Option. It may be sent zero-length if one of Film Consumption Sequence or Billing Supplies and Devices Sequence is also populated.
- [IHE-2] A Modality Billing Code Table shall be configured on the Acquisition Modality. This table shall be synchronized with the Department System Scheduler/Order Filler. The codes provided by the Acquisition Modality might not be the same as the code the Department System Scheduler/Order Filler is required to use when posting Charges to the Charge Processor.
- [IHE-3] Film Consumption Sequence shall be present if films have been printed during this Performed Procedure Step. Information provided in Film Consumption Sequence may not be sufficient to properly calculate charges. For example, to take into account quality and sensitivity of film, Department System Scheduler/Order Filler shall obtain additional information before calculating and posting charges to the Charge Processor.
- [IHE-4] Different coding schemes may be used for codes of Billing Items, for example, DCMR CID 12 - Radiographic Contrast Agent may be used to record quantity of contrast used.

4.7.4.1.2.4 Protocol Handling

See Section 4.6.4.1.2.4 for a description of protocol handling.

4.7.4.1.3 Expected Actions

The Image Manager, Report Manager and Department System Scheduler/Order Filler receive information about the Performed Procedure Step being complete or discontinued. The Image Manager, Report Manager and Department System Scheduler are not required to act on intermediate N-SET messages with the MPPS Status "IN PROGRESS".

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The Requested Procedure may be considered complete if all Performed Procedure Steps related to all Scheduled Procedure Steps have been completed (or properly discontinued). Additional new (unscheduled) Performed Steps may be performed at any time, even after the Requested Procedure has been assigned complete scanning status. See relationship between Scheduled and Performed Procedure Steps in Section 4.6.4.1.2.3 for detailed discussion of this issue.

4.7.4.1.3.1 PPS Exception Management Option

When a DSS/Order Filler or Image Manager/Archive supports the PPS Exception Management Option, it shall use the reason codes in the final N-SET sent with the status of DISCONTINUED.

When the Modality Procedure Step is received with the Status DISCONTINUED, the receiver shall interpret the Performed Procedure Step Discontinuation Reason Code Sequence (0040,0281) values as defined in DICOM (see Table 4.7-1). When received by the Department System Scheduler/Order Filler and the Image Manager/Archive, the Reason Code may indicate the necessity for modification or canceling of an order). With the Reason Code: "Incorrect Worklist Entry Selected", the Acquisition Modality conveys that the wrong SPS has been selected (e.g., incorrect patient or incorrect Requested procedure/order for the same patient). In this case the Image Manager and Department System Scheduler shall take the appropriate action to ensure that already received incorrect instances (i.e., SOP Instances referenced by this Discontinued PPS) are not mistakenly used. If the images, presentation states, or key image notes are not actually deleted, the Image Manager shall:

- not return SOP Instance UIDs for the images in query responses
- not return such images in Patient, Study, Series, or Instance level retrievals

On the DSS and Image Manager, the Order/Requested Procedure status shall be corrected to indicate that the discontinued PPS (with wrong worklist entry selected) is not valid. Therefore, the Order Filler/Department System Scheduler shall not query for those instances with an Image Availability transaction.

4.7.4.1.3.2 Billing and Material Management Information

When Billing and Material Management information is provided in the MPPS N-SET, the DSS/Order Filler shall use the billing codes and material usage information provided in the final N-SET for calculation of charges that it will eventually post to the Charge Processor. It is recommended that DSS/Order Filler verifies the consistency of provided billing codes with Requested Procedure Code and Performed Procedure Step Protocol codes supplied in the same N-SET.

4.7.4.1.3.3 Procedure and Protocol Changes at the Modality in Mammography Acquisition Workflow

This section is currently in the Mammography Acquisition Workflow (MAWF) Trial Implementation Supplement.

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4.8 Modality Images Stored [RAD-8]

4.8.1 Scope

In the Modality Images Stored transaction, the Acquisition Modality sends the acquired images to the Image Archive. The information provided from the Modality Worklist transaction (see Section 4.5) shall be included in the headers of the generated images.

4.8.2 Actor Roles

Actor: Acquisition Modality

Role: Transmit acquired image data to Image Archive.

Actor: Image Archive

Role: Accept and store images from Acquisition Modalities.

4.8.3 Referenced Standards

DICOM PS3.4 Annex B: Storage Service Class

4.8.4 Messages

Figure 4.8.4-1: Interaction Diagram

4.8.4.1 Images Stored

4.8.4.1.1 Trigger Events

The Acquisition Modality can transfer images to the Image Archive sequentially within one or more DICOM associations, as the images become available or collectively.

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4.8.4.1.1.1 Study UIDs and Series UIDs

Study UID creation details and timing are clearly defined by the IHE. The Scheduled Workflow and Patient Reconciliation Profiles explain how the Study information and identifiers such as the Study Instance UID are generated by the Order Filler and made available to the modality through the Modality Worklist. Generation of these items by the modality or workstation are restricted in general and are only permitted in specifically outlined exception cases, when a PPS is unscheduled (RAD TF-2x: Appendix A, Table A.1-2) or when several SPS belonging to different Requested Procedures are satisfied by a single PPS (RAD TF-2x: Appendix A, Table A.1-5).

Series UID creation must be compatible with a number of DICOM rules.

Multiple performed procedure steps are not permitted to reference the same series. So conversely, one series cannot contain the output of different performed procedure steps. Therefore, adding images to a series in a procedure step which has been completed is not permitted since a procedure step cannot be modified.

Note that a series *may* fulfill more than one *scheduled* procedure step. This is referred to in IHE as the group case.

Adding images after completion of a procedure step shall trigger the creation of a new series.

One series cannot contain the output of different equipment (in part because a series must have a single Frame Of Reference). Creating images on different equipment shall trigger the creation of a new series.

All images in a series must share the same Frame Of Reference. Generally this means creating images with different patient positioning shall trigger the creation of a new series. Note that if the Frame Of Reference is not present (at the Series level), this requirement is avoided.

Images reconstructed on a different piece of equipment are required to be in a separate Series.

For consistency, IHE specifies that reconstructed images shall be stored in a separate series from the acquired tomographic images from which they were reconstructed regardless of whether they are reconstructed on the Acquisition Modality or an Evidence Creator.

4.8.4.1.2 Message Semantics

The Acquisition Modality uses the DICOM C-STORE message to transfer the images. The Acquisition Modality is the DICOM Storage SCU and the Image Archive is the DICOM Storage SCP.

The technologist validates the available information for the patient and the Scheduled Procedure Step/Requested Procedure. It is a requirement that certain information be recorded in the image header. The details of the mapping to DICOM image instances are specified in RAD TF-2x: Appendix A. Effectively, that appendix strengthens the type definition of some DICOM attributes for the IHE Technical Framework.

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4.8.4.1.2.1 Storage of Localizer Images (MR and CT)

In addition to these general mapping requirements, in MR and CT images the relationship between localizer or plan images and related slice images shall be recorded when such slice images were planned or prescribed from the localizer or plan images. In this case, the attribute Referenced Image Sequence (0008,1140) of the slice image shall refer to the related localizer or plan image(s). The coordinate space for this set of related images shall be the same, which is indicated by having a single value for the attribute Frame of Reference UID (0020,0052). For CT images the slice images shall have the value AXIAL in the attribute Image Type, and the localizer image the value LOCALIZER. For MR images no specific value for image type is used to further qualify the relationship between plan and related slice images. The Acquisition Modality shall not use the method of burning-in localizer lines in the pixel sample values (pixel sample value is the "bits stored" part of the pixel data) of the localizer or plan image(s).

Image Display Actors that want to show the localizer lines will be able to calculate the position of these lines of intersection (if visible) based on the information recorded in the images by the Acquisition Modality.

4.8.4.1.2.2 Storage of NM Images (NMI)

Systems supporting the NM Image Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+).

Note that the NM Image Profile is undergoing revision, and vendors considering implementation are advised to include the modifications contained in the "NM Image Profile with Cardiac Option" Trial Implementation Supplement. For additional information please contact the IHE Radiology Technical Committee at IHE-Rad-Tech@googlegroups.com.

This section is referred to in the Creator Images Stored [RAD-18] transaction and so the Evidence Creator may also be referred to in the text here.

Table 4.8-2: Required Attributes in Nuclear Medicine Images

Attribute	Tag	Image Type									
		General						Cardiac			
		STATIC	DYNAMIC	WHOLE BODY	GATED	TOMO	RECON TOMO	TOMO	RECON TOMO	GATED TOMO	RECON GATED TOMO
Detector Information Sequence	(0054,0022)										
> Image Position	(0020,0032)						R+		R+		R+

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Attribute	Tag	Image Type									
		General						Cardiac			
		STATIC	DYNAMIC	WHOLE BODY	GATED	TOMO	RECON TOMO	TOMO	RECON TOMO	GATED TOMO	RECON GATED TOMO
> Image Orientation	(0020,0037)					R+	R+	R+	R+	R+	R+
> View Code Sequence	(0054,0220)										
>> Code Value	(0008,0100)			R+					R+[1]		R+[1]
>> Coding Scheme Designator	(0008,0102)			R+					R+[1]		R+[1]
Slice Progression Direction	(0054,0500)								R+[2]		R+[2]
Spacing Between Slices	(0018,0088)						R+[4]		R+[4]		R+[4]
Acquisition Context Sequence	(0040,0555)										
> Concept-Name Code Sequence	(0040,A043)							R+[3]	R+[3]	R+[3]	R+[3]
> Concept Code Sequence	(0040,A168)							R+[3]	R+[3]	R+[3]	R+[3]
Frame of Reference UID	(0020,0052)					R+	R+	R+	R+	R+	R+

Note 1: Required for images from one of the standard cardiac views: Short Axis, Vertical Long Axis, or Horizontal Long Axis. For a definition of these terms and the implied orientation of the heart in the frame (refer to Nuclear Cardiology Nomenclature, Cequeria MD, et al, Journal of Nuclear Cardiology, 2002, 9:240-245).
The Code Values shall be taken from DICOM CID 27. (Earlier versions of the Radiology Technical Framework contained the SNM3 equivalents of the codes in CID 27; those codes are now retired. See DICOM PS3.16 Section 8.3 "Retired Codes and Expected Behavior".)

Note 2: Slice Progression Direction is required for Images in which the View Code Sequence indicates Short Axis views. The DICOM defined values are APEX_TO_BASE and BASE_TO_APEX.

Note 3: The Acquisition Context Module and the Acquisition Context Sequence (0040,0555) contained within it are required for cardiac stress/rest images. As defined in the DICOM Standard, the Concept Name Code Sequence (0040,A043) shall contain values from DICOM CID 3101. (Earlier versions of the Radiology Technical Framework contained an SRT code for

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"Resting State" and a DCM code for "Cardiac Stress State". Those codes are now retired. See DICOM PS3.16 Section 8.3 "Retired Codes and Expected Behavior".)

Note 4: The 'Spacing Between Slices' attribute is required by IHE to contain a valid value for the RECON image types.

It is recommended that when multiple energy windows are present that descriptive values be provided for the following attributes: Energy Window Name (0054,0018), Energy Window Lower Limit (0054,0014) and Energy Window Upper Limit (0054,0015).

It is recommended that when multiple detectors are present that descriptive values be provided in the codes contained in the View Code Sequence (0054,0220).

It is recommended that when multiple phases are present that descriptive values be provided for the Phase Description (0054,0039).

The Acquisition Modality or Evidence Creator shall be capable of encoding the data for NM images with Image Type (0008,0008) equal to TOMO or GATED TOMO as if it were created on a single detector system. This means setting the Number of Detectors (0054,0021) to 1 and reordering the frame data to be consistent with acquisition by a single detector system regardless of the number of actual detectors used to acquire the image data. The system may additionally support encoding the data with the actual detector configuration.

When the Image Type (0008,0008) is RECON TOMO or RECON GATED TOMO, the Image Position (0020,0032), Image Orientation (0020,0037), and the View Code Sequence (0054,0220) shall describe the orientation of the reconstructed frames within the Image.

When the Image Type (0008,0008) is TOMO or RECON TOMO or GATED TOMO or RECON GATED TOMO, the Frame of Reference UID (0020,0052) Attribute shall be present with a value and describe the patient-relative frame of reference in which Image Position (Patient) (0020,0032) and Image Orientation (Patient) (0020,0037) are defined, for the purpose of allowing correlation with other images in the same frame of reference.

When the Image Type (0008,0008) is WHOLE BODY, the useful image data is generally rectangular in shape (e.g., 256x1024). Acquisition Modalities and Evidence Creators shall be capable of creating these images without padding to create square frames.

Although the DICOM standard does not rigorously specify the order of frames in the image object, the following practice is commonly used and is required by the NM Image Profile:

Images shall be stored with the frames sorted into "vector sorted order". That is, the frames shall be ordered such that the frames are sorted first by the values of the first vector, then within a value for the first vector, the frames are sorted by the values of the second vector, etc. This order is referred to in this document as "vector sorted order".

For details on vectors and examples of "vector sorted order", refer to RAD TF-1x: Appendix E.4.2 NM Image IOD: Multi-Frames & Vectors.

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4.8.4.1.2.3 Storage of Full Field Digital Mammography Images

When participating in the Modality Images Stored transaction and the Mammography Image Integration Profile, the Acquisition Modality that creates in vivo clinical full field digital mammography images, whether using a digital detector, by computed radiography, or by digitizing film, shall use the DICOM Digital Mammography X-Ray Image IOD, and shall supply the attributes with the additional requirements presented in Table 4.8.4.1.2.3-1.

The less stringent requirements for Attributes for digitized film in Table 4.8.4.1.2.3-1 apply only if the intent of digitization is not for primary diagnosis, but for other purposes such as CAD and use as priors for comparison, since additional information otherwise required may not be obtainable at the time of digitization.

Table 4.8.4.1.2.3-1: Required Additional Attributes in Mammography Images

Attribute	Tag	DX, CR	Film	Rationale
Patient's Name	(0010,0010)	R+	R+	Used for identification during display
Patient ID	(0010,0020)	R+	R+	Used for identification during display
Patient's Birth Date	(0010,0030)	R+	O	Used for identification during display
Patient's Age	(0010,1010)	R+	O	Used for identification during display
Acquisition Date	(0008,0022)	R+	R+	Used for identification during display
Acquisition Time	(0008,0032)	R+	O	Used for identification during display
Operator's Name	(0008,1070)	R+	O	Used for identification during display
Manufacturer	(0008,0070)	R+	O	Used for quality control display
Institution Name	(0008,0080)	R+	O	Used for identification during display
Institution Address	(0008,0081)	R+	O	Used for quality control display
Manufacturer's Model Name	(0008,1090)	R+	O	Used for quality control display
Device Serial Number	(0018,1000)	R+	O	Used for quality control display
Detector Type	(0018,7004)	R+	R+	Used to distinguish scanned film; Type 2 in DICOM, but in IHE MAMMO shall not be empty and shall contain a Defined Term provided in the standard
Detector ID	(0018,700A)	R+	O	Used for quality control display; this attribute in the Mammography IOD replaces the function in the CR IOD of Plate or Cassette ID for a CR mammography system
Software Versions	(0018,1020)	R+	O	Used for CAD systems to be sure that processing is appropriate to the software version that created the images.
Station Name	(0008,1010)	R+	O	Used for identification of the system that acquired the images during display.
Gantry ID	(0018,1008)	RC+	O	Used for identification of the system that acquired the images during display. Required for images acquired by CR, since the Station Name (0008,1010) will normally identify the plate reader, not the acquisition device.

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Attribute	Tag	DX, CR	Film	Rationale
Source Image Sequence	(0008,2112)	R+	O	Needed to allow Image Displays to apply CAD marks to for presentation images when CAD was performed on for processing images
>Spatial Locations Preserved	(0028,135A)	R+	O	Needed to allow Image Displays to apply CAD marks to for presentation images when CAD was performed on for processing images; see also DICOM CP 564. Shall be YES if only a flip or rotation of the image pixel data has been performed.
KVP	(0018,0060)	R+	O	Used for display of the kVP technical factor
Exposure	(0018,1152)	R+	O	Used for display of the mAs technical factor
Exposure Time	(0018,1150)	R+	O	Used for display of the exposure time technical factor
Filter Material	(0018,7050)	R+	O	Used for display of the filter technical factor
Anode Target Material	(0018,1191)	R+	O	Used for display of the target technical factor
Compression Force	(0018,11A2)	R+	O	Used for display of the compression force technical factor
Body Part Thickness	(0018,11A0)	R+	O	Used for display of the compressed breast thickness technical factor
Positioner Primary Angle	(0018,1510)	R+	O	Used for display of the degree of obliquity technical factor
Relative X-ray Exposure	(0018,1405)	R+	O	Used for the display of the relative exposure technical factor. Note that Sensitivity (0018,6000) is NOT used for this purpose.
Entrance Dose in mGy	(0040,8302)	R+	O	Used for display of the estimated skin dose technical factor. Note that this attribute is used instead of the less precise (0040,0302) whose integer value is in dGy units.
Organ Dose	(0040,0316)	R+	O	Used for the display of the estimated mean glandular dose technical factor
VOI LUT Sequence	(0028,3010)	C	C	Required if Window Center and Width not present
>LUT Explanation	(0028,3003)	RC+	RC+	Required if more than one sequence item or at least one sequence item and window center/width pair is present in order to allow Image Display to present to the user a selection of LUTs or windows described by the explanation.
Window Center and Width Explanation	(0028,1055)	RC+	RC+	Required if more than one VOI LUT Sequence item or window center/width pair and at least one VOI LUT Sequence item is present in order to allow Image Display to present to the user a selection of LUTs or windows described by the explanation.
VOI LUT Function	(0028,1056)	RC+	RC+	Required if Window Center and Width are not intended to be interpreted as parameters of a linear function in order to allow Image Display to perform appropriate contrast transformation. Enumerated Values LINEAR or SIGMOID. See DICOM CP 467.
Burned In Annotation	(0028,0301)	R	R	Shall have the enumerated value of “NO”, unless the image was obtained by film digitization.

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Attribute	Tag	DX, CR	Film	Rationale
Implant Present	(0028,1300)	R+	O	Used to control hanging and processing (including CAD); not identical to Implant Displaced value for View Modifier Code Sequence, since an implant may be present but not displaced.
Pixel Padding Value	(0028,0120)	RC+	RC+	Required if background air suppression has been performed by replacing the pixels with a value not used within the breast tissue, so that pixels with this value can be excluded from contrast transformations. May be present otherwise. See Section 4.8.4.1.2.3.2.
Pixel Padding Range Limit	(0028,0121)	RC+	RC+	Required if Pixel Padding Value (0028,0120) is present and the padding values are a range rather than a single value. See Section 4.8.4.1.2.3.2.
Estimated Radiographic Magnification Factor	(0018,1114)	R+	O	Used to adjust Imager Pixel Spacing (0018,1164) to account for geometric magnification for normal and magnified views when making distance measurements and displaying or printing calipers.
Date of Last Detector Calibration	(0018,700C)	RC+	O	Used for quality control display. Required if detector undergoes periodic calibration (e.g., may not be applicable for CR).

See Section 2.2 “DICOM Usage Conventions”.

4.8.4.1.2.3.1 Partial View Option

The Partial View Option requires that the Acquisition Modality always send a flag indicating whether or not the image is part of a set of images (a mosaic) used to cover the area of a breast that is larger than the detector, and which part of the set the image represents.

The Partial View (0028,1350) attribute shall be sent and have a value of NO for magnification and spot compression images.

Table 4.8.4.1.2.3.1-1: Required Additional Attributes in Mammography Images for the Partial View Option

Attribute	Tag	IHE	Rationale
Partial View	(0028,1350)	R+	Required to control hanging of mosaics.
Partial View Code Sequence	(0028,1352)	RC+	Required if Partial View (0028,1350) has a value of YES, to control hanging of mosaics.

4.8.4.1.2.3.2 Background Air Suppression

For full field images (but not magnification or specimen images), the Acquisition Modality shall detect air outside the breast or the skin line, so as to provide for image contrast adjustment of the breast without adjusting the contrast of the background, and shall encode the region of the background to be excluded in “For Presentation” images by one of two means:

- a single Pixel Padding Value (0028,0120) that is used to indicate a value in the pixel data that is outside the breast

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- a range of pixel values between Pixel Padding Value (0028,0120) and Pixel Padding Range Limit (0028,0121) inclusive that is used to indicate values in the pixel data that are outside the breast

The air suppression mechanism used shall not obscure any burned in lead markers present in the image.

4.8.4.1.2.3.3 Cleavage Views

In a cleavage view that is not centered between both breasts or for which the operator designates one breast as primary, then the value of Image Laterality (0020,0062) shall be "L" or "R", rather than "B".

4.8.4.1.2.3.4 Digitized Film

The Digital Mammography X-Ray Image IOD, not the Secondary Capture Image IOD, shall be used for digitized film. Presentation Intent Type (0008,0068) shall be FOR PRESENTATION. Detector Type (0018,7004) shall be "FILM".

The values of the pixel size encoded in Imager Pixel Spacing (0018,1164) shall be the physical distance on the film being digitized or scanned between the center of each pixel.

The Study Date (0008,0020), Study Time (0008,0030), Acquisition Date (0008,0022) and Acquisition Time (0008,0022) shall be the date and time of acquisition of the film-screen exposure, not when the film was digitized.

Burned In Annotation (0028,0301) shall be present and may have a value of YES if the digitized image contains patient identification information.

There are no specific requirements in this transaction for the reconciliation of identifiers during digitization. However, the Acquisition Modality may be grouped with an Importer in the Import Reconciliation Workflow Integration Profile.

The output of the grayscale pipeline in a Digital Mammography X-Ray Image IOD FOR PRESENTATION image is always in P-Values; therefore, the optical density values obtained during film digitization shall be converted to P-Values, using appropriate assumed viewing conditions for the original film.

4.8.4.1.2.4 Recording of X-Ray Dose Information

Acquisition Modality Actors claiming the Radiation Exposure Monitoring (REM) Profile shall record the Irradiation Event UID (0008,3010) of the event(s) that resulted in the data from which the image was derived in each image created; if the image or frame is derived from more than one irradiation event, multiple values shall be present (see DICOM CP 1090). The value(s) of the Irradiation Event UID shall match those encoded in the corresponding SR Dose Information instance. If the SR Dose Information instance is not being created by the equipment that actually administered the radiation, the equipment creating the SR Dose Information shall assure that all images contain the correct Irradiation Event UIDs.

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The Irradiation Event UIDs may be used to identify images corresponding to irradiation events for purposes such as identifying irradiated tissues and organs for dose mapping or for advanced effective dose estimations or for comparing the noise characteristics of the images with the dose.

The Irradiation Event UIDs (0008,3010) shall be included in both original and derived images produced by the Acquisition Modality (such as retrospective reconstructions from the same raw data with different slice thickness or reconstruction intervals, multi-planar or 3D reconstructions from the same irradiation event, as well as for processing and for presentation projection images).

For further information on Irradiation Events, see Section 4.62 Store Dose Information transaction, and RAD TF-1: 22 “Radiation Exposure Monitoring Profile”.

4.8.4.1.2.5 Storage of Enhanced DICOM Objects

This section is currently in the CT/MR Perfusion Imaging with Contrast (PERF) and MR Diffusion Imaging (DIFF) Trial Implementation Supplements.

4.8.4.1.2.6 Storage of Stereotactic Mammography Images

This section is currently in the Stereotactic Mammography Image (SMI) Trial Implementation Supplement.

4.8.4.1.2.7 Storage of Digital Breast Tomosynthesis Images

The Acquisition Modality in the Digital Breast Tomosynthesis Profile shall support the DICOM Breast Tomosynthesis Image Storage SOP Class and the additional attributes specified in Table 4.8.4.1.2.7-2 and Table 4.8.4.1.2.7-3.

If conventional 2D mammography images are acquired, the Acquisition Modality shall support the Digital Mammography X-Ray Image Storage - For Presentation and For Processing SOP Classes and the additional attributes specified in Table 4.8.4.1.2.3-1.

The Acquisition Modality that supports the For Presentation Breast Projection X-Ray Images Option shall support the Breast Projection X-Ray Image For Presentation SOP Class and the additional attributes specified in Table 4.8.4.1.2.7-2 and Table 4.8.4.1.2.7.2-1.

The Acquisition Modality that supports the For Processing Breast Projection X-Ray Images Option shall support the Breast Projection X-Ray Image For Processing SOP Class and the additional attributes specified in Table 4.8.4.1.2.7-2 and Table 4.8.4.1.2.7.2-1.

Note 1: These requirements are consistent with those for conventional 2D mammography images defined in Table 4.8.4.1.2.3-1, but specialized to account for the encoding of multiple frames in a single image instance and the use of multi-frame functional groups. The convention used in the CT/MR Perfusion Imaging with Contrast (PERF) Profile is used to indicate nesting within a functional group sequence.

Note 2: Unlike the Digital Mammography X-Ray Image IOD, the Breast Tomosynthesis Image and Breast Projection X-Ray Image IODs use the Enhanced General Equipment Module, which already makes various equipment-related attributes mandatory, but these are repeated here for clarity.

Note 3: Since support for the Breast Projection X-Ray Image IOD is optional, additional requirements to include acquisition information in the Breast Tomosynthesis Image instances are to preserve the technique information for quality control.

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Acquisition Modalities capable of creating generated 2D images mathematically from tomosynthesis data (e.g., by Maximum Intensity Projection) shall encode them using the Breast Tomosynthesis Image Storage SOP Class.

The Acquisition Modality is not required to use Stacks, or the Multi-frame Dimensions Module, but is not prohibited from doing so. Concatenations are forbidden. In order to distinguish the different types of tomosynthesis images, the Image Type (0008,0008) attribute shall be populated according to Table 4.8.4.1.2.7-1.

Table 4.8.4.1.2.7-1: Image Type in Breast Tomosynthesis Images

Type of tomosynthesis image	Image Type Value 1	Image Type Value 3	Image Type Value 4
Thin Slices	ORIGINAL/DERIVED	TOMOSYNTHESIS	NONE
Thick Slices (Slabs)	DERIVED	TOMOSYNTHESIS	e.g., MAXIMUM, MEAN
Tomosynthesis Generated 2D	DERIVED	TOMOSYNTHESIS	GENERATED_2D

Note: This table is adapted from DICOM CP 1342 and will be finalized after CP 1342 is approved.

Table 4.8.4.1.2.7-2: Required additional attributes common to DBT Reconstruction and Project Images

Attribute	Tag	Tomo	Proj	Rationale
Patient's Name	(0010,0010)	R+	R+	Used for identification during display
Patient ID	(0010,0020)	R+	R+	Used for identification during display
Patient's Birth Date	(0010,0030)	R+	R+	Used for identification during display
Patient's Age	(0010,1010)	R+	R+	Used for identification during display
Operators' Name	(0008,1070)	R+	R+	Used for identification during display
Manufacturer	(0008,0070)	R	R	Used for quality control display
Institution Name	(0008,0080)	R+	R+	Used for identification during display
Institution Address	(0008,0081)	R+	R+	Used for quality control display
Manufacturer's Model Name	(0008,1090)	R	R	Used for quality control display
Device Serial Number	(0018,1000)	R	R	Used for quality control display
Station Name	(0008,1010)	R+	R+	Used for identification of the system that acquired the images during display

Table 4.8.4.1.2.7-3: Required Additional Attributes for DBT Reconstruction Images (Breast Tomosynthesis Image SOP Class)

Attribute	Tag	Tomo	Rationale
Image Type	(0008,0008)	R	Used for display in order to distinguish between different reconstructions

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Attribute	Tag	Tomo	Rationale
Number of Frames	(0028,0008)	R	Used for display during scrolling
X-Ray 3D Reconstruction Sequence	(0018,9530)	RC+	Type 1 in Type U X-Ray 3D Reconstruction Module. Required if the image represents an additional reconstruction (e.g., slabs) Note: If the X-Ray 3D Reconstruction Sequence is sent, all other mandatory attributes need to be sent as well
>Reconstruction Description	(0018,9531)	RC+	Used to display the way how reconstructed images were generated. Shall be required for additional reconstructions (e.g., slabs)
Pixel Padding Value	(0028,0120)	RC+	Required if background air suppression has been performed by replacing the pixels with a value not used within the breast tissue, so that pixels with this value can be excluded from contrast transformations. May be present otherwise. See Section 4.8.4.1.2.3.2
Pixel Padding Range Limit	(0028,0121)	RC+	Required if Pixel Padding Value (0028,0120) is present and the padding values are a range rather than a single value. See Section 4.8.4.1.2.3.2
Breast Implant Present	(0028,1300)	R	Used to control hanging and processing; not identical to Implant Displaced value for View Modifier Code Sequence, since an implant may be present but not displaced
Frame VOI LUT With LUT Functional Macro (could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
Frame VOI LUT Sequence	(0028,9132)	R	
>VOI LUT Sequence	(0028,3010)	C	Required if Window Center and Width not present
>>LUT Explanation	(0028,3003)	RC+	Required if more than one sequence item or at least one sequence item and window center/width pair is present in order to allow Image Display to present to the user a selection of LUTs or windows described by the explanation
>Window Center	(0028,1050)	C	Required if VOI LUT Sequence is not present
>Window Width	(0028,1051)	C	Required if VOI LUT Sequence is not present
>Window Center and Width Explanation	(0028,1055)	RC+	Required if more than one VOI LUT Sequence item or window center/width pair and at least one VOI LUT Sequence item is present in order to allow Image Display to present to the user a selection of LUTs or windows described by the explanation
>VOI LUT Function	(0028,1056)	RC+	Required if Window Center and Width are not intended to be interpreted as parameters of a linear function in order to allow Image Display to perform appropriate contrast transformation. Enumerated Values LINEAR or SIGMOID

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Attribute	Tag	Tomo	Rationale
Pixel Measures Functional Macro (could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
Pixel Measures Sequence	(0028,9110)	R	
>Pixel Spacing	(0028,0030)	RC	Required in order to perform measurements and annotations
>Slice Thickness	(0018,0050)	RC	Used for display
Plane Position (Patient) Functional Group Macro (may be in the Shared Functional Groups Sequence (5200,9229) if only a single frame is present, otherwise will be in the Per-frame Functional Groups Sequence (5200,9230))			
Plane Position Sequence	(0020,9113)	R	
>Image Position (Patient)	(0020,0032)	R	Used to identify location of slice in volume Shall be different for every frame (i.e., one traversal of the volume)
Plane Orientation (Patient) Functional Group Macro (shall be in Shared Functional Groups Sequence (5200,9229))			
Plane Orientation Sequence	(0020,9116)	R	
>Image Orientation (Patient)	(0020,0037)	R	Used for determination of the direction of rows and columns relative to the patient instead of Patient Orientation (0020,0020)
Frame Anatomy Functional Group Macro (shall be in Shared Functional Groups Sequence (5200,9229))			
Frame Anatomy Sequence	(0020,9071)	R	
>Frame Laterality	(0020,9072)	R	Used to describe which breast is imaged; all frames share the same value
Information related to the acquisition of the source projection images			
Breast Tomosynthesis Contributing Sources			
Contributing Sources Sequence	(0018,9506)	R+	Type 1 in Type U Breast Tomosynthesis Contributing Sources Module
>Detector ID	(0018,700A)	R	Used for quality control display
>Date of Last Detector Calibration	(0018,700C)	R	Used for quality control display
>Acquisition DateTime	(0008,002A)	R+	Used for identification during display
Breast Tomosynthesis Acquisition			
X-Ray 3D Acquisition Sequence	(0018,9507)	R+	Type 1 in Type U Breast Tomosynthesis Acquisition Module

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Attribute	Tag	Tomo	Rationale
>Source Image Sequence	(0008,2112)	RC	Used to identify breast projection X-Ray images that were used to generate this image
>KVP	(0018,0060)	R	Used for display of the kVp technical factor
>X-Ray Tube Current in mA	(0018,9330)	R	Used for display of the mA technical factor
>Filter Material	(0018,7050)	R	Used for display of the filter technical factor
>Anode Target Material	(0018,1191)	R	Used for display of the target technical factor
>Compression Force	(0018,11A2)	R	Used for display of the compression force technical factor
>Body Part Thickness	(0018,11A0)	R	Used for display of the compressed breast thickness technical factor
>Primary Positioner Scan Start Angle	(0018,9510)	R	Used for display of the degree of obliquity technical factor
>Primary Positioner Scan Arc	(0018,9508)	R	Used for display of the degree of obliquity technical factor
>Exposure in mAs	(0018,9332)	R	Used for display of the mAs technical factor
>Exposure Time in ms	(0018,9328)	R	Used for display of the exposure time technical factor
>Entrance Dose in mGy	(0040,8302)	R+	Used for display of the estimated skin dose technical factor Note: This attribute is added in DICOM CP 1285 (final text)
>Organ Dose	(0040,0316)	R+	Used for the display of the estimated mean glandular dose technical factor Note: This attribute is added in DICOM CP 1285 (final text)

Note: This table is not an exhaustive list of all attributes that are required by DICOM, but highlights those that are referred to elsewhere in the DBT Profile.

4195 Acquisition Modalities participating in the Digital Breast Tomosynthesis Profile may support the following transfer syntaxes as listed in Table 4.8.4.1.2.7-4 for all supported SOP Classes.

Table 4.8.4.1.2.7-4: Compression Transfer Syntaxes in Digital Breast Tomosynthesis Profile

Transfer Syntax UID	Name
1.2.840.10008.1.2.4.51	JPEG Extended (Process 2 & 4): Default Transfer Syntax for Lossy JPEG 12 Bit Image Compression (Process 4 only)
1.2.840.10008.1.2.4.57	JPEG Lossless, Non-Hierarchical (Process 14)
1.2.840.10008.1.2.4.70	JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14)
1.2.840.10008.1.2.4.90	JPEG 2000 Image Compression (Lossless Only)
1.2.840.10008.1.2.4.91	JPEG 2000 Image Compression

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4.8.4.1.2.7.1 Partial View Option

Acquisition Modalities supporting the Partial View Option in the Digital Breast Tomosynthesis Profile shall fulfill all requirements listed in Section 4.8.4.1.2.3.1 for tomosynthesis reconstructions, 2D images, and projection images (if one of the Breast Project X-Ray Images Option is supported).

4.8.4.1.2.7.2 Breast Projection X-Ray Images Options

The Acquisition Modality and Image Manager/Archive supporting the For Presentation Breast Projection X-Ray Images Option of the Digital Breast Tomosynthesis Profile shall additionally support the Breast Projection X-Ray Image For Presentation SOP Class as specified in Table 4.8.4.1.2.7-2 and in Table 4.8.4.1.2.7.2-1.

The Acquisition Modality and Image Manager/Archive supporting the For Processing Breast Projection X-Ray Images Option of the Digital Breast Tomosynthesis Profile shall additionally support the Breast Projection X-Ray Image For Processing SOP Class as specified in Table 4.8.4.1.2.7-2 and in Table 4.8.4.1.2.7.2-1.

Table 4.8.4.1.2.7.2-1: Required Additional Attributes for Breast Projection X-Ray Images

Attribute	Tag	Proj	Rationale
Acquisition DateTime	(0008,002A)	R	Used for identification during display
Image Type	(0008,0008)	R	Used to indicate projection images
Detector ID	(0018,700A)	R+	Used for quality control display
Date of Last Detector Calibration	(0018,700C)	R+	Used for quality control display
Number of Frames	(0028,0008)	R	Used for display during scrolling
Patient Orientation	(0020,0020)	RC	Used for hanging protocol configuration- Pixel data orientation of the most representative frame
KVP	(0018,0060)	R	Used for display of the kVp technical factor
X-Ray Tube Current in mA	(0018,9330)	R+	Used for display of the mA technical factor
Exposure in mAs	(0018,9332)	R+	Used to display cumulative Exposure parameters
Exposure Time in ms	(0018,9328)	R+	Used to display cumulative Exposure parameters
Entrance Dose in mGy	(0040,8302)	R	Used for display of the collective total skin dose technical factor
Organ Dose	(0040,0316)	R	Used for the display of the collective total glandular dose technical factor
Anode Target Material	(0018,1191)	R	Used for display of the target technical factor
Compression Force	(0018,11A2)	R	Used for display of the compression force technical factor
Body Part Thickness	(0018,11A0)	R	Used for display of the compressed breast thickness technical factor

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Attribute	Tag	Proj	Rationale
Pixel Padding Value	(0028,0120)	RC+	Required if background air suppression has been performed by replacing the pixels with a value not used within the breast tissue, so that pixels with this value can be excluded from contrast transformations. May be present otherwise. See Section 4.8.4.1.2.3.2
Pixel Padding Range Limit	(0028,0121)	RC+	Required if Pixel Padding Value (0028,0120) is present and the padding values are a range rather than a single value. See Section 4.8.4.1.2.3.2
Breast Implant Present	(0028,1300)	R	Used to control hanging and processing; not identical to Implant Displaced value for View Modifier Code Sequence, since an implant may be present but not displaced
X-Ray Filter Macro (could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
X-Ray Filter Sequence	(0018,9556)	R+	Type 1 in Type U X-Ray Filter Macro
>Filter Material	(0018,7050)	R+	Used for display of the filter technical factor
Breast X-Ray Acquisition Dose Macro (could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
X-Ray Acquisition Dose Sequence	(0018,9542)	R	
>Exposure in mAs	(0018,9332)	R	Used for display of the mAs technical factor
>Exposure Time in ms	(0018,9328)	R	Used for display of the exposure time technical factor
>Relative X-Ray Exposure	(0018,1405)	R+	Used for the display of the relative exposure technical factor
>Entrance Dose in mGy	(0040,8302)	R	Used for display of the estimated skin dose technical factor
>Organ Dose	(0040,0316)	R	Used for the display of the estimated mean glandular dose technical factor
Frame VOI LUT With LUT Functional Macro (could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
Frame VOI LUT Sequence	(0028,9132)	R	
>VOI LUT Sequence	(0028,3010)	C	Required if Window Center and Width not present
>>LUT Explanation	(0028,3003)	RC+	Required if more than one sequence item or at least one sequence item and window center/width pair is present in order to allow Image Display to present to the user a selection of LUTs or windows described by the explanation
>Window Center	(0028,1050)	C	Required if VOI LUT Sequence is not present
>Window Width	(0028,1051)	C	Required if VOI LUT Sequence is not present

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Attribute	Tag	Proj	Rationale
>Window Center and Width Explanation	(0028,1055)	RC+	Required if more than one VOI LUT Sequence item or window center/width pair and at least one VOI LUT Sequence item is present in order to allow Image Display to present to the user a selection of LUTs or windows described by the explanation
>VOI LUT Function	(0028,1056)	RC+	Required if Window Center and Width are not intended to be interpreted as parameters of a linear function in order to allow Image Display to perform appropriate contrast transformation. Enumerated Values LINEAR or SIGMOID
Breast X-Ray Positioner Macro (could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
Positioner Position Sequence	(0018,9405)	R	
>Positioner Primary Angle	(0018,1510)	R	Used for display of the degree of obliquity technical factor
>Positioner Primary Angle Direction	(0018,9559)	R	Used for display of the degree of obliquity technical factor
Breast X-Ray Geometry Functional Macro (could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
X-Ray Geometry Sequence	(0018, 9476)	R	
>Estimated Radiographic Magnification Factor	(0018,1114)	R	Used to adjust Imager Pixel Spacing (0018,1164) to account for geometric magnification for normal and magnified views when making distance measurements and displaying or printing calipers
X-Ray Frame Pixel Data Properties Functional Group Macro (could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
Frame Pixel Data Properties Sequence	(0018,9443)	R	
>Imager Pixel Spacing	(0018,1164)	R+	Used for measurements
Frame Anatomy Functional Group Macro (shall be in Shared Functional Groups Sequence (5200,9229))			
Frame Anatomy Sequence	(0020,9071)	R	
>Frame Laterality	(0020,9072)	R	Used to describe which breast is imaged; all frames share the same value
Derivation Image Macro (could either be in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229))			
Derivation Image Sequence	(0008,9124)	RC	Type 2 in Type C Derivation Image Macro

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Attribute	Tag	Proj	Rationale
>Source Image Sequence	(0008,2112)	RC+	Used in "For Presentation" images to reference the corresponding "For Processing" images; shall have item(s) if "For Processing" images are produced as DICOM SOP instances

The Acquisition Modality shall be capable of sending all supported SOP Classes to multiple destinations.

The Breast Projection X-Ray Image "For Presentation" instances shall contain a reference to the SOP Instance UID of the corresponding "For Processing" image in Source Image Sequence (0008,2112), if any.

4.8.4.1.2.8 Enterprise Identity Option

An Acquisition Modality supporting the Enterprise Identity Option shall copy values for the following Patient Context-critical attributes from the information received in the Modality Worklist, if provided, as specified in RAD TF-2x: Appendix A, to ensure consistency with the Performed Procedure Step object attributes, and the generated MPPS objects:

Table 4.8.4.1.2.8-1: Patient Context Critical Attributes

Patient Context-critical Attributes	Tag
Issuer of Patient ID	(0010,0021)
Issuer of Patient ID Qualifiers Sequence	(0010,0024)
>Universal Entity ID	(0040,0032)
>Universal Entity ID Type	(0040,0033)
Other Patient ID Sequence	(0010, 1002)
>Patient ID	(0010,0020)
>Issuer of Patient ID	(0010,0021)
>Issuer of Patient ID Qualifiers Sequence	(0010,0024)
>>Universal Entity ID	(0040,0032)
>>Universal Entity ID Type	(0040,0033)
>Type of Patient ID	(0010,0022)

In the case where Issuer of Patient ID and Issuer of Patient ID Qualifiers Sequence attributes are not explicitly supplied by the DSS/Order Filler in the Modality Worklist (e.g., in the Unscheduled Case), the Acquisition Modality shall not include values for these attributes in the generated SOP Instances.

Note: this requirement is intended to reduce complexity of information reconciliation on the Image Manager and Order Filler. An implementation that supports configuration of default values for these attributes will need to be configured, so that these defaults contain no value.

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An Acquisition Modality supporting the Enterprise Identity Option shall copy values for the following Accession Context-critical attributes from the information received in the Modality Worklist, if provided, as specified in RAD TF-2x: Appendix A to ensure consistency with the Performed Procedure Step object attributes, and the information included in the generated MPPS objects.

Table 4.8.4.1.2.8-2: Accession Context Critical Attributes

Accession Context-critical Attributes	Tag
Issuer of Accession Number Sequence	(0008,0051)
>Local Namespace Entity ID	(0040,0031)
>Universal Entity ID	(0040,0032)
>Universal Entity ID Type	(0040,0033)

4.8.4.1.2.9 View correction in Mammography images (MAWF)

This section is currently in the Mammography Acquisition Workflow (MAWF) Trial Implementation Supplement.

4.8.4.1.2.10 Recording of Radiopharmaceutical Administered Activity Information

Acquisition Modality Actors claiming the Radiation Exposure for Nuclear Medicine (REM-NM) Profile shall copy the dose information, if present in the Radiopharmaceutical Radiation Dose SR object (RRDSR), into each created image instance (both original and derived) as shown in Table 4.8.4.1.2.10-1. The values from the SR Concepts in this table shall supersede any corresponding information the Acquisition Modality obtains from Query Modality Worklist [RAD-5].

This requirement applies to both original and derived images produced by the Acquisition Modality (such as attenuation corrected and non-attenuation corrected images created from the same raw data, or retrospective reconstructions from the same raw data with different slice thickness or number of iterations).

The Synchronization Module shall be included in PET and NM Images.

Table 4.8.4.1.2.10-1: Mapping Radiopharmaceutical Dose Information to Images

SR Concept	Attribute	RRDSR	NM IOD	PET IOD	Enhanced PET IOD
EV (F-61FDB, SRT, "Radiopharmaceutical agent")	Radiopharmaceutical Code Sequence (0054,0304)	Source-1	Copy-1	Copy-1	Copy-1
EV (C-10072, SRT, "Radionuclide")	Radionuclide Code Sequence (0054,0300)	Source-1	Copy-1	Copy-1	Copy-1
EV (123007, DCM, "Radiopharmaceutical Specific Activity")	Radiopharmaceutical Specific Activity (0018,1077)	Source-1	n.a.	Copy-1	Copy-1
EV (113503, DCM, "Radiopharmaceutical Administration Event UID")	Radiopharmaceutical Administration Event UID (0008,3012)	Source-1	Copy-1	Copy-1	Copy-1

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SR Concept	Attribute	RRDSR	NM IOD	PET IOD	Enhanced PET IOD
EV (123003, DCM, "Radiopharmaceutical Start DateTime")	Radiopharmaceutical Start Time (0018,1072)	Source-1	Copy-1	Radiopharmaceutical Start Time (0018,1072) Radiopharmaceutical Start DateTime (0018,1078)	Radiopharmaceutical Start DateTime (0018,1078)
EV (123004, DCM, "Radiopharmaceutical Stop DateTime")	Radiopharmaceutical Stop Time (0018,1073)	Source-1	Copy-1	Radiopharmaceutical Stop Time (0018,1073) Radiopharmaceutical Stop DateTime (0018,1079)	Radiopharmaceutical Stop DateTime (0018,1079)
EV (113507, DCM, "Administered activity")	Radionuclide Total Dose (0018,1074)	Source-1	Copy-1	Copy-1 {convert MBq to Bq}	Copy-1
EV (123005, DCM, "Radiopharmaceutical Volume")	Radiopharmaceutical Volume (0018,1071)	Source-1	Copy-1	Copy-1	Copy-1
EV (G-C340, SRT, "Route of administration")	Radiopharmaceutical Route (0018,1070)	Source-1	Copy-1	Radiopharmaceutical Route (0018,1070) Administration Route Code Sequence (0054,0302)	Administration Route Code Sequence (0054,0302)
EV (8302-2, LN, "Patient Height")	Patient's Size (0010,1020)	Source-1	Copy-1	Copy-1	Copy-1
EV (29463-7, LN, "Patient Weight")	Patient's Weight (0010,1030)	Source-1	Copy-1	Copy-1	Copy-1
EV (14749-6, LN, "Glucose")	Acquisition Context Sequence (0040,0555) TID 3470 NM/PET Acquisition Context	Source-1	n.a.	Copy-1	Copy-1

The Radiopharmaceutical Administration Event UID (0008,3012) may be used to identify images corresponding to radiopharmaceutical administration events for purposes such as identifying irradiated tissues and organs for dose mapping or for advanced effective dose estimations or for comparing the noise characteristics of the images with the dose.

For further information on Radiopharmaceutical Administration Events, see Section 4.110 Store Radiopharmaceutical Activity Information, and RAD TF-1: 40 REM for Nuclear Medicine Profile.

When two or more radiopharmaceuticals are being imaged together, the same workflow applies, except that the RAS will have created an RRDSR for each radiopharmaceutical administered to the patient. The modality will need to retrieve all pertinent RRDSR objects from the Image Manager/Archive. Each RRDSR will correspond to a unique subset of sequence Items in the Radiopharmaceutical Information Sequence encoded in the NM, PET or Enhanced PET IOD.

4.8.4.1.3 Expected Actions

The Image Archive will store the received DICOM objects.

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The DICOM objects shall be stored such that they can be later retrieved (see Section 4.16 Retrieve Images) in a fashion meeting the requirements defined for a DICOM Level 2 Storage SCP (Refer to DICOM PS3.4 Section. B.4.1).

4.8.4.1.3.1 DICOM Image Storage SOP Classes

The DICOM Standard defines a number of image specific storage SOP classes. It is expected that Image Archive will support multiple storage SOP classes as defined in Table 4.8-1.

Table 4.8-1: Suggested Image SOP Classes

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.1	Computed Radiography Image Storage
1.2.840.10008.5.1.4.1.1.2	CT Image Storage
1.2.840.10008.5.1.4.1.1.4	MR Image Storage
1.2.840.10008.5.1.4.1.1.20	Nuclear Medicine Image Storage
1.2.840.10008.5.1.4.1.1.128	Positron Emission Tomography Image Storage
1.2.840.10008.5.1.4.1.1.481.1	RT Image Storage
1.2.840.10008.5.1.4.1.1.7	Secondary Capture Image Storage
1.2.840.10008.5.1.4.1.1.6.1	Ultrasound Image Storage
1.2.840.10008.5.1.4.1.1.3.1	Ultrasound Multi-frame Image Storage
1.2.840.10008.5.1.4.1.1.12.1	X-Ray Angiographic Image Storage
1.2.840.10008.5.1.4.1.1.12.2	X-Ray Radiofluoroscopic Image Storage
1.2.840.10008.5.1.4.1.1.1.1	Digital X-Ray Image Storage – For Presentation
1.2.840.10008.5.1.4.1.1.1.1.1	Digital X-Ray Image Storage – For Processing
1.2.840.10008.5.1.4.1.1.1.2	Digital Mammography X-Ray Image Storage – For Presentation
1.2.840.10008.5.1.4.1.1.1.2.1	Digital Mammography X-Ray Image Storage – For Processing
1.2.840.10008.5.1.4.1.1.13.1.3	Breast Tomosynthesis Image Storage
1.2.840.10008.5.1.4.1.1.13.1.4	Breast Projection X-Ray Image Storage – For Presentation
1.2.840.10008.5.1.4.1.1.13.1.5	Breast Projection X-Ray Image Storage – For Processing
1.2.840.10008.5.1.4.1.1.1.3	Digital Intra-oral X-Ray Image Storage – For Presentation
1.2.840.10008.5.1.4.1.1.1.3.1	Digital Intra-oral X-Ray Image Storage – For Processing
1.2.840.10008.5.1.4.1.1.77.1.1	VL Endoscopic Image Storage
1.2.840.10008.5.1.4.1.1.77.1.2	VL Microscopic Image Storage
1.2.840.10008.5.1.4.1.1.77.1.3	VL Slide-Coordinates Microscopic Image Storage
1.2.840.10008.5.1.4.1.1.77.1.4	VL Photographic Image Storage

Image Manager/Image Archives claiming the NM Image Profile are required to support all of the SOP classes listed in Table 4.8-3 below. Acquisition Modalities claiming the NM Image Profile are required to support Nuclear Medicine Image Storage.

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Table 4.8-3: Nuclear Medicine SOP Classes

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.20	Nuclear Medicine Image Storage
1.2.840.10008.5.1.4.1.1.7	Secondary Capture Image Storage
1.2.840.10008.5.1.4.1.1.7.2	Multi-frame Grayscale Byte Secondary Capture Image Storage
1.2.840.10008.5.1.4.1.1.7.4	Multi-frame True Color Secondary Capture Image Storage

Acquisition Modalities shall be capable of providing all created Nuclear Medicine image types using the Nuclear Medicine Image SOP class.

Acquisition Modalities and Image Manager/Image Archives claiming the Mammography Image Profile are required to support all of the SOP classes listed in Table 4.8-4.

Table 4.8-4: Mammography SOP Classes for Acquisition and Archival

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.1.2	Digital Mammography Image Storage – For Presentation
1.2.840.10008.5.1.4.1.1.1.2.1	Digital Mammography Image Storage – For Processing

Film digitizers are only required to create "For Presentation" images. All other Acquisition Modalities claiming the Mammography Image Profile shall be capable of sending both "For Presentation" and "For Processing" images for every image stored, though not necessarily to the same target (e.g., "For Processing" images may be sent to the actor corresponding to the CAD device and "For Presentation" images or both to the Image Manager/Archive).

The "For Presentation" images shall contain a reference to the SOP Instance UID of the corresponding "For Processing" image in Source Image Sequence (0008,2112).

The Image Manager/ Image Archive shall be able to accept both "For Processing" and "For Presentation" images from the Acquisition Modality, and make both available for retrieval, but is not required to be able to make "For Processing" images "presentable".

Acquisition Modalities and Image Manager/Image Archives participating in the Digital Breast Tomosynthesis Profile shall support the SOP classes with the optionality listed in Table 4.8-5.

Table 4.8-5: Digital Breast Tomosynthesis SOP Classes for Acquisition and Archival

SOP Class UID	SOP Class Name	Optionality (Acq. Mod)	Optionality (IM/IA)
1.2.840.10008.5.1.4.1.1.13.1.3	Breast Tomosynthesis Image Storage	R	R
1.2.840.10008.5.1.4.1.1.1.2	Digital Mammography X-Ray Image Storage – For Presentation	O	R
1.2.840.10008.5.1.4.1.1.1.2.1	Digital Mammography X-Ray Image Storage – For Processing	O	R
1.2.840.10008.5.1.4.1.1.13.1.4	Breast Projection X-Ray Image Storage – For Presentation (Note 1)	O	O

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SOP Class UID	SOP Class Name	Optionality (Acq. Mod)	Optionality (IM/IA)
1.2.840.10008.5.1.4.1.1.13.1.5	Breast Projection X-Ray Image Storage – For Processing (Note 2)	O	O

Note 1: The Breast Projection X-Ray Image Storage – For Presentation SOP Class is required for Acquisition Modalities and Image Manager/Archives if the For Presentation Breast Projection X-Ray Image Option is supported.

Note 2: The Breast Projection X-Ray Image Storage – For Processing SOP Class is required for Acquisition Modalities and Image Manager/Archives if the For Processing Breast Projection X-Ray Image Option is supported.

Image Manager/ Image Archives participating in the Digital Breast Tomosynthesis Profile shall support the compression transfer syntaxes as listed in Table 4.8.4.1.2.7-4 above.

4.8.4.1.3.2 Enterprise Identity Option

An Image Manager supporting the Enterprise Identity Option shall be capable of coercing the following Patient Context-critical attributes, when absent, to default values in the received SOP instances, before storing them:

Patient Context-critical Attributes	Tag
Issuer of Patient ID	(0010,0021)
Issuer of Patient ID Qualifiers Sequence	(0010,0024)
>Universal Entity ID	(0040,0032)
>Universal Entity ID Type	(0040,0033)

Note: The Other Patient IDs Sequence (0010,1002) can contain additional identifiers (with issuer's information) for the same patient. An Image Manager in a federated environment may be able to populate one or more entries in this sequence. This is permitted but not required.

An Image Manager supporting the Enterprise Identity Option shall be capable of coercing the following Accession Context-critical attributes, when absent, to default values in the received SOP instances before storing them:

Accession Context-critical Attributes	Tag
Issuer of Accession Number Sequence	(0008,0051)
>Local Namespace Entity ID	(0040,0031)
>Universal Entity ID	(0040,0032)
>Universal Entity ID Type	(0040,0033)

An Image Manager supporting the Enterprise Identity Option shall be capable of coercing the following Institution Context-critical attributes, when absent, to default values in the received SOP instances before storing them:

Institution Context-critical Attributes	Tag
Institution Name	(0008,0080)
Institution Address	(0008,0081)

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Institution Context-critical Attributes	Tag
Institution Code Sequence	(0008,0082)
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)
>Code Meaning	(0008,0104)

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4.9 Modality Presentation State Stored [RAD-9]

4.9.1 Scope

This section describes DICOM Storage requests of Grayscale Softcopy Presentation States issued by the Acquisition Modality to the Image Archive. The Acquisition Modality sends Presentation States for storage along with the images so they can be later used for support of consistent display of imaging data

4.9.2 Actor Roles

Actor: Acquisition Modality

Role: Generate Grayscale Softcopy Presentation States to be applied to image data. This actor will support the ability to send Presentation State data to an Image Archive.

Actor: Image Archive

Role: Accept and store Grayscale Softcopy Presentation State SOP Instances received from the Acquisition Modality.

4.9.3 Referenced Standards

DICOM PS3.4 Annex B: Storage Service Class

DICOM PS3.4 Annex N: Grayscale Softcopy Presentation State Storage

DICOM PS3.14: Grayscale Standard Display Function

4.9.4 Messages

Figure 4.9.4-1: Interaction Diagram

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4.9.4.1 Modality Presentation State Stored

4.9.4.1.1 Trigger Events

The Acquisition Modality generates a Grayscale Softcopy Presentation State and sends it to the Image Archive for storage. A Presentation State shall be generated as part of a Performed Procedure Step (see Section 4.6.4). It can be either as part of a Simple, Unscheduled, Append, Discontinue or Grouped Cases for which the same requirements as images apply. When generated as part of a Presentation of Grouped Procedure Case it shall follow the specific requirements defined in Section 4.6.4.1.2.3.6.

4.9.4.1.2 Message Semantics

The Acquisition Modality uses the DICOM C-STORE message to store Grayscale Softcopy Presentation States. All grayscale processing operations, and all spatial and graphical operations, that are relevant to the resulting presentation of the referenced image, have to be recorded in the presentation state. This will preserve the "as-last-seen" view of the image, with for example the contrast setting, rotation, flip and text annotation. The image operations in the presentation state override whatever is recorded in the image itself, even in the case that no attributes for a specific operation (e.g., Window Width/Window Level operation) are present in the presentation state. The latter case by definition specifies an identity operation. The full message semantics are defined in the Grayscale Softcopy Presentation State Storage SOP Class Behavior section of DICOM PS3.4. The Acquisition Modality will be the DICOM Storage SCU and the Image Archive will be the DICOM Storage SCP.

4.9.4.1.3 Expected Actions

The Image Archive will store the received Grayscale Softcopy Presentation State objects.

4.10 Storage Commitment [RAD-10]

4.10.1 Scope

After a Requester has sent images, Presentation States, Spatial Registration objects, Dose Objects, Evidence Documents or Key Image Notes, it requests that the Responder accept responsibility for them.

The objective of this transaction is to provide a formal release of storage responsibility to the Requester, allowing it to reuse its internal resources allocated to the study.

4.10.2 Actor Roles

The roles in this transaction are defined in the following table and may be played by the actors shown here:

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Table 4.10.2-1 Actor Roles

Role:	Requester: Requests a storage commitment from the Responder for DICOM objects previously transmitted.
Actor(s):	The following actors may play the role of Requester: Acquisition Modality Evidence Creator Importer Workitem Performer
Role:	Responder: Assumes responsibility for reliable storage, retrieval, and validity of the referenced DICOM objects.
Actor(s):	The following actors may play the role of Responder: Imager Manager/Archive Report Manager Report Repository

Transaction text specifies behavior for each role. The behavior of specific actors may also be specified when it goes beyond that of the general role.

4.10.3 Referenced Standards

DICOM PS3.4 Section J.3: Storage Commitment Push Model SOP Class.

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4.10.4 Messages

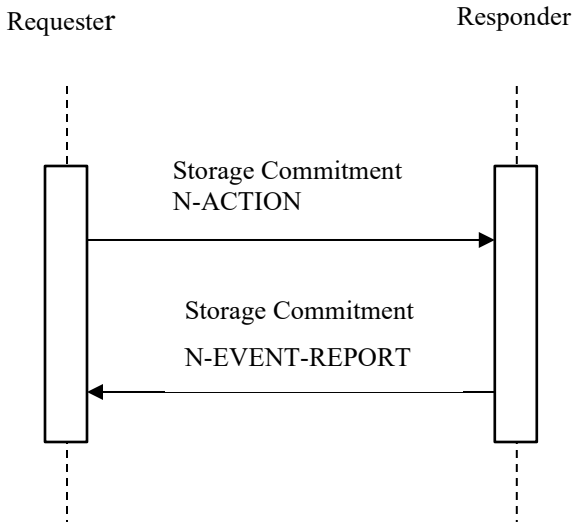

Figure 4.10.4-1: Interaction Diagram

4.10.4.1 Request Commitment Message

The Requester sends a request for storage commitment to the Responder.

4.10.4.1.1 Trigger Events

The Requester successfully transferred one or more SOP Instances to the Responder.

The Requester may make the request at any time after storage.

4.10.4.1.2 Message Semantics

The message is an N-ACTION in the DICOM Storage Commitment Push Model SOP Class. The Requester is the SCU, and the Responder is the SCP.

The Storage Commitment AE Title provided by the Responder may or may not be the same AE Title as the one provided for storing the referenced DICOM objects. The Requester shall support this flexibility with respect to the AE Title.

4.10.4.1.3 Expected Actions

The Responder shall accept and process the N-ACTION request.

4.10.4.2 Report Commitment Result Message

The Responder reports the outcome of a request for storage commitment to the Requester.

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4.10.4.2.1 Trigger Events

The Responder determines the outcome (successful or unsuccessful) of a requested storage commitment.

Note: There may be significant time between the Request Commitment Message and the Report Commitment Result Message.

4.10.4.2.2 Message Semantics

The message is an N-EVENT-REPORT in the DICOM Storage Commitment Push Model SOP Class. The Responder is the SCU, the Requester is the SCP.

The Responder determines the presence of and whether it accepts responsibility for the safe storage of the DICOM instances referenced in the request.

The N-EVENT-REPORT sent by the Responder may or may not occur on the same association as the N-ACTION request.

4.10.4.2.3 Expected Actions

With a successful result, ownership of data transfers from the Requester to the Responder, the Requester is then free to manage its own internal resources accordingly.

In the event that the Responder cannot service the storage commitment request, which can be determined by the "Failure Reason", it is expected that the Requester will neither delete nor modify the respective SOP instance(s).

Note: A Requester may receive the Retrieve AE Title in a Storage Commitment Message (N-EVENT REPORT). However, this N-EVENT REPORT may happen well after a corresponding Modality Performed Procedure Step N-SET (Complete) was performed. For this reason, the IHE Radiology Technical Framework does not require that the Requester send the Retrieve AE Title Attribute (0008,0054) in the Modality and Creator Performed Procedure Step N-SET (see Sections 4.7 and 4.21).

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4.11 Image Availability Query [RAD-11]

4.11.1 Scope

The purpose of this transaction is for the Department System Scheduler/Order Filler and Report Manager to determine whether SOP instances associated with a particular performed procedure step have been stored and are available for use in subsequent workflow steps as well as the storage location for retrieval of these SOP instances. The Image Manager is assumed to possess image availability information. The following examples show possible uses of the Image Availability Query:

- The Department System Scheduler/Order Filler queries the Image Manager after receiving notification, that images have been acquired (by MPPS N-SET message with PPS status of "COMPLETED" – see transaction [RAD-7]) until it receives a list of all images listed in the PPS.
- The Department System Scheduler/Order Filler needs to verify the availability of prior images pre-fetched according to workflow rules. In this case the availability of a single image may have to be verified.
- The Report Manager queries the Image Manager after receiving notification, that images have been acquired (by MPPS N-SET message with PPS status of "COMPLETED" – see transaction [RAD-7]) until it receives a list of all images listed in the PPS. At this time the Report Manager may schedule the appropriate task so that the reporting process can commence.
- The Report Manager needs to verify the availability of prior images pre-fetched according to workflow rules. In this case the availability of a single image may have to be verified.

Image availability is determined by the fact that the Image Instance UID in question is returned in response to the query. However, for the purposes of workflow management, image availability is generally qualified with additional parameters, such as:

Storage Location describes a system or system component (for instance, an Image Archive) that can be identified as a holder of images at a particular period in time.

Access Time is a period of time that is required for images to be moved from a storage location to be ready for distribution; i.e., this does not take into consideration the outbound network transfer time or the performance of the receiver application to display the images. The exact access time is difficult to determine and is highly implementation-dependent. Nevertheless, it is possible to approximate access time by using a degree or level of image availability.

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4.11.2 Actor Roles

Actor: Department System Scheduler/Order Filler

Role: Queries Image Manager to determine availability of images for use in the processes according to department workflow (for example, interpretation)

Actor: Report Manager

Role: Queries Image Manager to determine availability of images for use in the processes according to department workflow (for example, interpretation)

Actor: Image Manager

Role: Supplies image availability information to Department System Scheduler/Order Filler

4.11.3 Referenced Standards

DICOM PS3.4 Annex C: Query/Retrieve Service Class

4.11.4 Messages

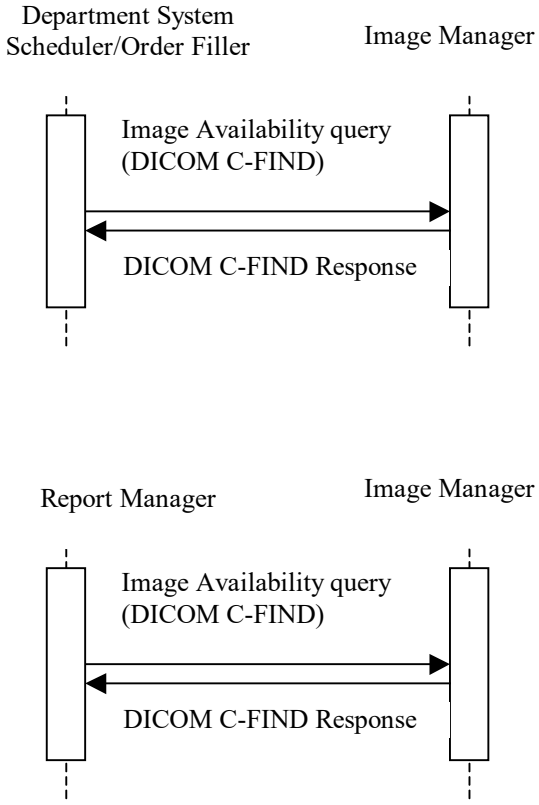

Figure 4.11.4-1: Interaction Diagrams

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4.11.4.1 Query Image Availability

4.11.4.1.1 Trigger Events

After receiving MPPS N-SET message with PPS status of "COMPLETED" or at a later time, the Department System Scheduler/Order Filler or Report Manager needs to verify image availability.

4.11.4.1.2 Message Semantics

The Department System Scheduler/Order Filler or Report Manager issues a C-FIND request as specified in the DICOM Standard for the Study Root Query/Retrieve Information Model – FIND SOP Class. The Department System Scheduler/Order Filler and Report Manager must be configured with the AE information of the Image Managers to be queried. To obtain the list of images in question, the Department System Scheduler/Order Filler and Report Manager shall perform a query on the Image Level based on the specification in DICOM. The Hierarchical Search Method shall be supported. The following table highlights important attributes of the query. It is not the intent of this transaction to provide a mechanism for polling. The Department System Scheduler/Order Filler and Report Manager shall query the Image Manager with the minimal number of queries necessary. For example, if the purpose is to verify availability of all images in a series, DSS/OF shall not send queries on an image-by-image basis. In this case, a single, zero length value for the SOP Instance UID could be sent, then all matched images information will be returned.

Table 4.11-1: Images Availability Query Keys

Attribute	Tag	Query Key value
Query/Retrieve Level	(0008,0052)	IMAGE
Study Instance UID	(0020,000D)	Unique value for single-value match
Series Instance UID	(0020,000E)	Unique value for single-value match
SOP Instance UID	(0008,0018)	Single value, zero length value or list of UIDs

Per the DICOM standard, Retrieve AE Title (0008,0054) shall be supported and returned by the Image Manager as part of the response.

To better quantify Access Time, the optional attribute Instance Availability (0008,0056) with enumerated values of "ONLINE", "NEARLINE" and "OFFLINE" may be used. In terms of access times and results of subsequent Retrieve (C-MOVE) request, the Image Availability values shall be interpreted as follows:

Table 4.11-2: Image Access Time

Level	Description	Access time
ONLINE	Images can be retrieved from storage location and be ready for distribution within a reasonable period of time (what time is reasonable is implementation-specific)	Typically, seconds to a few minutes
NEARLINE	Before distribution, images have to be processed at a storage location; total retrieval time is longer than "reasonable"	Typically, minutes to an hour
OFFLINE	Image cannot be distributed without human user intervention	Typically, minutes to hours to days

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4.11.4.1.3 Expected Actions

The Image Manager shall respond to the C-FIND as specified in the DICOM standard, including returning the SOP Instance UIDs (0008,0018) and corresponding Retrieve AE title (0008,0054) when the match is successful.

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4.12 Patient Update [RAD-12]

4.12.1 Scope

This transaction involves changes to patient information, including demographics, patient identification, patient location/class changes, and patient merges. These changes may occur at any time for a patient record. This transaction is used for both inpatients (i.e., those who are assigned a bed at the facility) and outpatients (i.e., those who are not assigned a bed at the facility) if the patient has been previously registered.

4.12.2 Actor Roles

Actor: ADT

Role: Adds and modifies patient demographic and encounter information.

Actor: Order Placer

Role: Receives patient and encounter information for use in order entry.

Actor: Department System Scheduler / Order Filler

Role: Receives and updates patient and encounter information to maintain consistency with the ADT system. Shall provide the updated patient and encounter information to the Image Manager.

Actor: Image Manager

Role: Receives patient and encounter information for use in maintaining its database of images and other evidence documents and, possibly, for management such as auto-routing evidence objects to a specific in-patient floor.

Actor: Report Manager

Role: Receives patient and encounter information for use in maintaining its report database.

4.12.3 Referenced Standards

HL7 v2.3.1 Chapters 2, 3

HL7 v2.5.1 Chapters 2, 3

ITI Technical Framework

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4.12.4 Messages

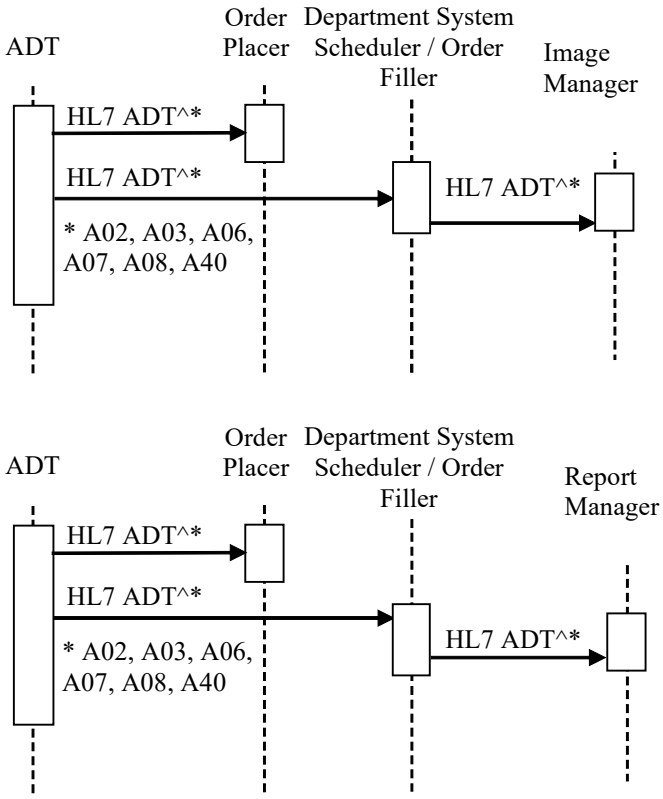

Figure 4.12.4-1: Interaction Diagrams

4.12.4.1 Patient Management – Patient Transfer

4.12.4.1.1 Trigger Events

Changes in patient location result in the following Update Patient message:

A02 – Patient Transfer

An A02 event is issued as a result of the patient changing his or her assigned physical location.

The message shall be generated by the system that performs the update whenever an error is resolved or a change occurs in patient location.

4.12.4.1.2 Message Semantics

The Update Patient transaction is an HL7 ADT message.

Message semantics are defined for both HL7 v2.3.1 and HL7 v2.5.1. The Profile and/or Options being claimed that incorporate this transaction will specify whether actors are required to support one, the other, or both sets of semantics.

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4.12.4.1.2.1 Message Semantics (HL7 v2.3.1)

The segments of the **Patient Transfer** message listed below are required, and the detailed description of messages is provided in the following subsections.

ADT A02	Patient Administration Message	Chapter in HL7 v2.3.1
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
PV1	Patient Visit	3

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of ADT message to its sender. See Section 2.4.3 “Acknowledgement Modes” for definition and discussion of the ACK message.

4.12.4.1.2.1.1 MSH Segment (HL7 v2.3.1)

MSH segment shall be constructed as defined in the Section 2.4.2.2 “Message Control”.

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of “ADT”; the second component shall have value of A02. The third component is optional; however, if present, it shall have a value of ADT_A02.

4.12.4.1.2.1.2 EVN Segment (HL7 v2.3.1)

See Section 4.1.4.1.2.1.2 for required and optional fields of the EVN segment.

4.12.4.1.2.1.3 PID Segment (HL7 v2.3.1)

Most of the fields in PID segment are optional, except those listed in Table 4.12-1. See Section 4.1.4.1.2.1.3 for the list of all fields of the PID segment.

Table 4.12-1: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	20	CX	R		00106	Patient Identifier List
5	48	XPN	R		00108	Patient Name
18	20	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.3.1

4.12.4.1.2.1.4 PV1 Segment (HL7 v2.3.1)

Most of the fields in PV1 segment are optional, except those listed in Table 4.12-2. See Section 4.1.4.1.2.1.4 for the list of all fields of the PV1 segment.

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Table 4.12-2: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
3	80	PL	C		00133	Assigned Patient Location
6	80	PL	C		00136	Prior Patient Location
10	3	IS	R	0069	00140	Hospital Service
11	80	PL	C		00141	Temporary Location
19	20	CX	C		00149	Visit Number
43	80	PL	C		00173	Prior Temporary Location
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.3.1

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued. Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

The new patient location shall appear either in the field *PV1-3 Assigned Patient Location* or *PV1-11 Temporary Location* (if the transfer is to a temporary location). The old patient location shall appear in the field *PV1-6 Prior Patient Location* or *PV1-43 Prior Temporary Location* (if the transfer is from a temporary location).

4.12.4.1.2.2 Message Semantics (HL7 v2.5.1)

The [RAD-12] Patient Management-Patient Transfer message is defined in the ITI Technical Framework as follows:

- ADT^A02 Admit Patient in ITI TF-2: 3.31.7.11 Patient Transfer (ADT^A02^ADT_A02)

The segments listed below are required or conditionally required. All other segments are optional.

Segment	Meaning	Usage	Card.	HL7 chapter
MSH	Message Header	R	[1..1]	2
EVN	Event Type	R	[1..1]	3
PID	Patient Identification	R	[1..1]	3
PV1	Patient Visit	R	[1..1]	3
ROL	Role	R2	[0..*]	15
OBX	Observation/Result	C	[0..*]	7
AL1	Allergy Information	C	[0..*]	3

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The allergy segment AL1 shall be present if allergy information is added/updated. The OBX segment(s) shall be present if patient weight and/or height is updated.

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of ADT message to its sender. See Section 2.4 for definition and discussion of the ACK message.

4.12.4.1.2.2.1 MSH Segment (HL7 v2.5.1)

The MSH segment shall be constructed as defined in ITI TF-2: 3.30.5.1 MSH – Header Segment. Additional specifications for actors complying with the Radiology Technical Framework are defined in Section 2.4.

Field *MSH-9-Message Type* shall have three components. The first component shall have a value of ADT; the second component shall have a value of A02; the third component shall have a value of ADT_A02.

4.12.4.1.2.2.2 EVN Segment (HL7 v2.5.1)

The EVN segment shall be constructed as defined in ITI TF-2: 3.30.5.2 EVN – Event Type Segment.

4.12.4.1.2.2.3 PID Segment (HL7 v2.5.1)

Most of the fields in the PID segment are optional, except those listed in Table 4.12-3. See ITI TF-2: 3.30.5.3 for a list of all of the fields of the PID segment.

Table 4.12-3: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	250	CX	R		00106	Patient Identifier List
5	250	XPN	R		00108	Patient Name
18	250	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.5.1

4.12.4.1.2.2.4 PV1 Segment (HL7 v2.5.1)

Most of the fields in the PV1 segment are optional, except those listed in Table 4.12-4. See ITI TF-2: 3.30.5.4 for a list of all of the fields of the PV1 segment.

Table 4.12-4: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
3	80	PL	C		00133	Assigned Patient Location
6	80	PL	C		00136	Prior Patient Location
10	3	IS	R	0069	00140	Hospital Service
11	80	PL	C		00141	Temporary Location
19	250	CX	C		00149	Visit Number

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SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
43	80	PL	C		00173	Prior Temporary Location
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.5.1

Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

The PV1 segment shall be followed, for each of the consulting doctor(s), attending doctor, admitting doctor, and referring doctor, by a ROL segment.

Field *PV1-9-Consulting Doctor* shall not be present. The consulting doctor(s) are entirely described in the ROL segments.

At least one of the fields *PID-18-Patient Account Number* or *PV1-19-Visit Number* shall be valued.

Field PV1-51-Visit *Indicator* shall be valued with value “V” if the field *PV1-19 Visit Number* is value. It may be omitted otherwise.

The new patient location shall appear either in the field *PV1-3-Assigned Patient Location* or *PV1-11-Temporary Location* (if the transfer is to a temporary location). The old patient location shall appear in the field *PV1-6-Prior Patient Location* or *PV1-43-Prior Temporary Location* (if the transfer is from a temporary location).

4.12.4.1.2.2.5 ROL Segment (HL7 v2.5.1)

One ROL segment shall be included for each attending doctor, admitting doctor, referring doctor and consulting doctor, if any. Note that some Provider Role codes in the ROL Segment use the word "Provider" rather than "Doctor".

The ROL Segment shall be constructed as defined in ITI TF-2: 3.30.5.6 ROL- Role Segment.

4.12.4.1.3 Expected Actions

It is expected that after receiving Patient Transfer message (A02) the receiving system will change its records about patient location.

It is the responsibility of the Image Manager and the Report Manager to ensure that the patient information (including the patient location) has been updated in the diagnostic reports and any relevant objects they manage when they are retrieved.

4.12.4.2 Patient Management – Update Patient Class

4.12.4.2.1 Trigger Events

Changes “in patient” class (that is from an inpatient status to outpatient, from an outpatient status to inpatient, from “admitted” or “non-admitted” status to discharged) result in one of the following Update Patient messages:

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- A03 – Patient Discharge
- A06 – Change an Outpatient to an Inpatient
- A07 – Change an Inpatient to an Outpatient

An A03 event signals the end of a patient's stay in a healthcare facility. For in-patient, it signals that the patient's status has changed to "discharged" and the patient is no longer in the facility. For outpatient, it signals the end of current visit of a patient to the facility. An A06 event is sent when a patient who was present for a non-admitted visit is being admitted. This event changes a patient's status from non-admitted to "admitted". An A07 event is sent when a patient who was admitted changes his/her status to "no longer admitted" but is still being seen for this episode of care. This event changes a patient from an "admitted" to a "non-admitted" status.

4.12.4.2.2 Message Semantics

Message semantics are defined for both HL7 v2.3.1 and HL7 v2.5.1. The Profile and/or Options being claimed that incorporate this transaction will specify whether actors are required to support one, the other, or both sets of semantics.

4.12.4.2.2.1 Message Semantics (HL7 v2.3.1)

The Update Patient transaction is an HL7 ADT message. The message shall be generated by the system that performs the update whenever patient class changes.

The segments of the **Update Patient Class** messages listed below are required, and the detailed description of messages is provided in Sections 4.12.4.1.2.1.1 through 4.12.4.1.2.1.3.

ADT A03/A06/A07	Patient Administration Message	Chapter in HL7 v2.3.1
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
PV1	Patient Visit	3

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of ADT message to its sender. See Section 2.4.3 "Acknowledgement Modes" for definition and discussion of the ACK message.

4.12.4.2.2.1.1 MSH Segment (HL7 v2.3.1)

MSH segment shall be constructed as defined in the Section 2.4.2.2 "Message Control".

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of "ADT"; the second component shall have value of A03, A06 or A07, as appropriate. The third component is optional; however, if present, it shall have a value of ADT_A03 (for A03 message) or ADT_A06 (for A06 and A07 messages).

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4.12.4.2.2.1.2 EVN Segment (HL7 v2.3.1)

See Section 4.1.4.1.2.1.2 for required and optional fields of the EVN segment.

4.12.4.2.2.1.3 PID Segment (HL7 v2.3.1)

Most of the fields in PID segment are optional, except those listed in Table 4.12-5. See Section 4.1.4.1.2.1.3 for the list of all fields of the PID segment.

Table 4.12-5: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	20	CX	R		00106	Patient Identifier List
5	48	XPN	R		00108	Patient Name
18	20	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.3.1

4.12.4.2.2.1.4 PV1 Segment (HL7 v2.3.1)

Most of the fields in PV1 segment are optional, except those listed in Table 4.12-6. See Section 4.1.4.1.2.1.4 for the list of all fields of the PV1 segment.

Table 4.12-6: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
3	80	PL	R		00133	Assigned Patient Location
6	80	PL	C		00136	Prior Patient Location
7	60	XCN	C	0010	00137	Attending Doctor
8	60	XCN	C	0010	00138	Referring Doctor
9	60	XCN	R2	0010	00139	Consulting Doctor
17	60	XCN	C	0010	00147	Admitting Doctor
19	20	CX	C		00149	Visit Number
43	80	PL	C		00173	Prior Temporary Location
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.3.1

Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued.

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

For "Discharge Patient" (A03) message:

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- Field *PV1-3 Assigned Patient Location* shall contain the patient's location prior to discharge.
- Field *PV1-45 Discharge Date/Time* does not have to be present in A03. If PV1-45 is not present then the timestamp in the EVN segment (*EVN-2 Recorded Date/Time*) signifies date and time of discharge.

For "Change an Outpatient to an Inpatient" (A06) message:

- The new patient class shall appear in PV1-2-patient class.
- The new patient location shall appear in PV1-3-assigned patient location.
- The old patient location (if relevant) shall appear in PV1-6-prior patient location.
- The current active account number shall appear in PID-18-patient account number.
- The Attending Doctor in PV1-7, the Referring Doctor in PV1-8, and the Consulting Doctor in PV1-9, may be different, if there are changes to those values.

For "Change an Inpatient to an Outpatient" (A07) message:

- The new patient class shall appear in PV1-2-patient class.
- The old patient location shall appear in PV1-6-prior patient location or *PV1-43 Prior Temporary Location*.
- The current active account number shall appear in field PID-18-patient account number.
- The Attending Doctor in PV1-7, the Referring Doctor in PV1-8, and the Consulting Doctor in PV1-9, may be different, if there are changes to those values.

A06 and A07 messages shall be used exclusively to send fields pertinent to the change in patient class between inpatient and outpatient.

Modification of any patient demographic information or non-patient-class visit information must be done by in addition sending an Update Patient Information (A08) message.

4.12.4.2.2.2 Message Semantics (HL7 v2.5.1)

The messages that are used to implement the [RAD-12] Patient Management – Update Patient Class message are described in the following Sections:

- ITI TF-2: 3.31.7.4 Discharge/End Visit (ADT^A03^ADT_A03)
- ITI TF-2: 3.31.7.9 Change an Outpatient to an Inpatient (ADT^A06^ADT_A06)
- ITI TF-2: 3.31.7.10 Change an Inpatient to an Outpatient (ADT^A07^ADT_A06)

The segments of the Update Patient Class message listed below are required or conditionally required. The detailed description of each segment is provided in the following subsections, including references to the corresponding ITI section, followed by additional requirements to comply with the IHE Radiology Technical Framework.

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Segment	Meaning	Usage	Card.	HL7 chapter
MSH	Message Header	R	[1..1]	2
EVN	Event Type	R	[1..1]	3
PID	Patient Identification	R	[1..1]	3
PV1	Patient Visit	R	[1..1]	3
ROL	Role	R2	[0..*]	15
OBX	Observation/Result	C	[0..*]	7
AL1	Allergy Information	C	[0..*]	3

The allergy segment AL1 shall be present if allergy information is added/updated. The OBX segment(s) shall be present if patient weight and/or height is updated.

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of ADT message to its sender. See Section 2.4.4.3 “Acknowledgement Modes” for definition and discussion of the ACK message.

4.12.4.2.2.2.1 MSH Segment (HL7 v2.5.1)

The MSH segment shall be constructed as defined in ITI TF-2: 3.30.5.1 MSH – Header Segment. Additional specifications for actors conforming to the IHE Radiology Technical Framework are defined in Section 2.4.

Field *MSH-9-Message Type* shall have three components. The first component shall have a value of ADT; the second component shall have a value of A03, A06, or A07, as appropriate; the third component shall have a value of ADT_A03 (for A03 message) or ADT_A06 (for A06 and A07 messages).

4.12.4.2.2.2.2 EVN Segment (HL7 v2.5.1)

The EVN segment shall be constructed as defined in ITI TF-2: 3.30.5.2 EVN – Event Type Segment.

4.12.4.2.2.2.3 PID Segment (HL7 v2.5.1)

Most of the fields in the PID segment are optional, except those listed in Table 4.12-7. See ITI TF-2: 3.30.5.3 for a list of all of the fields of the PID segment.

Table 4.12-7: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	250	CX	R		00106	Patient Identifier List
5	250	XPN	R		00108	Patient Name
18	250	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.5.1

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4.12.4.2.2.2.4 PV1 Segment (HL7 v2.5.1)

Most of the fields in the PV1 segment are optional, except those listed in Table 4.12-8. See ITI TF-2: 3.30.5.4 for a list of all of the fields of the PV1 segment.

Table 4.12-8: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
3	80	PL	R		00133	Assigned Patient Location
6	80	PL	C		00136	Prior Patient Location
7	250	XCN	C	0010	00137	Attending Doctor
8	250	XCN	C	0010	00138	Referring Doctor
9	250	XCN	X	0010	00139	Consulting Doctor
17	250	XCN	C	0010	00147	Admitting Doctor
19	250	CX	C		00149	Visit Number
43	80	PL	C		00173	Prior Temporary Location
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.5.1

Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the Radiology Technical Framework (see RAD TF-4).

At least one of the fields *PID-18-Patient Account Number or PV1-19-Visit Number* shall be valued.

Field *PV1-51-Visit Indicator* shall be valued with value "V" if field *PV1-19-Visit Number* is valued. It may be omitted otherwise.

For the "Discharge Patient" (A03) message:

- Field *PV1-3-Assigned Patient Location* shall contain the patient's location prior to discharge.
- Field *PV1-45-Discharge Date/Time* does not have to be present in A03. If PV1-45 is not present then the timestamp in the EVN segment (*EVN-2-Recorded Date/Time*) signifies the date and time of discharge.

For "Change an Outpatient to an Inpatient" (A06) message:

- The new patient class shall appear in *PV1-2-patient class*.
- The new patient location shall appear in *PV1-3-assigned patient location*.
- The old patient location (if relevant) shall appear in *PV1-6-prior patient location*.
- The current active account number shall appear in *PID-18-patient account number.*
- *PV1-7-Attending Doctor* and *PV1-8-Referring Doctor* may be different, if there are changes to those values.

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- The Consulting Doctor, if changed, will be communicated in a ROL segment immediately following the PV1 segment.

For "Change an Inpatient to an Outpatient" (A07) message:

- The new patient class shall appear in *PV1-2-patient class*.
- The old patient location shall appear in PV1-6-prior patient location or PV1-43 Prior Temporary Location.
- The current active account number shall appear in field *PID-18-patient account number*.
- *PV1-7-Attending Doctor* and *PV1-8-Referring Doctor* may be different, if there are changes to those values.
- The Consulting Doctor, if changed, will be communicated in a ROL segment immediately following the PV1 segment.

The PV1 segment shall be followed, for each of the attending doctor, admitting doctor, and referring doctor, by a ROL segment.

A06 and A07 messages shall be used exclusively to send fields pertinent to the change in patient class between inpatient and outpatient.

Modification of any patient demographic information or non-patient-class visit information must be done by sending a Patient Information Update message (see Section 4.12.4.3) in addition to the Update Patient Class message.

4.12.4.2.2.2.5 ROL Segment (HL7 v2.5.1)

One ROL segment shall be included for each attending doctor, admitting doctor, referring doctor and consulting doctor that is changed. Note that some Provider Role codes in the ROL Segment use the word "Provider" rather than "Doctor".

The ROL Segment shall be constructed as defined in ITI TF-2: 3.30.5.6 ROL - Role Segment.

4.12.4.2.3 Expected Actions

It is expected that after receiving Patient Class Change message (A03/A06/A07), the receiving system will change its local patient visit information.

It is the responsibility of the Image Manager and the Report Manager to ensure that the patient information (including the patient location) has been updated in the diagnostic reports and any relevant objects they manage when they are retrieved.

4.12.4.3 Patient Management – Patient Information Update

4.12.4.3.1 Trigger Events

Changes to patient demographics and account information (e.g., change in patient name, patient address, etc.) shall trigger the following Update Patient message:

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- A08 – Update Patient Information

The message shall be generated by the system that performs the update whenever an error is resolved or a change occurs in patient demographics.

4.12.4.3.2 Message Semantics

The Update Patient transaction is an HL7 ADT message.

All of the required (R and R2) information for a patient record shall be re-sent in an A08 message. Any information received as NULL (i.e., transmitted as two double quote marks "") in the A08 message shall be removed from the receiving system's database for that patient record. If no value is sent (i.e., omitted) in the A08 message, the old value shall remain unchanged in the receiving system's database for that patient record.

An A08 message is the only method that may be used to update patient demographic and visit information. However Patient ID cannot be updated with an A08 message. An A40 message shall be used for this purpose (see Section 4.12.4.4.2.1.5 for HL7 v2.3.1 or Section 4.12.4.4.2.2.5 for HL7 v2.5.1).

4.12.4.3.2.1 Message Semantics (HL7 v2.3.1)

The segments of the **Update Patient Information** message listed below are required, and the detailed description of the message is provided in Section 4.12.4.1.2.1.4. The allergy segment AL1 shall be present if allergy information is added/updated. OBX segment(s) shall be present if patient weight and/or height is updated.

ADT A08	Patient Administration Message	Chapter in HL7 v2.3.1
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
PV1	Patient Visit	3
[{OBX}]	Observation/results	7
[{AL1}]	Allergy	3

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of ADT message to its sender. See Section 2.4.3 "Acknowledgement Modes" for definition and discussion of the ACK message.

4.12.4.3.2.1.1 MSH Segment (HL7 v2.3.1)

MSH segment shall be constructed as defined in the Section 2.4.2.2 "Message Control".

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of "ADT"; the second component shall have value of A08. The third component is optional; however, if present, it shall have a value of ADT_A08.

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4.12.4.3.2.1.2 EVN Segment (HL7 v2.3.1)

See Section 4.1.4.1.2.1.2 for required and optional fields of the EVN segment.

4.12.4.3.2.1.3 PID Segment (HL7 v2.3.1)

The required fields of the PID segment are listed in Table 4.12-9. All other fields are conditional and shall be present if the value of the field has been changed by the ADT. See Section 4.1.4.1.2.1.3 for the list of all fields of the PID segment.

Note that certain visit information, such as patient location and class may not be changed with this message. In these cases, **Patient Transfer** and **Change Patient Class** messages shall be used.

Table 4.12-9: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	20	CX	R		00106	Patient Identifier List
5	48	XPN	R		00108	Patient Name
18	20	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.3.1

4.12.4.3.2.1.4 PV1 Segment (HL7 v2.3.1)

Most of the fields in PV1 segment are optional, except those listed in Table 4.12-10. See Section 4.1.4.1.2.1.4 for the list of all fields of the PV1 segment.

Table 4.12-10: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	20	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.3.1

Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF- 4).

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued.

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

4.12.4.3.2.1.5 AL1 Segment (HL7 v2.3.1)

See Section 4.1.4.1.2.1.5 for required and optional fields of the AL1 segment.

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4.12.4.3.2.1.6 OBX Segment (HL7 v2.3.1)

See Section 4.1.4.1.2.1.6 for required and optional fields of the OBX segment.

4.12.4.3.2.2 Message Semantics (HL7 v2.5.1)

The [RAD-12] Patient Management-Patient Information Update is defined in ITI TF-2: 3.31.7.6 Patient Update Information (ADT^A08^ADT_A01)

The required segments of the **Patient Update Information** message are listed below. The detailed description of each segment is provided in the following subsections, including references to the corresponding ITI section, followed by additional requirements to comply with the IHE Radiology Technical Framework.

ADT A08	Patient Administration Message	Chapter in HL7 v2.5.1
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
PV1	Patient Visit	3
ROL	Role	15
[{OBX}]	Observation/results	7
[{AL1}]	Allergy	3

The allergy segment AL1 shall be present if allergy information is added/updated. OBX segment(s) shall be present if patient weight and/or height is updated.

4.12.4.3.2.2.1 MSH Segment (HL7 v2.5.1)

The MSH segment shall be constructed as defined in ITI TF-2: 3.30.5.1 MSH – Header Segment. Additional specifications for actors complying with the IHE Radiology Technical Framework are defined in Section 2.4.2.2 “Message Control”.

Field *MSH-9-Message Type* shall have three components. The first component shall have a value of ADT; the second component shall have a value of A08; the third component shall have a value of ADT_A08.

4.12.4.3.2.2.2 EVN Segment (HL7 v2.5.1)

The EVN segment shall be constructed as defined in ITI TF-2: 3.30.5.2 EVN – Event Type Segment.

4.12.4.3.2.2.3 PID Segment (HL7 v2.5.1 Option)

Most of the fields in the PID segment are optional, except those listed in Table 4.12-11. See ITI TF-2: 3.30.5.3 for a list of all of the fields of the PID segment**.**

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Table 4.12-11: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	250	CX	R		00106	Patient Identifier List
5	250	XPN	R		00108	Patient Name
18	250	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.5.1

Note that certain visit information, such as patient location and class, may not be changed with this message. In these cases, Patient Transfer and Change Patient Class messages shall be used.

4.12.4.3.2.2.4 PV1 Segment (HL7 v2.5.1)

All of the fields in the PV1 segment are optional, except those listed in Table 4.12-12. See Section 4.1.4.1.2.2.4 for a full discussion of the PV1 segment.

Table 4.12-12: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	250	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.5.1

At least one of the fields *PID-18-Patient Account Number* or *PV1-19-Visit Number* shall be valued. Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4). It is required if it has been present in the registration message A01, A04 or A05 that is being cancelled by this message.

Field *PV1-51-Visit Indicator* shall be valued with value "V" if the field *PV1-19-Visit Number* is valued. It may be omitted otherwise.

4.12.4.3.2.2.5 OBX Segment (HL7 v2.5.1)

See Section 4.1.4.1.2.2.6 for required and optional fields of the OBX segment.

4.12.4.3.2.2.6 AL1 Segment (HL7 v2.5.1)

See Section 4.1.4.1.2.2.7 for required and optional fields of the AL1 segment.

4.12.4.3.3 Expected Actions

It is expected that after receiving Patient Information Update message (A08) the receiving system will update its local patient demographic, visit, allergy, and/or insurance information. Any information received as null in the new A08 message shall be removed locally.

It is the responsibility of the Image Manager and the Report Manager to ensure that the patient information has been updated in the diagnostic reports and evidence objects (e.g., images, Key

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Image Notes, Grayscale Softcopy Presentation States, Evidence Documents, etc.) they manage when they are retrieved from.

4.12.4.4 Patient Management – Patient Merge

4.12.4.4.1 Trigger Events

When two patient records are found to identify the same patient and are merged, the following message shall be triggered:

- A40 – Merge Patient – Internal ID

An A40 message indicates that a merge has been done at the internal identifier level. That is, PID-3 Patient ID identifier has been merged with MRG-1 Patient ID. This message is initiated by the system that performs the merge.

4.12.4.4.2 Message Semantics

4.12.4.4.2.1 Message Semantics (HL7 v2.3.1)

The Update Patient transaction is an HL7 ADT message. The message shall be generated by the system that performs the update whenever Patient ID changes or two records are found to reference the same person.

The segments of the **Merge Patient** message listed below are required, and the detailed description of the message is provided in Section 4.12.4.1.2.1.5. The PV1 segment is optional.

ADT A40	Patient Administration Message	Chapter in HL7 v2.3.1
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
MRG	Merge Information	3
[PV1]	Patient Visit	3

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of ADT message to its sender. See Section 2.4.3 “Acknowledgement Modes” for definition and discussion of the ACK message.

4.12.4.4.2.1.1 MSH Segment (HL7 v2.3.1)

MSH segment shall be constructed as defined in the Section 2.4.2.2 “Message Control”.

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of “ADT”; the second component shall have value of A40. The third component is optional; however, if present, it shall have a value of ADT_A39.

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4.12.4.4.2.1.2 EVN Segment (HL7 v2.3.1)

See Section 4.1.4.1.2.1.2 for required and optional fields of the EVN segment.

4.12.4.4.2.1.3 PID Segment (HL7 v2.3.1)

Most of the fields in PID segment are optional, except those listed in Table 4.12-13. See Section 4.1.4.1.2.1.3 for the list of all fields of the PID segment.

Table 4.12-13: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	20	CX	R		00106	Patient Identifier List
5	48	XPN	R		00108	Patient Name

Adapted from the HL7 standard, version 2.3.1

4.12.4.4.2.1.4 PV1 Segment (HL7 v2.3.1)

Most of the fields in PV1 segment are optional, except those listed in Table 4.12-14. See Section 4.1.4.1.2.1.4 for the list of all fields of the PV1 segment.

Table 4.12-14: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
11	80	PL	O		00141	Temporary Location

Adapted from the HL7 standard, version 2.3.1

4.12.4.4.2.1.5 MRG Segment (HL7 v2.3.1)

The PID segment contains the dominant patient information, including Patient ID (and Issuer of Patient ID). The MRG segment identifies the “old” or secondary patient records to be de-referenced. HL7 does not require that the “old” record be deleted; it does require that the "incorrect" identifier not be referenced in future transactions following the merge.

Table 4.12-15: IHE Profile - MRG segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	20	CX	R		00211	Prior Patient Identifier List
2	20	CX	O		00212	Prior Alternate Patient ID
3	20	CX	O		00213	Prior Patient Account Number
4	20	CX	R2		00214	Prior Patient ID
5	20	CX	O		01279	Prior Visit Number
6	20	CX	O		01280	Prior Alternate Visit ID
7	48	XPN	R2		01281	Prior Patient Name

Adapted from the HL7 Standard, version 2.3.1

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A separate merge message shall be sent for each patient record to be merged. For example, if Patients A, B, and C are all to be merged into Patient B, two MRG messages would be sent. In the first MRG message patient B would be identified in the PID segment and Patient A would be identified in the MRG segment. In the second MRG message, patient B would be identified in the PID segment, and Patient C would be identified in the MRG segment. The visits and accounts of patients A and C will now belong to patient B's record along with B's original visits and accounts.

Modification of any patient demographic information shall be done by sending a separate Update Patient Information (A08) message for the current Patient ID. An A40 message is the only method that may be used to update a Patient ID.

A new Patient shall be created in the Image Manager and the Report Manager using the demographics contained in the Patient Merge (A40) message when the prior Patient to be merged does not exist on the Image Manager. This shall be followed by a Patient Update (A08) Message to update any of the demographics missing in the Patient Merge (A40) message.

4.12.4.4.2.2 Message Semantics (HL7 v2.5.1)

The [RAD-12] Patient Merge message is defined in ITI TF-2: 3.31.7.31 Merge Two Patients (ADT^A40^ADT_A39)

4.12.4.4.2.2.1 MSH Segment (HL7 v2.5.1)

The MSH segment shall be constructed as defined in ITI TF-2: 3.30.5.1 MSH – Header Segment. Additional specifications for actors complying with the IHE Radiology Technical Framework are defined in Section 2.4.

Field *MSH-9-Message Type* shall have three components. The first component shall have a value of ADT; the second component shall have a value of A40; the third component shall have a value of ADT_A39.

4.12.4.4.2.2.2 EVN Segment (HL7 v2.5.1)

The EVN segment shall be constructed as defined in ITI TF-2: 3.30.5.2 EVN – Event Type Segment.

4.12.4.4.2.2.3 PID Segment (HL7 v2.5.1)

Most of the fields in the PID segment are optional, except those listed in Table 4.12-16. See ITI TF-2: 3.30.5.3 for a list of all of the fields of the PID segment.

Table 4.12-16: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	250	CX	R		00106	Patient Identifier List
5	250	XPN	R		00108	Patient Name

Adapted from the HL7 standard, version 2.5.1

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4.12.4.4.2.2.4 PV1 Segment (HL7 v2.5.1)

Most of the fields in the PV1 segment are optional, except those listed in Table 4.12-17. See ITI TF-2: 3.30.5.4 for a list of all of the fields of the PV1 segment.

Table 4.12-17: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
11	80	PL	O		00141	Temporary Location

Adapted from the HL7 standard, version 2.5.1

4.12.4.4.2.2.5 MRG Segment (HL7 v2.5.1)

The PID segment contains the dominant patient information, including Patient ID (and Issuer of Patient ID). The MRG segment identifies the “old” or secondary patient records to be de-referenced. HL7 does not require that the “old” record be deleted; it does require that the "incorrect" identifier not be referenced in future messages following the merge.

Table 4.12-18: IHE Profile - MRG segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	250	CX	R		00211	Prior Patient Identifier List
2	250	CX	O		00212	Prior Alternate Patient ID
3	250	CX	O		00213	Prior Patient Account Number
4	250	CX	R2		00214	Prior Patient ID
5	250	CX	O		01279	Prior Visit Number
6	250	CX	O		01280	Prior Alternate Visit ID
7	250	XPN	R2		01281	Prior Patient Name

Adapted from the HL7 Standard, version 2.5.1

A separate merge message shall be sent for each patient record to be merged. For example, if Patients A, B, and C are all to be merged into Patient B, two MRG messages would be sent. In the first MRG message patient B would be identified in the PID segment and Patient A would be identified in the MRG segment. In the second MRG message, patient B would be identified in the PID segment, and Patient C would be identified in the MRG segment. The visits and accounts of patients A and C will now belong to patient B’s record along with B’s original visits and accounts.

Modification of any patient demographic information shall be done by sending a Patient Update Information (ADT^A08^ADT_A01) message for the current Patient ID. An A40 message is the only method that may be used to update a Patient ID.

A new Patient shall be created in the Image Manager and the Report Manager using the demographics contained in the Patient Merge (A40) message when the prior Patient to be merged does not exist on the Image Manager. This shall be followed by a Patient Update Information

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(ADT^A08^ADT_A01) message to update any of the demographics missing in the Patient Merge (A40) message.

4.12.4.4.3 Expected Actions

It is expected that after receiving a Patient Merge message (A40) the receiving system will perform updates to reflect the fact that two patient records have been merged into a single record. If the correct target patient was not known to the receiving system, it is expected that the receiving system will create a patient record using the patient identifiers and demographics from the available PID segment data.

It is the responsibility of the Image Manager and the Report Manager to ensure that the patient information has been updated in the diagnostic reports and evidence objects (e.g., images, Key Image Notes, Grayscale Softcopy Presentation States, Evidence Documents, etc.) they manage when they are retrieved.

4.12.4.5 Patient Management – Cancel Patient Transfer/Discharge

4.12.4.5.1 Trigger Events

The following events will trigger one of the Cancel messages:

- A12 – Transfer of a patient from one location to another has been cancelled due to error in the information or the decision not to transfer the patient.
- A13 – Discharge of a patient has been cancelled due to error in the information or the decision not to discharge the patient.

4.12.4.5.2 Message Semantics

Patient Transfer/Discharge conveyed by the HL7 ADT^A02 or ADT^A03 messages may have to be revoked due to the errors in the information or the decision of not transferring/discharging patient. Cancellation transaction is conveyed by the HL7 ADT^A12 or ADT^A13 messages. ADT^A12 shall be used to revoke transaction conveyed by the ADT^A02 message. ADT^A13 shall be used to revoke the transaction conveyed by the ADT^A03 message.

Cancellation messages shall only be used if no other transactions were performed by the ADT on the patient record after the Patient Transfer/Discharge transaction was conveyed.

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of ADT message to its sender. See Section 2.4.3 “Acknowledgement Modes” for definition and discussion of the ACK message.

4.12.4.5.2.1 Message Semantics (HL7 v2.3.1)

The segments of the message listed below are required, and their detailed descriptions are provided in subsections below. All other segments are optional.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.3.

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ADT	Patient Administration Message	Chapter in HL7 2.3.1 and HL7 v2.5.1
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
PV1	Patient Visit	3

4.12.4.5.2.1.1 MSH Segment (HL7 v2.3.1)

MSH segment shall be constructed as defined in the Section 2.4.2.2 "Message Control".

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of "ADT"; the second component shall have values of A12 or A13 as appropriate. The third component is optional; however, if present, it shall have a value of ADT_A12 (for the A12 message) or ADT_A01 (for A13 message).

4.12.4.5.2.1.2 EVN Segment (HL7 v2.3.1)

See Section 4.1.4.1.2.1.2 for required and optional fields of the EVN segment.

4.12.4.5.2.1.3 PID Segment (HL7 v2.3.1)

All of the fields in PID segment are optional, except those listed in Table 4.12-19. See Section 4.1.4.1.2.1.3 for the list of all fields of the PID segment.

Table 4.12-19: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	20	CX	R		00106	Patient Identifier List
5	48	XPN	R		00108	Patient Name
18	20	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.3.1

4.12.4.5.2.1.4 PV1 Segment (HL7 v2.3.1)

All of the fields in PV1 segment are optional, except those listed in Table 4.12-20. See Section 4.1.4.1.2.1.4 for the list of all fields of the PV1segment.

Table 4.12-20: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	20	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.3.1

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At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued. Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF- 4).

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

4.12.4.5.2.2 Message Semantics (HL7 v2.5.1)

For HL7 v2.5.1, the messages used to communicate the Cancel Patient Transfer/Discharge messages are described in the following sections in the ITI Technical Framework:

- ITI TF-2: 3.31.7.12 Cancel Patient Transfer (ADT^A12^ADT_A12)
- ITI TF-2: 3.31.7.5 Cancel Discharge/End Visit (ADT^A13^ADT_A01)

4.12.4.5.2.2.1 MSH Segment (HL7 v2.5.1)

The MSH segment shall be constructed as defined in ITI TF-2: 3.30.5.1 MSH – Header Segment. Additional specifications for actors complying with the IHE Radiology Technical Framework are defined in Section 2.4.

Field *MSH-9-Message Type* shall have three components. The first component shall have a value of ADT. For the A12 message, the second component shall have a value of A12 and the third component shall have a value of ADT_A09. For the A13 message, the second component shall have a value of A13 and the third component shall have a value of ADT_A01.

4.12.4.5.2.2.2 EVN Segment (HL7 v2.5.1)

The EVN segment shall be constructed as defined in ITI TF-2: 3.30.5.2 EVN – Event Type Segment.

4.12.4.5.2.2.3 PID Segment (HL7 v2.5.1)

All of the fields in the PID segment are optional, except those listed in Table 4.12-21. See ITI TF-2: 3.30.5.3 for a list of all of the fields of the PID segment.

Table 4.12-21: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	250	CX	R		00106	Patient Identifier List
5	250	XPN	R		00108	Patient Name
18	250	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.5.1

4.12.4.5.2.2.4 PV1 Segment (HL7 v2.5.1)

Most of the fields in the PV1 segment are optional, except those listed in Table 4.12-22. See ITI TF-2: 3.30.5.4 for a list of all of the fields of the PV1 segment.

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Table 4.12-22: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	250	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.5.1

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued. Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is valued. It may be omitted otherwise.

4.12.4.5.3 Expected Actions

If the patient record was modified as a result of Patient Transfer/Discharge transaction, it shall be reverted.

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4.13 Procedure Update [RAD-13]

4.13.1 Scope

This transaction involves changes to procedure information communicated from the Department System Scheduler to the Image Manager and Report Manager. Unlike the order message sent between the Order Placer and Order Filler (where only the order status can be updated without requiring a Cancel/New Order to change an order), the ORM or OMI message from the Department System Scheduler/Order Filler and Image Manager may reference a previously scheduled Requested Procedure identified by a Study Instance UID.

The organization operating the DSS/OF and the Image Manager/Image Archive is responsible for synchronizing Procedure and Protocol Codes between all the systems that use such codes. IHE does not yet define a common mechanism for code synchronization or access.

4.13.2 Actor Roles

Actor: Department System Scheduler/Order Filler

Role: Responsible for scheduling placed orders and sending the timing, resource, procedure and other information to the Image Manager.

Actor: Image Manager

Role: May use the scheduling, resource, procedure, and other information to perform image management tasks such as auto routing or pre fetching of images.

Actor: Report Manager

Role: May use the scheduling, resource, procedure, and other information to perform detailed report scheduling tasks.

4.13.3 Referenced Standards

HL7 v2.3.1 Chapters 2, 4

HL7 v2.5.1 Chapters 2, 4

4.13.4 Messages

The following diagrams illustrate interactions between actors implementing HL7 v2.3.1:

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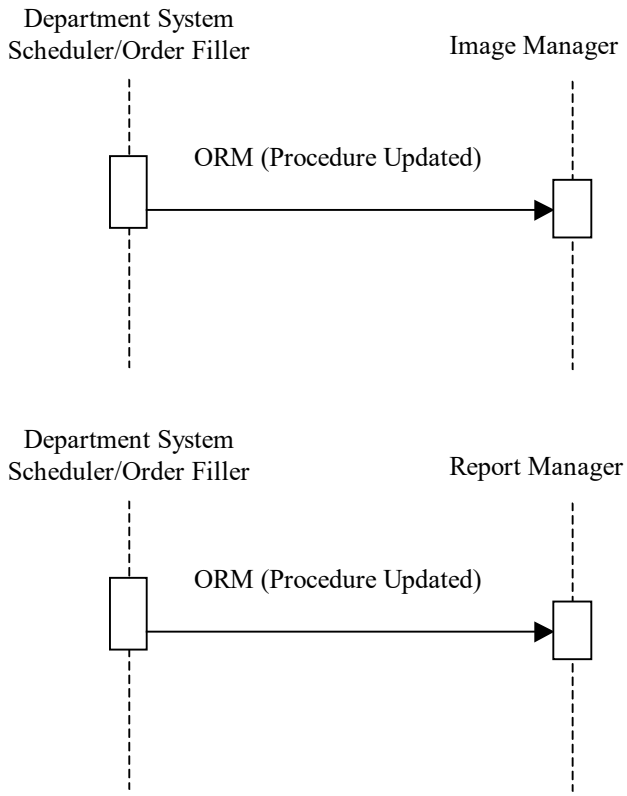
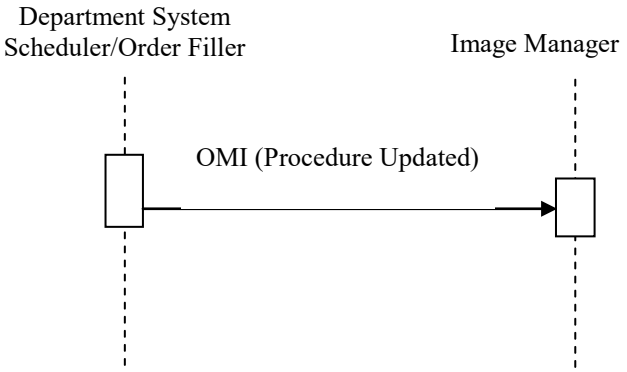


Figure 4.13.4-1: Interactions between actors implementing HL7 v2.3.1

The following diagram illustrates interactions between actors implementing HL7 v2.5.1:



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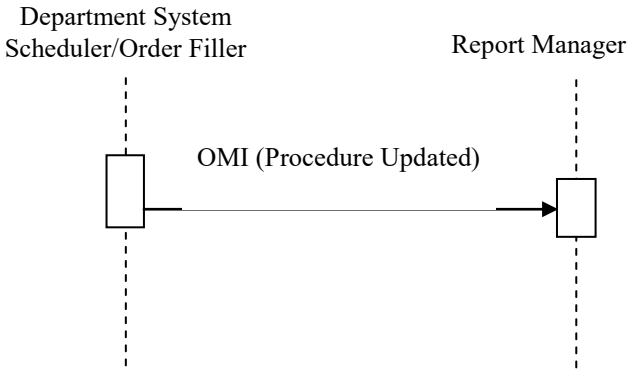

Figure 4.13.4-2: Interactions between actors implementing HL7 v2.5.1

4.13.4.1 Trigger Events

A Procedure Update transaction is triggered in the case when the Department System Scheduler cancels, re-schedules or modifies characteristics of the procedure it previously scheduled and transmitted to the Image Manager and Report Manager via a Procedure Scheduled [RAD-4] transaction.

4.13.4.2 Message Semantics

4.13.4.2.1 Message Semantics (HL7 v2.3.1)

The Procedure Update transaction is conveyed by the HL7 ORM message formatted according to the rules described in Section 4.4.

The following Order Control Codes and Order Statuses are applicable for use in the *ORC-1* and *ORC-5* fields respectively.

Table 4.13-1: IHE Profile - Required Order Control Codes and Order Statuses

ORC-1 Value	ORC-1 Description	Originator	ORC-5 Value
CA	Cancel order request	DSS	CA
DC	Discontinue order request	DSS	CA
XO	Change order request, order is still scheduled or in progress	DSS	SC
XO	Change order request, order has been completed	DSS	CM

Adapted from the HL7 Standard, version 2.3.1

The value of the field *ORC-5 Order Status* shall reflect status of the underlying order. If the order has been cancelled by either the Order Placer or the Order Filler, the value in the field *ORC-5* shall be set to 'CA'. In particular, if the field *ORC-1* is sent with the values of 'CA' or 'DC', the field *ORC-5* will be valued as 'CA'. If the order is changed and is still scheduled or in progress, *ORC-1 is* set to 'XO' and *ORC-5* will be valued as 'SC'.

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If the order is changed and has been completed, *ORC-1* is set to 'XO' and *ORC-5* will be valued as 'CM'. (This is done by the DSS/OF to update or synchronize procedure information with the IM/IA in the case the modality performed a procedure other than what was originally requested).

Only procedural information that is conveyed in the OBR and ORC segments of the message may be changed. Any updates of patient or visit information shall be performed by the Patient Update [RAD-12] transaction (see Sections 4.1 and 4.12 for PID and PV1 information and updates).

All (ORC, OBR) segment pairs sent in the Procedure Scheduled message shall be present in the Procedure Update message, not only the pairs introducing a change.

The ORC and OBR elements given in Table 4.13-2 shall not be altered after the initial Procedure Scheduled (Section 4.4), regardless of the type of control code.

Table 4.13-2: Procedure Update Elements that shall not be changed

Element Name	Element Number(s)
Placer Order Number	OBR-2, ORC-2
Filler Order Number	OBR-3, ORC-3
Placer Group Number	ORC-4
Study Instance UID	ZDS-1

Any other elements in the OBR or ORC segments may be changed when the Order Control Code = XO.

Note: Additional information regarding HL7 conventions, profiling, and implementation considerations are given in Section 2.3.

4.13.4.2.2 Message Semantics (HL7 v2.5.1)

The Procedure Update message is conveyed by the HL7 OMI message formatted according to the rules described in Section 4.4.

The following Order Control Codes and Order Statuses are applicable for use in the *ORC-1* and *ORC-5* fields respectively.

Table 4.13-3: IHE Profile - Required Order Control Codes and Order Statuses

ORC-1 Value	ORC-1 Description	Originator	ORC-5 Value
CA	Cancel order request	DSS	CA
DC	Discontinue order request	DSS	CA
XO	Change order request, order is still scheduled or in progress	DSS	SC
XO	Change order request, order has been completed	DSS	CM

Adapted from the HL7 Standard, version 2.5.1

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The value of field *ORC-5-Order Status* shall reflect the status of the underlying order. If the order has been cancelled by either the Order Placer or the Order Filler, the value in field ORC-5 shall be set to CA. In particular, if field ORC-1 is sent with a value of CA or DC, field ORC-5 shall be valued CA. If the order is changed and is still scheduled or in progress, ORC-1 shall be valued XO and ORC-5 shall be valued SC.

If the order is changed and has been completed, ORC-1 shall be valued XO and *ORC-5* shall be valued CM. (This is done by the DSS/OF to update or synchronize procedure information with the IM/IA in the case the modality performed a procedure other than what was originally requested.)

Only procedural information that is conveyed in the OBR and ORC segments of the message may be changed. Any updates of patient or visit information shall be performed by the Patient Update [RAD-12] transaction (see Sections 4.1 and 4.12 for PID and PV1 information and updates).

All ORC-TQ1-OBR-IPC segment groups sent in the Procedure Scheduled message shall be present in the Procedure Update message, not only the pairs introducing a change.

The ORC and OBR elements given in Table 4.13-4 shall not be altered after the initial Procedure Scheduled message (Section 4.4), regardless of the type of control code.

Table 4.13-4: Procedure Update Elements that shall not be changed

Element Name	Element Number(s)
Placer Order Number	OBR-2, ORC-2
Filler Order Number	OBR-3, ORC-3
Placer Group Number	ORC-4
Study Instance UID	IPC-3

Any other elements in the OBR or ORC segments may be changed when the Order Control Code = XO.

Note: Additional information regarding HL7 conventions, profiling, and implementation considerations are given in Section 2.3.

4.13.4.3 Expected Actions

The Image Manager and Report Manager are expected to perform the following actions based on the value of the field *ORC-1 Order Control Code*:

CA – Procedure has been cancelled, usually due to the cancellation of the underlying order; the Image Manager and the Report Manager shall inactivate corresponding procedure information using Study Instance UID as a unique key of the Requested Procedure in question. Information from PID and PV1 segments shall not be used to update patient or visit information. If the Department System Scheduler/Order Filler has been notified that a Performed Procedure Step is in progress for a Requested Procedure, the order control code DC shall be used.

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XO – Procedure-related information (including scheduled date/time and/or resource) has been changed. The Image Manager and Report Manager shall modify corresponding procedure information using the Study Instance UID as a unique key of the procedure in question. Information from PID and PV1 segments shall not be used to update patient or visit information.

DC – Order to which the particular procedure is related has been discontinued after at least one Performed Procedure Step for this procedure has started. The Image Manager and the Report Manager shall consider all remaining SPS known for that procedure (if any) cancelled. The Image Manager shall use the Study Instance UID as a unique key of the procedure in question. Information from PID and PV1 segments shall not be used to update patient information.

4.14 Query Images [RAD-14]

4.14.1 Scope

The Image Display queries the Image Archive for study, series and image instances for retrieval.

4.14.2 Actor Roles

Actor: Image Archive

Role: Responds to queries for Studies, Series, and Images.

Actor: Image Display

Role: Issues Queries for Studies, Series, Images

4.14.3 Referenced Standards

DICOM PS3.4 Annex C: Query/Retrieve Service Class

4.14.4 Messages

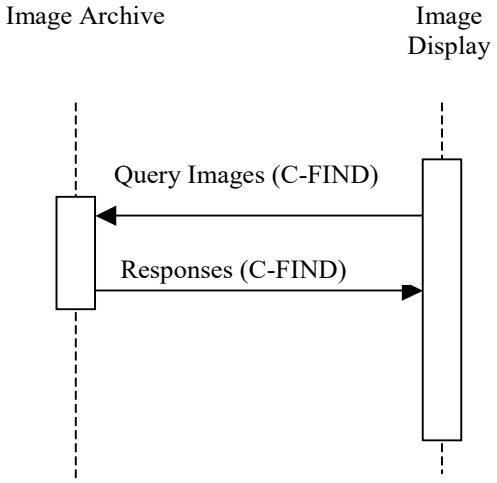

Figure 4.14.4-1: Interaction Diagram

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4.14.4.1 Query Images

The Query (Study Root – FIND and optionally Patient Root – FIND) SOP Classes shall be supported. Refer to DICOM PS3.4 Annex C for detailed descriptive semantics.

4.14.4.1.1 Trigger Events

The user at the Image Display wishes to view selected images.

4.14.4.1.2 Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes.

A C-FIND Request from the DICOM Study Root Query/Retrieve Information Model – FIND SOP Class or optionally the DICOM Patient Root Query/Retrieve Information Model – FIND SOP Class shall be sent from the Image Display to the Image Archive. Hierarchical Search Method shall be supported.

The Image Display (SCU) shall be able to perform at least Study and Series level queries. The Image Manager (SCP) shall support Study, Series, Composite Object Instance and Image Specific level queries.

The Image Display uses one or more matching keys as search criteria to obtain the list of matching entries in the Image Archive at the selected level (Patient & Study/Series/Image). Based on this list of entries, the Image Display may select relevant entries to be retrieved.

The matching keys and return keys to be supported by the Image Display (SCU) and the Image Manager (SCP) are defined in Table 4.14-1 and Table 4.14-2 below. The table includes the definition of return and matching keys specified by DICOM. The table specifies for both the Query SCU (Image Display) and the Query SCP (Image Archive) whether Matching Keys (keys used as matching criteria in the Query request) and Returned Keys (Keys used to request attributes to be returned in the query responses) are Required (R) or Optional (O). Requirements indicated with R+ or R+* highlight the requirements added by the IHE Radiology Technical Framework. See Section 2.2 for more information on the notation in these tables.

Table 4.14-1: Images Query Matching and Return Keys

Attributes Name	Tag	Query Keys Matching		Query Keys Return		Notes
		SCU	SCP	SCU	SCP	
Study Level						
Study Date	(0008,0020)	R+	R	R+	R	
Study Time	(0008,0030)	R+	R	R+	R	
Accession Number	(0008,0050)	R+	R	R+	R	
Issuer of Accession Number Sequence	(0008,0051)	O	O	O	O	IHE-7, IHE-8
>Local Namespace Entity ID	(0040,0031)	O	O	O	O	IHE-7, IHE-8
>Universal Entity ID	(0040,0032)	O	O	O	O	IHE-7, IHE-8

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Attributes Name	Tag	Query Keys Matching		Query Keys Return		Notes
		SCU	SCP	SCU	SCP	
>Universal Entity ID Type	(0040,0033)	O	O	O	O	IHE-7, IHE-8
Patient Name	(0010,0010)	R+	R	R+	R	IHE-1, IHE-2
Patient ID	(0010,0020)	R+	R	R+	R	
Issuer of Patient ID	(0010,0021)	O	O	O	O	IHE-7, IHE-8
Issuer of Patient ID Qualifiers Sequence	(0010,0024)	O	O	O	O	IHE-7, IHE-8
>Universal Entity ID	(0040,0032)	O	O	O	O	IHE-7, IHE-8
>Universal Entity ID Type	(0040,0033)	O	O	O	O	IHE-7, IHE-8
Other Patient IDs Sequence	(0010,1002)	O	O	O	O	IHE-7, IHE-8
>Patient ID	(0010,0020)	O	O	O	O	IHE-7, IHE-8
>Issuer of Patient ID	(0010,0021)	O	O	O	O	IHE-7, IHE-8
>Issuer of Patient ID Qualifiers Sequence	(0010,0024)	O	O	O	O	IHE-7, IHE-8
>>Universal Entity ID	(0040,0032)	O	O	O	O	IHE-7, IHE-8
>>Universal Entity ID Type	(0040,0033)	O	O	O	O	IHE-7, IHE-8
>Type of Patient ID	(0010,0022)	O	O	O	O	IHE-7, IHE-8
Study ID	(0020,0010)	R+	R	R+	R	
Study Instance UID	(0020,000D)	R+*	R	R+*	R	IHE-5
Modalities in Study	(0008,0061)	R+	R+	R+	R+	
Referring Physician's Name	(0008,0090)	R+	R+	R+	R+	IHE-1, IHE-2
Study Description	(0008,1030)	O	O	O	O	IHE-6
Procedure Code Sequence	(0008,1032)					
>Code Value	(0008,0100)	O	O	O	O	
>Coding Scheme Designator	(0008,0102)	O	O	O	O	
>Coding Scheme Version	(0008,0103)	O	O	O	O	
>Code Meaning	(0008,0104)	O	O	O	O	
Name of Physician(s) Reading Study	(0008,1060)	O	O	O	O	IHE-1, IHE-2
Admitting Diagnoses Description	(0008,1080)	O	O	O	O	
Referenced Study Sequence	(0008,1110)					

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Attributes Name	Tag	Query Keys Matching		Query Keys Return		Notes
		SCU	SCP	SCU	SCP	
>Referenced SOP Class UID	(0008,1150)	O	O	O	O	
>Referenced SOP Instance UID	(0008,1155)	O	O	O	O	
Referenced Patient Sequence	(0008,1120)					
>Referenced SOP Class UID	(0008,1150)	O	O	O	O	
>Referenced SOP Instance UID	(0008,1155)	O	O	O	O	
Patient's Birth Date	(0010,0030)	O	O	R+	R+	
Patient's Birth Time	(0010,0032)	O	O	O	O	
Patient's Sex	(0010,0040)	O	O	R+	R+	
Other Patient IDs	(0010,1000)	O	O	O	O	
Other Patient Names	(0010,1001)	O	O	O	O	IHE-1, IHE-2
Patient's Age	(0010,1010)	O	O	O	O	
Patient's Size	(0010,1020)	O	O	O	O	
Patient's Weight	(0010,1030)	O	O	O	O	
Ethnic Group	(0010,2160)	O	O	O	O	
Occupation	(0010,2180)	O	O	O	O	
Additional Patient History	(0010,21B0)	O	O	O	O	
Patient Comments	(0010,4000)	O	O	O	O	
Other Study Numbers	(0020,1070)	O	O	O	O	
Number of Patient Related Studies	(0020,1200)	N/A	N/A	O	O	
Number of Patient Related Series	(0020,1202)	N/A	N/A	O	O	
Number of Patient Related Instances	(0020,1204)	N/A	N/A	O	O	
Number of Study Related Series	(0020,1206)	N/A	N/A	O	R+	
Number of Study Related Instances	(0020,1208)	N/A	N/A	O	R+	
Interpretation Author	(4008,010C)	O	O	O	O	IHE-1, IHE-2
Series Level						
Modality	(0008,0060)	R+	R	R+	R	
Series Number	(0020,0011)	R+	R	R+	R	
Series Instance UID	(0020,000E)	R+*	R	R+*	R	IHE-5
Number of Series Related Instances	(0020,1209)	N/A	N/A	O	R+	

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Attributes Name	Tag	Query Keys Matching		Query Keys Return		Notes
		SCU	SCP	SCU	SCP	
Series Description	(0008,103E)	O	O	R+	R+	
Performed Procedure Step ID	(0040, 0253)	O	O	O	O	
Referenced Performed Procedure Step Sequence	(0008,1111)					
>Referenced SOP Class UID	(0008,1150)	O	O	O	O	
>Referenced SOP Instance UID	(0008,1155)	O	O	O	O	
Request Attribute Sequence	(0040, 0275)					IHE-3
>Requested Procedure ID	(0040,1001)	R+	R+	R+	R+	
>Scheduled Procedure Step ID	(0040,0009)	R+	R+	R+	R+	
Performed Procedure Step Start Date	(0040,0244)	R+	R+	R+	R+	
Performed Procedure Step Start Time	(0040,0245)	R+	R+	R+	R+	
Body Part Examined	(0018,0015)	O	O	O	O	
Institution Name	(0008,0080)	O	O	O	O	IHE-7, IHE-8
Institution Address	(0008,0081)	O	O	O	O	IHE-7, IHE-8
Institution Code Sequence	(0008,0082)	O	O	O	O	IHE-7, IHE-8
>Code Value	(0008,0100)	O	O	O	O	IHE-7, IHE-8
>Coding Scheme Designator	(0008,0102)	O	O	O	O	IHE-7, IHE-8
>Code Meaning	(0008,0104)	O	O	O	O	IHE-7, IHE-8
Composite Object Instance Level						
Instance Number	(0020,0013)	O	R	O	R	
SOP Instance UID	(0008,0018)	O	R	O	R	
SOP Class UID	(0008,0016)	O	R+	O	R+	IHE-4

Table 4.14-2 extends the table above with image-specific keys.

5255 **Table 4.14-2: Image Specific Query Matching and Return Keys**

Attribute Name	Tag	Query Keys Matching		Query Keys Return		Notes
		SCU	SCP	SCU	SCP	
Image Specific Level						
Rows	(0028,0010)	O	O	O	R+	

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Attribute Name	Tag	Query Keys Matching		Query Keys Return		Notes
		SCU	SCP	SCU	SCP	
Columns	(0028,0011)	O	O	O	R+	
Bits Allocated	(0028,0100)	O	O	O	R+	
Number of Frames	(0028,0008)	O	O	O	R+	

The SCP is required (R+) to support the query return key elements: Rows, Columns, Bits Allocated and Number of Frames for calculating the storage size needed for retrieving (storing) the images. Furthermore, the image Bits Allocated is used in matching the image pixel bit depth to the Hard Copy Device (Printer) pixel bit depth.

- **IHE-1:** Case insensitive matching is allowed for attributes of VR PN per DICOM.
- **IHE-2:** SCUs are recommended to append wildcard "*" at the end of each component of any structured name to facilitate matching (i.e., PN attributes).
- **IHE-3:** Universal Matching (selecting return keys) against an Attribute of VR SQ, may be requested by the Query SCU using a Zero Length Sequence Attribute. Query SCPs shall accept such Universal Match Requests. In addition, Query SCPs are required by the DICOM Standard to support requests for a Universal Match for an SQ attribute encoded as a zero-length item.
- **IHE-4:** A SOP Class UID is a non-ambiguous key to identify a specific type of image (Modality is not).
- **IHE-5:** SCUs shall be able to include Study and Series UIDs as Matching Keys in queries. UID values will most probably originate from actor-internal logic that was performed prior to the Image Query, not from direct user input. For instance, an Image Display wants to display images of a series that is referenced in a DICOM Presentation State instance it just has retrieved - it includes the Series Instance UID value from the Presentation State as a query matching key.
- **IHE-6:** Study Description as a Return Key shall be supported as R+ by SCUs and SCPs in the SWF.b Profile.
- **IHE-7:** Image Displays that support the Enterprise Identity Option shall request Institution Name, Institution Address, Institution Code Sequence, Issuer of Accession Number Sequence, Issuer of Patient ID, Issuer of Patient ID Qualifiers Sequence and Other Patient IDs Sequence. See Section 4.14.4.1.2.1.
- **IHE-8:** Image Managers that support the Enterprise Identity Option shall provide the Institution Name, Institution Address, Institution Code Sequence, Issuer of Accession Number Sequence, Issuer of Patient ID, Issuer of Patient ID Qualifiers Sequence and Other Patient IDs Sequence upon request by an SCU. See Section 4.14.4.1.2.1.

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4.14.4.1.2.1 Enterprise Identity Option

An Image Display and Image Manager supporting the Enterprise Identity Option shall implement the requirements in this section.

An Image Display shall request additional return keys in queries. Table 4.14-3 contains attributes for the Query Return Keys that have optionality R+* (rather than O) for an SCU in Table 4.14-1.

An Image Manager shall provide the additional return keys in queries upon request from the SCU. Table 4.14-3 contains attributes for the Query Return Keys that have an optionality R+* (rather than O) for the SCP in Table 4.14-1.

Table 4.14-3: Query Return Keys for Enterprise Identity Option

Return Key Attributes	Tag
Issuer of Accession Number Sequence	(0008,0051)
>Local Namespace Entity ID	(0040,0031)
>Universal Entity ID	(0040,0032)
>Universal Entity ID Type	(0040,0033)
Issuer of Patient ID	(0010,0021)
Issuer of Patient ID Qualifiers Sequence	(0010,0024)
>Universal Entity ID	(0040,0032)
>Universal Entity ID Type	(0040,0033)
Other Patient IDs Sequence	(0010,1002)
>Patient ID	(0010,0020)
>Issuer of Patient ID	(0010,0021)
>Issuer of Patient ID Qualifiers Sequence	(0010,0024)
>>Universal Entity ID	(0040,0032)
>>Universal Entity ID Type	(0040,0033)
>Type of Patient ID	(0010,0022)
Institution Name	(0008,0080)
Institution Address	(0008,0081)
Institution Code Sequence	(0008,0082)
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)
>Code Meaning	(0008,0104)

An Image Display shall support additional matching keys in queries. Table 4.14-4 contains attributes for the Query Matching Keys that have optionality R+* (rather than O) for an SCU in Table 4.14-1.

An Image Manager shall perform matching for the additional matching keys in queries upon request from the SCU. Table 4.14-4 contains attributes for the Query Matching Keys that have an optionality R+* (rather than O) for an SCP in Table 4.14-1.

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Table 4.14-4: Query Matching Keys for Enterprise Identity Option

Matching Key Attributes	Tag
Issuer of Accession Number Sequence	(0008,0051)
>Local Namespace Entity ID	(0040,0031)
>Universal Entity ID	(0040,0032)
>Universal Entity ID Type	(0040,0033)
Issuer of Patient ID	(0010,0021)

4.14.4.1.3 Expected Actions

The Image Archive receives the C-FIND request, performs the matching on the provided keys and sends the list of matching records back to the Image Display via C-FIND responses. It is the responsibility of the Image Manager to ensure that the patient and procedure information is current in the images when they are retrieved from the Image Archive. The patient and procedure information are updated through transactions [RAD-12] and [RAD-13].

This means the Image Display may receive patient data inconsistent with those received from a previously issued query or retrieve operation. For example, in the event that a patient has been renamed, the Image Display will receive images with the same Study Instance UID, Series Instance UID and SOP Instance UIDs, but with a different patient name. The Image Display shall use the just queried information or the most recently received instances to ensure that the most recent patient data from the Image Manager/Archive is displayed.

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4.15 Query Presentation States [RAD-15]

4.15.1 Scope

This section describes the sequence of messages required for the Image Display to query the Image Archive for instances of Grayscale Softcopy Presentation States. The Image Display will query and then retrieve Presentation State objects together with the image data referenced in the return keys supplied in the response from the Image Archive or referenced in the Presentation State object. The transformations will be applied by the Image Display to the image data to assure the image display is consistent with the device that originally created and stored the Presentation State. The Image Display will be required to support all transformations defined in DICOM PS3.4: Grayscale Softcopy Presentation State Storage. In addition, multiple Presentation States may exist that reference the same image data.

4.15.2 Actor Roles

Actor: Image Display

Role: Query for Grayscale Softcopy Presentation State objects together with the referenced image data and apply the transformations specified by the Presentation State. This actor must support pixel rendering according to the Grayscale Standard Display Function (GSDF) defined in DICOM PS3.14 Section 7. This device will implement the Query/Retrieve SOP Classes in the role of SCU.

Actor: Image Archive

Role: Respond to queries from the Image Display for Grayscale Softcopy Presentation States objects. This device will implement the Query/Retrieve SOP Classes in the role of SCP.

4.15.3 Referenced Standards

DICOM PS3.4 Annex C: Query/Retrieve Service Class

DICOM PS3.14: Grayscale Standard Display Function

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4.15.4 Messages

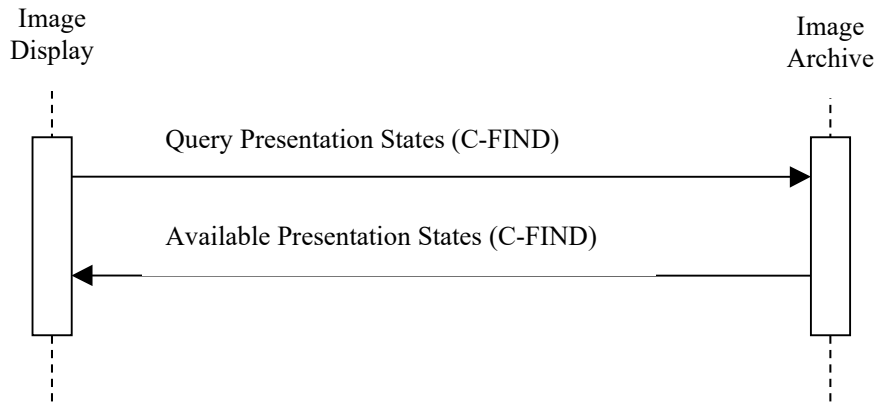

Figure 4.15.4-1: Interaction Diagram

4.15.4.1 Query for Grayscale Softcopy Presentation States

The Query (Study Root – FIND and optionally Patient Root – FIND) SOP Classes will be supported. Refer to DICOM PS3.4 Annex C: Query/Retrieve Service Class for detailed descriptive semantics.

4.15.4.1.1 Trigger Events

The user of the Image Display wishes to query instances of Grayscale Softcopy Presentation States.

4.15.4.1.2 Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes: A C-FIND Request from the DICOM Study Root Query/Retrieve Information Model – FIND SOP Class or the optional DICOM Patient Root Query/Retrieve Information Model – FIND SOP Class. The C-FIND request shall be sent from the Image Display to the Image Archive.

The matching keys and return keys to be supported by the Image Display (SCU) and the Image Archive (SCP) at the Study and Series level are defined in Table 4.14-1.

Table 4.15-1 below specifies for both the Query SCU (Image Display) and the Query SCP (Image Archive), additional Matching Keys (keys used as matching criteria in the Query request) and Return Keys (keys used to request attributes to be returned in the query responses) that are Required ("R") or Optional ("O"), specific (or pertaining) to Presentation State. See Section 2.2 for more information.

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Table 4.15-1: Presentation State Specific Query Matching and Return Keys

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
Content Label	(0070,0080)	O	O	R+	R+
Content Description	(0070,0081)	O	O	O	R+
Presentation Creation Date	(0070,0082)	O	O	R+	R+
Presentation Creation Time	(0070,0083)	O	O	R+	R+
Content Creator's Name	(0070,0084)	O	O	R+	R+
Referenced Series Sequence	(0008,1115)				
>Series Instance UID	(0020,000E)	O	O	O	R+
>Referenced Image Sequence	(0008,1140)				
>>Referenced SOP Class UID	(0008,1150)	O	O	O	R+
>>Referenced SOP Instance UID	(0008,1155)	O	O	O	R+

4.15.4.1.3 Expected Actions

The Image Archive receives the C-FIND request, matches on the provided keys and sends the list of matching records back to the Image Display via C-FIND responses. It is the responsibility of the Image Manager to ensure that the patient and procedure information is current in the images and Softcopy Presentation State objects when they are retrieved from the Image Archive. The patient and procedure information is updated through transactions [RAD-12] and [RAD-13].

This means the Image Display may receive patient data inconsistent with those received from a previously issued query or retrieve operation. For example, in the event that a patient has been renamed, the Image Display will receive Softcopy Presentation State objects with the same Study Instance UID, Series Instance UID and SOP Instance UIDs, but with a different patient name. The Image Display shall use the just queried information or the most recently received instances to ensure that the most recent patient data from the Image Manger/Archive is displayed.

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4.16 Retrieve Images [RAD-16]

4.16.1 Scope

After the Image Display or Imaging Document Consumer request for image retrieval, the requested DICOM Images are transferred from the Image Archive to the Image Display or from the Imaging Document Source to the Imaging Document Consumer for viewing.

4.16.2 Actor Roles

Actor: Image Archive

Role: Sends requested images to the Image Display.

Actor: Imaging Document Source:

Role: Sends requested images to the Imaging Document Consumer.

Actor: Image Display

Role: Receives requested images from the Image Archive.

Actor: Imaging Document Consumer

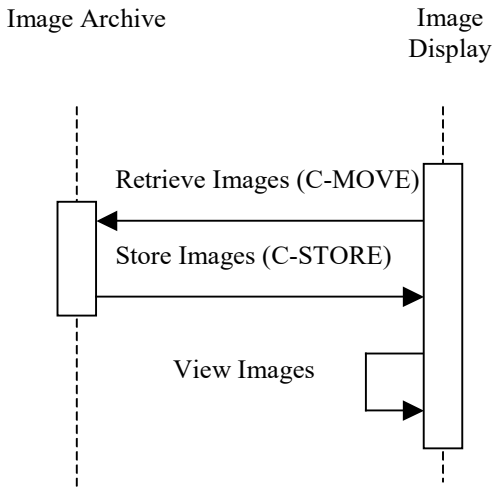
Role: Receives requested images from the Imaging Document Source.

4.16.3 Referenced Standards

DICOM PS3.4 Annex B: Storage Service Class

DICOM PS3.4 Annex C: Query/Retrieve Service Class

4.16.4 Messages



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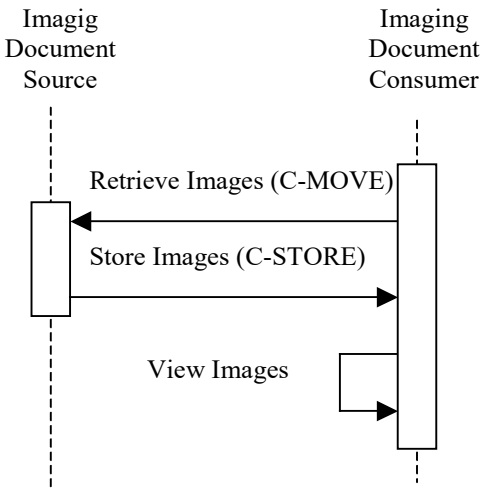

Figure 4.16.4-1: Interaction Diagram

4.16.4.1 Retrieve Images

The Retrieve (Study Root – MOVE and optionally Patient Root – MOVE) SOP Classes shall be supported. The DICOM Image Storage SOP Classes will be supported by the Image Archive or Imaging Document Source as an SCU. Refer to DICOM PS3.4 Annex C, for detailed descriptive semantics.

In the case of retrieving images in a Cross-Enterprise, imaging document sharing (XDS-I) network environment, a configuration of mapping the AE Titles to DICOM AE Network Addresses (IP Address and Port number) are needed to be exchanged between the Imaging Document Source and the Imaging Document Consumer. RAD TF-2x: Appendix G describes in detail the AE Title mapping to the DICOM AE Network Addresses.

4.16.4.1.1 Trigger Events

Images are selected for viewing at the Image Display or Imaging Document Consumer.

4.16.4.1.2 Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes and the DICOM Image Storage SOP Classes.

A C-MOVE Request from the DICOM Study Root Query/Retrieve Information Model – MOVE SOP Class or the DICOM Patient Root Query/Retrieve Information Model – MOVE SOP Class shall be sent from the Image Display to the Image Archive or from the Imaging Document Consumer to the Imaging Document Source.

4.16.4.1.3 Expected Actions

The Image Archive or Imaging Document Source receives the C-MOVE request, establishes a DICOM association with the Image Display or Imaging Document Consumer, respectively, and uses the appropriate DICOM Image Storage SOP Classes to transfer the requested images. The

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Image Display or Imaging Document Consumer is expected to support at least one of the SOP Classes specified in Table 4.8-1. It is assumed that support of retrieval for a SOP Class also means support for display.

4.16.4.1.3.1 NM Image Profile

Image Manager/Image Archive, Imaging Document Source, Image Displays and Imaging Document Consumer Actors that claim the NM Image Profile shall support all the SOP Classes specified in Table 4.8-3 in Section 4.8.

4.16.4.1.3.2 Mammography Image Profile

Image Manager/Image Archive Actors supporting the Mammography Image Profile shall support all the SOP Classes specified in Table 4.16.4.1.3.2-1.

An Image Display supporting the Mammography Image Profile shall support all the SOP Classes specified in Table 4.16.4.1.3.2-1.

Table 4.16.4.1.3.2-1: Mammography SOP Classes for Display

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.1.2	Digital Mammography Image Storage – For Presentation

Note that Image Displays are not required to support "For Processing" images.

4.16.4.1.3.3 Basic Image Review Profile

This section is currently in the Basic Image Review (BIR) Trial Implementation Supplement.

4.16.4.1.3.4 MR Diffusion Imaging Profile

This section is currently in the MR Diffusion Imaging (DIFF) Trial Implementation Supplement.

4.16.4.1.3.5 CT/MR Perfusion Imaging with Contrast Profile

This section is currently in the CT/MR Perfusion Imaging (PERF) Trial Implementation Supplement,.

4.16.4.1.3.6 Stereotactic Mammography Image Profile

This section is currently in the Stereotactic Mammography Image (SMI) Trial Implementation Supplement.

4.16.4.1.3.7 Digital Breast Tomosynthesis Profile

Image Display and Image Manager/Image Archive Actors in the Digital Breast Tomosynthesis Profile shall support retrieval of the SOP Classes with the optionality specified in Table 4.16.4.1.3.7-1.

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Table 4.16.4.1.3.7-1: DBT SOP Classes for Retrieval

SOP Class UID	SOP Class Name	Optionality (Image Display)	Optionality (Image Manager/Image Archive)
1.2.840.10008.5.1.4.1.1.13.1.3	Breast Tomosynthesis Image Storage	R	R
1.2.840.10008.5.1.4.1.1.1.2	Digital Mammography X-Ray Image Storage – For Presentation	R	R
1.2.840.10008.5.1.4.1.1.1.2.1	Digital Mammography X-Ray Image Storage – For Processing	O	R
1.2.840.10008.5.1.4.1.1.13.1.4	Breast Projection X-Ray Image Storage – For Presentation (Note 1)	O	O
1.2.840.10008.5.1.4.1.1.13.1.5	Breast Projection X-Ray Image Storage – For Processing (Note 2)	-	O

Note 1: Support for Breast Projection X-Ray Image Storage – For Presentation SOP Class is required if the For Presentation Breast Projection X-Ray Image Option is supported.

Note 2: Support for Breast Projection X-Ray Image Storage –For Processing SOP Classes is required if the For Processing Breast Projection X-Ray Image Option is supported.

Image Displays may support the transfer syntaxes listed in Table 4.8.4.1.2.7-4.

Image Displays are only expected to support a single traversal of a volume stored in a Breast Tomosynthesis Image Storage instance (i.e., Image Position (Patient) (0020, 0032) has a different value for each frame).

Image Manager/ Image Archives participating in the Digital Breast Tomosynthesis Profile shall support the compression transfer syntaxes as listed in Table 4.8.4.1.2.7-4 for retrieval.

4.16.4.2 View Images

This transaction relates to the "View Images" event of the above interaction diagram.

4.16.4.2.1 Trigger Events

The Image Display or Imaging Document Consumer is requested to be capable to display the images.

4.16.4.2.2 Invocation Semantics

This is a local invocation of functions at the Image Display or Imaging Document Consumer.

4.16.4.2.2.1 Display of Digital X-Ray, Mammo and Intra-Oral Images

For the Breast Tomosynthesis Image, "For Presentation" variant of the Digital X-Ray Image, the Digital Mammography X-Ray Image, the Breast Projection X-Ray Image, and the Digital Intra-oral X-Ray Image, the Image Display or Imaging Document Consumer shall have both the capability to apply all the transformations specified by the VOI LUT Sequence (0028,3010) and the capability to apply all the transformations specified by the Window Width

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(0028,1051)/Window Center (0028,1050)/VOI LUT Function (0028,1056) attributes as selected by the user from the choices available (e.g., guided by Window Center/Width Explanation (0028,1055) or LUT Explanation (0028,3003). These attributes may be nested in a Functional Groups Sequence depending on the SOP Class,

If VOI LUT Function (0028,1056) is absent, then Window Width (0028,1051)/Window Center (0028,1050) shall be assumed to be the parameters of a linear window operation. VOI LUT Function (0028,1056) values of "SIGMOID" and "LINEAR" shall be supported.

The Image Display or Imaging Document Consumer shall support the application of LUT Data (0028,3006) in items of the VOI LUT Sequence (0028,3010) regardless of the Value Representation (i.e., the DICOM standard allows either OW or US Value Representation).

The Image Display or Imaging Document Consumer must also support pixel rendering according to the Grayscale Standard Display Function (GSDF) defined in DICOM PS3.14, because the output values of these images are always P-Values.

If the DICOM image is referenced by other DICOM composite objects, such as Grayscale Softcopy Presentation States, it is optional for the Image Display or Imaging Document Consumer to actually retrieve and display/apply these objects.

4.16.4.2.2.1.1 Display of Digital Mammography Images

The contents of this section are required for Image Display claiming the Mammography Image Profile.

The following requirements are intended to establish a baseline level of capabilities. Providing more intelligent and advanced capabilities is both allowed and encouraged and the profile is not intended to be limiting in any way with respect to capabilities. The intention is not to dictate implementation details.

All mammography Image Displays shall support the Retrieve Images transaction for "For Presentation" images.

The Image Display shall be capable of displaying simultaneously a set of current and prior conventional four view screening mammogram images (left and right CC and MLO views), regardless of whether these images are in one or multiple DICOM Series.

An Image Display that supports the Mammography Image Profile shall support calibration as described in the DICOM Grayscale Standard Display Function (GSDF). The minimum and maximum luminance of the display shall be configurable by the site, within the gamut of the device, for the purpose of conforming to local, regional or national regulatory and other requirements for luminance settings throughout the organization. For example, a site may require that all Image Displays used for primary interpretation be calibrated to the same minimum and maximum luminance.

4.16.4.2.2.1.1.1 Background Air Suppression

Image Displays shall be capable of recognizing pixels that have the value specified in Pixel Padding Value (0028,0120) when present alone, and between Pixel Padding Value (0028,0120)

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and Pixel Padding Range Limit (0028,0121) inclusive when both elements are present, and setting them to a minimum display value that is not affected by image contrast adjustments, including inversion of the image contrast.

4.16.4.2.2.1.1.2 Image Orientation and Justification

Image Displays shall not assume that the pixel data is encoded with an orientation that is suitable for direct display to the user without flipping or rotating into the correct orientation.

The Image Display shall use the values of Image Laterality (0020,0062), View Code Sequence (0054,0220), View Modifier Code Sequence (0054,0222) and Patient Orientation (0020,0020) to display images according to the preferred hanging protocol of the current user, rather than depend on descriptive attributes such as Series Description (0008,103E).

The Image Display shall allow the user to select or configure hanging protocols such that given a set of images containing these attributes, the placement of images relative to one another, the required orientation of the images, the display of current and prior images, and the sequence of layouts displayed can be defined.

Note that images are normally displayed such that the axilla is towards the top of the viewport, except for cleavage views (which contain two axillas). The location of the axilla can be determined from the direction of the head encoded in Patient Orientation (0020,0020) in the case of lateral and oblique views, and the Image Laterality (0020,0062) in the case of cranio-caudal or caudo-cranial views. For cleavage views, indicated by the presence of a View Modifier Code Sequence (0054,0222) Item containing (399161006, SCT, “Cleavage”), either axilla may be at the top of the view port. (Earlier versions of the Radiology Technical Framework contained the SNM3 equivalent of the SCT code for “Cleavage”; the SNM3 code is now retired. See DICOM PS3.16 Section 8.3 “Retired Codes and Expected Behavior”.)

The Image Display shall be able to distinguish and display separately images with one or more Items in a View Modifier Code Sequence (0054,0222) from each other and those without a View Modifier Code Sequence (0054,0222) Item.

The Image Display shall be capable of horizontally justifying the image to the left or right side of the viewport rather than centering it, when the aspect ratio (ratio of the number of rows and columns) of the viewport does not match aspect ratio of the image, in order to avoid displaying any unnecessary padding between the adjacent chest walls of back to back images; excessive window decoration (such as scroll bars) shall not be displayed between back to back viewports.

4.16.4.2.2.1.1.3 Image Size

The physical size of the pixels in an image for the purposes of the display modes defined in this section shall be approximated by using the values of Imager Pixel Spacing (0018,1164).

The physical size of the pixels in an image for the purposes of distance measurements and the display of a distance caliper shall be approximated by using the values of Imager Pixel Spacing (0018,1164) divided by Estimated Radiographic Magnification Factor (0018,1114).

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For contact (unmagnified) views, the value of Estimated Radiographic Magnification Factor (0018,1114) is typically 1, or close to 1, depending on the distance between the detector side of the compressed breast and the front of the detector housing (the latter being the plane in which Imager Pixel Spacing (0018,1164) is defined), and what depth the nominal location of the object plane is within the compressed breast.

For magnification views, the spacing between the detector side of the compressed breast and the detector is increased substantially relative to the distance to the x-ray source to obtain geometric magnification, and Estimated Radiographic Magnification Factor (0018,1114) will have a value substantially greater than 1.

Pixel Spacing (0028,0030) shall not be used to determine size for the purpose of sizing for display or distance measurements. DICOM CP 586, which clarifies the meaning of Pixel Spacing (0028,0030) values that differ from Imager Pixel Spacing (0018,1164) values when an image has been calibrated by use of a fiducial of known size within the image, is not relevant to mammography applications.

Note that the use of Imager Pixel Spacing (0018,1164) is sufficient regardless of the physical size of the detector used.

4.16.4.2.2.1.1.3.1 Same Size

The Image Display shall be capable of displaying multiple images such that all images are at the same relative physical size, regardless of whether they have the same values of Imager Pixel Spacing (0018,1164) or not.

For example, a user reviewing a four-view screening mammogram together with a four-view prior mammogram might want to display eight viewports, each showing one view, such that each view is at the same relative physical size, even if the images were obtained on detectors with different sized pixels. This allows the user to compare features in the prior and current images to visually assess whether or not they have changed in size.

Note that it is not expected that the Image Display attempt to compensate for the location of the object within the compressed breast of finite thickness along the x-ray beam, since the convention for measurement from film-screen practice assumes that all objects are located at the cassette (detector) side of the breast.

This mode of display is not intended for comparison of geometrically magnified views at the same time as non-magnified views, since the geometrically magnified view would then be displayed too small.

4.16.4.2.2.1.1.3.2 True Size

The Image Display shall be capable of displaying multiple images such that all images are true size, regardless of whether they have the same values of Imager Pixel Spacing (0018,1164) or not.

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True size is defined as the display of an image such that an object in the image when measured with a hand-held ruler on the surface of the display measures as closely as possible to the true physical size of the object if located on the front face of the detector housing.

This mode of display is not intended for geometrically magnified views, since the geometrically magnified view would then be displayed too small.

4.16.4.2.2.1.1.3.3 View Actual Pixels

The Image Display shall be capable of displaying multiple images such that each encoded pixel occupies one display pixel in the viewport.

If the size of the pixel data exceeds the size of the viewport, it may not be possible to display all of the encoded pixels at once, in which case some form of pan or quadrant navigation functionality shall be provided.

Since there is no minification or magnification, images with different pixel physical size will be displayed in this mode such that the physical size in the patient will appear different.

4.16.4.2.2.1.1.4 Image Contrast Adjustment

As described in Section 4.16.4.2.2.1 Display of Digital X-Ray, Mammography and Intra-Oral Images, the Image Display shall provide the user with the ability to select amongst the available window and VOI LUT choices available in the image object.

Subsequent to the initial application of the chosen contrast transformation, the Image Display shall allow the user to adjust the contrast without reverting to a purely linear transformation:

- If the chosen contrast transformation is a lookup table, then the Image Display shall allow the input value of the lookup table to be stretched and translated so as to give the effect of adjusting contrast and brightness whilst applying the same general shape as the curve encoded in the lookup table. To provide feedback to the user, the “window width” can be reported as the adjusted range of input values to the LUT, and the “window center” can be reported as the center value of that range.
- If the chosen contrast transformation is a sigmoid shaped VOI LUT Function parameterized by the window center and width, then the Image Display shall allow the window center and width values to be adjusted and a sigmoid function reapplied.

If a Pixel Padding Value (0028,0120) only is present in the image then image contrast manipulations shall not be applied to those pixels with the value specified in Pixel Padding Value (0028,0120).

If both Pixel Padding Value (0028,0120) and Pixel Padding Range Limit (0028,0121) are present in the image then image contrast manipulations shall not be applied to those pixels with values in the range between the values of Pixel Padding Value (0028,0120) and Pixel Padding Range Limit (0028,0121), inclusive.

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4.16.4.2.2.1.1.5 Annotation of Image Information

Quite apart from good practice, there are nationally-specific requirements for information to be displayed (or displayable) to the user in order to ensure correct identification of the patient and study during reporting and review as well as the resolution of quality issues.

This profile defines the union of currently known and anticipated nationally-specific requirements with respect to annotation.

It is desirable that the subset of attributes displayed be configurable by the user or the site.

If annotations are overlayed on the displayed image, the Image Display shall not annotate the edge that contains the chest wall, as determined from (0020,0020) Patient Orientation, so as to avoid covering breast tissue.

4.16.4.2.2.1.1.5.1 Annotation of Identification Information

The Image Display shall be capable of displaying the information contained in the attributes listed in Table 4.16.4.2.2.1.1.5.1-1. The required information is defined in two categories:

- Clinical - Those attributes that are useful during interpretation and review of the images for clinical purposes, and which under normal circumstances should be displayed
- Investigative - Those attributes that are useful for investigative purposes, such as to trace a quality problem, and which under normal circumstances are a distraction and should not be displayed until requested by the user

Table 4.16.4.2.2.1.1.5.1-1: Identification Attributes for Display

Attribute	Tag	Requirement
Patient's Name	(0010,0010)	Clinical
Patient ID	(0010,0020)	Clinical
Patient's Birth Date	(0010,0030)	Clinical
Patient's Age	(0010,1010)	Clinical
Acquisition Date	(0008,0022)	Clinical
Acquisition Time	(0008,0032)	Clinical
Operator's Name	(0008,1070)	Clinical
Manufacturer	(0008,0070)	Investigative
Institution Name	(0008,0080)	Clinical
Institution Address	(0008,0081)	Investigative
Manufacturer's Model Name	(0008,1090)	Investigative
Device Serial Number	(0018,1000)	Investigative
Detector ID	(0018,700A)	Investigative
Software Versions	(0018,1020)	Investigative
Station Name	(0008,1010)	Clinical
Gantry ID	(0018,1008)	Clinical (for CR overrides Station Name, which is plate reader)

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Attribute	Tag	Requirement
Date of Last Detector Calibration	(0018,700C)	Investigative

Note that it is common practice to use the Operator's Name (0008,1070) to encode the initials rather than the full name of the operator, and this is sufficient to meet known regulatory requirements.

Note also that Station Name (0008,1010) (or Gantry ID (0018,1008) for CR) are typically short, human-recognizable strings meaningful to the users, and are preferred for satisfying any regulatory requirement for "mammography unit identification" over the more cryptic but precise attributes like Device Serial Number (0018,1000).

The Image Display shall make the investigative set of values available to the ordinary user, but these need not necessarily be annotated directly on the image, e.g., they might be displayed in a separate pop-up window.

It shall be possible to turn on or off either set of annotations at the user's discretion.

4.16.4.2.2.1.1.5.2 Annotation of Technical Factor Information

Good practice dictates that certain technical factors be displayed (or displayable) to the user in order to detect and resolve quality issues.

In addition, there are technical factors that are unique to the digital realm. One such factor is related to the adjustment of the sensitivity and/or dynamic range of the sensor or processing, corresponding to the amount of radiation reaching the detector. These are variously referred to by manufacturers as ADU, exposure index, or sensitivity. Note that interpretation of this value is vendor-specific, though may be standardized in the future by AAPM.

The Image Display shall be capable of displaying the information contained in the attributes listed in Table 4.16.4.2.2.1.1.5.2-1.

Table 4.16.4.2.2.1.1.5.2-1: Technique Attributes for Display

Attribute	Tag
KVP	(0018,0060)
Exposure	(0018,1152)
Exposure Time	(0018,1150)
Filter Material	(0018,7050)
Anode Target Material	(0018,1191)
Compression Force	(0018,11A2)
Body Part Thickness	(0018,11A0)
Positioner Primary Angle	(0018,1510)
Relative X-ray Exposure	(0018,1405)
Entrance Dose in mGy	(0040,8302)
Organ Dose	(0040,0316)

It shall be possible to turn on or off the annotations at the user's discretion.

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4.16.4.2.2.1.1.5.3 Annotation of View Information

Traditional film-screen practice requires the use of lead markers consisting of letters encoding the type of view, located in the corner of the film that is opposite the chest wall and towards the axilla.

Image Displays shall mimic this practice by annotating the viewport with abbreviations derived from the value of Image Laterality (0020,0062), View Code Sequence (0054,0220) and any values of View Modifier Code Sequence (0054,0222) Items that are present.

Unless otherwise overridden by nationally specific extensions, the specific abbreviations to be displayed are as defined in the View Modifier Abbreviations Column of DICOM PS3.16 CID 4014 and CID 4015, which is derived from ACR MQCM 1999, with the following clarifications:

- The Image Laterality shall be prepended to the abbreviation, e.g., a right CC view shall be displayed as "RCC"
- A CC view with a cleavage modifier shall be annotated as only "CV" if Image Laterality has a value of "B", i.e., the "CC" shall not be displayed, and the laterality shall be omitted (in which case the left and right breast can be determined from the value of Patient Orientation (0020,0020)); otherwise "LCV" or "RCV" shall be used
- A right MLO view with the axillary tail modifier shall be annotated only as "RAT", i.e., the "MLO" shall not be displayed
- The implant displaced modifier shall be appended as a suffix to the view, as if it were defined as "…ID", e.g., a right implant displaced CC view would be annotated as "RCCID"
- A spot compression modifier shall be prepended as a prefix to the view, as if it were defined as "S…", e.g., a left spot compression CC view would be annotated as "LSCC"
- A tangential modifier shall be annotated as only "TAN", i.e., the "CC" or whatever else is encoded as the view, shall not be displayed
- When multiple prefix or suffix modifiers are present, they shall be sorted alphabetically, e.g., a right magnified, spot compression, implant displaced, rolled lateral CC view would be annotated as "RMSCCIDRL"

Spaces and other delimiters are permitted between components of the abbreviations.

Prior to any flip or rotation for display, the location of the corner opposite the chest wall and towards the axilla can be determined from the direction of the chest wall encoding in Patient Orientation (0020,0020), regardless of view, and the direction of the head encoded in Patient Orientation (0020,0020) in the case of lateral and oblique views, and the Image Laterality (0020,0062) in the case of cranio-caudal or caudo-cranial views. For cleavage views, the axilla at the top of the viewport shall be annotated. See also Section 4.16.4.2.2.1.1.2 Image Orientation and Justification.

It shall be possible to turn on or off the annotations at the user's discretion.

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4.16.4.2.2.1.1.6 Annotation of Size Information

For the purpose of this section, physical pixel size is as defined in Section 4.16.4.2.2.1.1.3 Image Size.

The user needs to be aware when the displayed image does not reflect a 1:1 rendition of an encoded image pixel to a displayed pixel, i.e., that some magnification or minification has taken place. Anything other than 1:1 rendition may result in loss or distortion of information.

Further, the user needs to be aware of whether or not the image is displayed at true size, and whether or not different images are at the same relative physical size.

Therefore, the Image Display shall be capable of annotating the displayed images with the following:

- Pixel Size Magnification - Number of displayed pixels relative to the number of encoded image pixels, such that a factor of 1.0 (or 100%) means 1:1 rendition, a factor of less than 1.0 means that one pixel on the display represents more than one pixel in the encoded image (minification), and a factor of greater than 1.0 means that pixels in the encoded image have been replicated or interpolated to span multiple displayed pixels (magnification)
- True Size Magnification - Size of the displayed pixels relative to true size, such that a factor of 1.0 (or 100%) means true size, a factor of less than 1.0 means smaller than true size, and a factor of greater than 1.0 means larger than true size

The exact form of these two relative pixel size indications is left to the discretion of the implementer.

The Image Display shall be capable of displaying a ruler or caliper indicating the physical size of the displayed image, for the purpose of providing a visual cue to the user of the general size of the features in the image. It shall be possible to turn on or off the ruler at the user's discretion.

The Image Display shall provide a means of accurately measuring distance between two points based on the physical size of the image pixels.

4.16.4.2.2.1.1.7 Partial View Option

If the Image Display supports the Partial View Option, it shall additionally annotate the displayed image in the view port to indicate:

- when the image is a partial view, as defined by the presence of Attribute Partial View (0028,1350) with a value of YES
- which region of the mosaic the image represents, as encoded in Partial View Code Sequence (0028,1352), if present

Whether or not this annotation is textual or in the form of some iconic graphic representation, and whether or not any navigational or layout assistance is provided for the entire mosaic is at the discretion of the implementer.

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4.16.4.2.2.1.1.8 Display of CAD Marks

Image Displays shall be able to apply marks on the displayed image corresponding to all findings encoded in Mammography CAD SR objects with a (111056, DCM, "Rendering Intent") value of (111150, DCM, "Presentation Required"). They may be able to display additional findings that have a (111056, DCM, "Rendering Intent") value of (111151, DCM, "Presentation Optional").

The Image Display shall make the user aware that CAD marks are available for display, and indicate whether or not CAD marks are currently activated. More than one set of CAD objects could be available that are applicable to the same image (e.g., CAD was run more than once on the same images). If this is the case then all CAD SRs shall be made available for display on the review workstation with the most recent CAD SR (by Content Date/Time) being displayed by default. The user shall be able to choose which CAD SR object is to be displayed.

Only a single CAD SR object at a time shall be applied to a displayed image.

The Image Display shall be able to apply the marks to "For Presentation" images that are referenced by the Mammography CAD SR SOP Instance.

The Image Display shall also be able to apply the marks to "For Presentation" images whose Source Image Sequence references the SOP Instance UID of the "For Processing" images that are referenced by the Mammography CAD SR SOP Instance, unless the Spatial Locations Preserved (0028,135A) is present in the Source Image Sequence Item and has a value of NO.

The Patient Orientation of the images referenced in the Source Image Sequence encoded in (111044, DCM, "Patient Orientation Row") and (111043, DCM, "Patient Orientation Column") of the Mammography CAD SR SOP Instance shall be used to transform (flip or rotate) the coordinates of the CAD marks if it differs from the Patient Orientation (0020,0020) of the corresponding "For Presentation" image.

The form in which the CAD marks are displayed may influence observer performance, and hence it may be necessary to display them in a manner prescribed by the CAD device vendor, which is not encoded in the DICOM object. The form of the CAD mark rendering is out of the scope of this profile to define.

The Image Display shall make available for display the following information about each CAD finding, if encoded in the CAD object:

- Manufacturer (0008,0070)
- Algorithm as defined in (111001, DCM, "Algorithm Name") and (111003, DCM, "Algorithm Version")
- Operating point as defined in (111071, DCM, "CAD Operating Point")
- Content Date (0008,0023) and Content Time (0008,0033) of the CAD SR instance, if more than one exists and applies to the displayed image

The Image Display shall indicate when CAD was not attempted or has failed, either entirely, or if some algorithms have succeeded and others failed, as distinct from when CAD has succeeded

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but there are no findings. This information shall be obtained from the status values of (111064, DCM, “Summary of Detections”) and (111065, DCM, “Summary of Analyses”).

4.16.4.2.2.1.1.9 Post-Processing of For Presentation Images

This profile does not constrain the ability of the Image Display to further post-process “For Presentation” images, for example with edge enhancement or noise reduction.

However, there shall be a mode in which actual pixels of “For Presentation” images are displayed not only with 1:1 display to encoded pixel size, but with no further processing or interpolation other than application of point grayscale transformations.

4.16.4.2.2.1.1.10 Accidental reading of prior studies

There is a significant risk that during primary interpretation the most recently available prior study on the Image Display will be interpreted by the user as the current study, if for some reason the current study is not available.

Accordingly, it is required that an Image Display explicitly warn the user if none of the studies being displayed are within a user configurable period from the current real time, as determined by Acquisition Date (0008,0022).

4.16.4.2.2.1.2 Display of Stereotactic Mammography Images

This section is currently in the Stereotactic Mammography Image (SMI) Trial Implementation Supplement.

4.16.4.2.2.1.3 Display of DBT Images

Image Displays participating in the Digital Breast Tomosynthesis Profile shall fulfill all requirements listed in Section 4.16.4.2.2.1.1 for the display of Digital Mammography X-Ray Image instances in addition to requirements listed in this section.

In the Digital Breast Tomosynthesis Profile, since current and prior studies may be performed with either conventional 2D mammography or DBT or both, and since DBT images may consist of tomosynthesis reconstructions alone, or together with either the projection images (if the For Presentation Breast Projection X-Ray Images Option is supported), or generated 2D images or both, the Image Display shall be capable of displaying combinations of screening views (typically left and right CC and MLO) from a current and prior set of a pair of any of the following types of acquisition:

- Tomosynthesis slices
- Tomosynthesis slabs
- Conventional 2D mammography images
- Generated 2D images derived from tomosynthesis data

I.e., Assuming an eight viewport layout, Image Displays shall be at minimum capable of displaying the following combinations based on the user preferences:

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- Up to four views of current and prior study of the same acquisition type (e.g., current and prior DBT slices, or current and prior conventional 2D mammography images).
- Up to four views of current study of one acquisition type compared with the same views of current exam of a different acquisition type (e.g., current conventional 2D mammography images and current DBT slices).
- Up to four views of current study of one acquisition type compared with the same views of a prior of a different acquisition type (e.g., current DBT slices with prior conventional 2D mammography images).

Furthermore, the user shall be provided with a means to toggle between the available conventional 2D mammography images, tomosynthesis slices, tomosynthesis projection images (if the For Presentation Breast Projection X-Ray Images Option is supported), and generated 2D image for the views currently displayed without affecting the display layout.

Image Displays shall support calibration as described in DICOM PS3.14 Grayscale Standard Display Function (GSDF). The minimum and maximum luminance of the display shall be configurable by the site, within the gamut of the device, for the purpose of conforming to local, regional or national regulatory and other requirements for luminance settings throughout the organization. For example, a site may require that all Image Displays used for consultation be calibrated to the same minimum and maximum luminance.

4.16.4.2.2.1.3.1 Background Air Suppression

Image Displays shall apply background air suppression to tomosynthesis slices and generated 2D images as defined in Section 4.16.4.2.2.1.1.1.

4.16.4.2.2.1.3.2 Image Orientation and Justification

Image Displays shall apply image orientation and justification requirements as described in Section 4.16.4.2.2.1.1.2 to tomosynthesis slices, and generated 2D images.

For images encoded with the Breast Tomosynthesis Image IOD, the orientation information is stored within the Image Orientation (Patient) (0020,0037) attribute in the Plane Orientation Sequence (0020,9116) of the Shared Functional Groups Sequence (5200,9229), and consideration of this pair of unit vectors describing the orientation of the image rows and columns with respect to the patient-relative 3D coordinate system is required to determine the orientation of the image, since Patient Orientation (0020,0020) is not present in the Breast Tomosynthesis Image IOD. The Image Display shall not assume that Patient Orientation (0020,0020), if present, is reliable, and shall not assume that the pixels are encoded with any particular or expected orientation.

For images encoded with the Breast Tomosynthesis Image IOD, the Image Display shall use the View Code Sequence (0054,0220), View Modifier Code Sequence (0054,0222) and Frame Laterality (0020,9072) in the Frame Anatomy Sequence (0020,9071) of the Shared Functional Groups Sequence (5200,9229) together with Image Orientation (Patient) (0020,0037) to display images according to the preferred hanging protocol of the current user.

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4.16.4.2.2.1.3.3 Image Size

The physical size of the pixels in an image encoded with the Breast Tomosynthesis Image IOD for the purposes of image sizing, distance measurements and the display of a distance caliper shall be approximated by using the values of Pixel Spacing (0028,0030) since geometric effects will have been accounted for during reconstruction.

Pixel Spacing (0028,0030) within the Pixel Measures Sequence (0028,9110) may either be part of the Shared Functional Groups Sequence (5200,9229) or the Per-frame Functional Groups Sequence (5200,9230).

4.16.4.2.2.1.3.3.1 Same Size

Image Displays shall be capable of displaying multiple single frame or multi-frame images such that all images are at the same relative physical size, regardless of whether they have the same values of Pixel Spacing (0028,0030) or not.

Further, within a single Breast Tomosynthesis Image instance, the Image Display shall be capable of displaying multiple frames of the image such that all frames are at the same relative physical size, regardless of whether they have the same values of Pixel Spacing (0028,0030) or not.

This means that as the user scrolls through each frame, the encoded pixel data for each frame may need to be interpolated with a different magnification factor than adjacent frames.

The location about which the frame pixel data is interpolated shall be chosen for successive slices such that the displayed image remains centered vertically at the middle of the vertical extent of the viewport and centered horizontally at the chest wall side of the viewport, until/if the user explicitly pans or zooms the displayed image to establish a new extent of pixels to be displayed.

The initial state (magnification factor relative to the physical size of the patient) is at the discretion of the implementer, but since multiple images (different views and prior images) are required to be at the same size, whether or not a particular tomosynthesis slice is used to establish the initial size is not of importance, since the variation in spatial extent (how much of the breast tissue occupies a particular frame or image) is likely to vary more between sides, views and priors than within a set of frames for one image.

For Same Size display of any supported combination of conventional 2D mammography images with tomosynthesis slices and/or generated 2D images, the physical size of the pixels in a conventional 2D mammography image shall be approximated by using the values of Imager Pixel Spacing (0018,1164) divided by Estimated Radiographic Magnification Factor (0018,1114), to account for geometric effects.

4.16.4.2.2.1.3.3.2 True Size

Image Displays shall be capable of displaying multiple single frame or multi-frame images such that all images are true size, regardless of whether they have the same values of Pixel Spacing (0028,0030) or not.

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Further, within a single Breast Tomosynthesis Image instance, the Image Display shall be capable of displaying multiple frames of the image such that all frames are at true size, regardless of whether they have the same values of Pixel Spacing (0028,0030) or not.

For True Size display of any supported combination of conventional 2D mammography images with tomosynthesis slices and/or generated 2D images, the physical size of the pixels in a conventional 2D mammography image shall be approximated by using the values of Imager Pixel Spacing (0018,1164) divided by Estimated Radiographic Magnification Factor (0018,1114), to account for geometric effects.

4.16.4.2.2.1.3.3.3 View Actual Pixels

For Image Displays, the view actual pixels display as described in Section 4.16.4.2.2.1.1.3.3 shall be applicable during display of any supported combination of conventional 2D mammography images, tomosynthesis slices and generated 2D images.

4.16.4.2.2.1.3.4 Image Contrast Adjustments

For Image Displays, the image contrast adjustment requirements in Section 4.16.4.2.2.1.1.4 shall be applied during the display of any combination of conventional 2D mammography images, tomosynthesis slices and generated 2D images.

VOI LUT Sequence (0028,3010), Window Center (0028,1050) and Window Width (0028,1051) within the Frame VOI LUT Sequence (0028,9132) may either be part of the Shared Functional Groups Sequence (5200,9229) or the Per-frame Functional Groups Sequence (5200,9230).

4.16.4.2.2.1.3.5 Annotation of Image Information

For Image Displays the annotation requirements in Section 4.16.4.2.2.1.1.5 and all its sub-sections shall be applied during the display of any combination of conventional 2D mammography images, tomosynthesis slices, and generated 2D images except that, for images encoded with the Breast Tomosynthesis Image IOD the chest wall determination shall be based on Image Orientation (Patient) (0020,0037) in the Plane Orientation Sequence (0020,9116) of the Shared Functional Groups Sequence (5200,9229) rather than Patient Orientation (0020,0020) to avoid covering of breast tissue with annotations.

4.16.4.2.2.1.3.5.1 Annotation of Identification Information

Image Displays shall fulfill the requirements defined in Section 4.16.4.2.2.1.1.5.1 for the attributes listed in Table 4.16.4.2.2.1.3.5.1-1.

Table 4.16.4.2.2.1.3.5.1-1: Identification Attributes for Display

Attribute	Tag	Requirement
Patient's Name	(0010,0010)	Clinical
Patient ID	(0010,0020)	Clinical
Patient's Birth Date	(0010,0030)	Clinical
Patient's Age	(0010,1010)	Clinical

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Attribute	Tag	Requirement
Operators' Name	(0008,1070)	Clinical
Manufacturer	(0008,0070)	Investigative
Institution Name	(0008,0080)	Clinical
Institution Address	(0008,0081)	Investigative
Manufacturer's Model Name	(0008,1090)	Investigative
Device Serial Number	(0018,1000)	Investigative
Software Versions	(0018,1020)	Investigative
Station Name	(0008,1010)	Clinical
Contributing Sources Sequence	(0018,9506)	
>Acquisition DateTime	(0008,002A)	Clinical
>Detector ID	(0018,700A)	Investigative
>Date of Last Detector Calibration	(0018,700C)	Investigative

4.16.4.2.2.1.3.5.2 Annotation of Technical Factor Information

Image Displays shall fulfill the requirements defined in Section 4.16.4.2.2.1.1.5.2 for the attributes in Table 4.16.4.2.2.1.3.5.2-1:

Table 4.16.4.2.2.1.3.5.2-1: Technique Attributes for Display

Attribute	Tag	Notes
X-Ray 3D Acquisition Sequence	(0018,9507)	
>KVP	(0018,0060)	
>Exposure in mAs	(0018,9332)	
>Exposure Time in ms	(0018,9428)	
>Filter Material	(0018,7050)	
>Anode Target Material	(0018,1191)	
>Compression Force	(0018,11A2)	
>Body Part Thickness	(0018,11A0)	
>Primary Positioner Scan Start Angle	(0018,9510)	Used to derive the angle of the center of the arc. For additional information on angles see also DICOM CP 1282 (final text).
>Primary Positioner Scan Arc	(0018,9508)	
>Entrance Dose in mGy	(0040,8302)	
>Organ Dose	(0040,0316)	
Image Type	(0008,0008)	Used to display a human readable value of Value 4 for a derived image, e.g., if Value 4 is GENERATED_2D, a string such as "Generated 2D" might be displayed.
X-Ray 3D Reconstruction Sequence	(0018,9530)	

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Attribute	Tag	Notes
>Reconstruction Description	(0018,9531)	

4.16.4.2.2.1.3.5.3 Annotation of View Information

Image Displays shall provide a mechanism to annotate view information as described in Section 4.16.4.2.2.1.1.5.3, except that the orientation information shall be obtained from Image Orientation (Patient) (0020,0037), see Section 4.16.4.2.2.1.3.2 Image Orientation and Justification.

For images encoded using the Breast Tomosynthesis Image IOD the Image Display shall derive the abbreviations displayed in the viewport from View Code Sequence (0054,0220), View Modifier Code Sequence (0054,0222) and Frame Laterality (0020,9072) in the Frame Anatomy Sequence (0020,9071) of the Shared Functional Groups Sequence (5200,9229).

4.16.4.2.2.1.3.5.4 Annotation of Frame Information

Image Displays shall fulfill the following annotation requirements:

- Frames shall be numbered from 1 to Number of Frames (0028,0008) corresponding to the encoded order of the Frames in Pixel Data (7FE0,0010). For each frame the annotation shall show the current frame number and the number of frames.
- For tomosynthesis frames, the thickness in mm of the frame based on the Slice Thickness (0018,0050) within Pixel Measures Sequence (0028,9110) of the Shared Functional Groups Sequence (5200,9229) or Per-frame Functional Groups Sequence (5200,9230) shall be displayed.
- For tomosynthesis frames the position within the stack of frames shall be displayed. The position shall be computed from the Image Position (Patient) (0020,0032) distance along the normal to the Image Orientation (Patient) (0020,0037) with an indication of the patient-relative direction along that normal (e.g., lateral to medial, head to foot).

4.16.4.2.2.1.3.6 Annotation of Size Information

For the purpose of this section, physical pixel size is as defined in Section 4.16.4.2.2.1.3.3. Image Displays shall fulfill requirements defined in Section 4.16.4.2.2.1.1.6.

Note: For tomosynthesis frames, the reported distance measured will be based on actual size within the patient estimated during the reconstruction process, and may not be directly comparable with size measured from conventional 2D mammography images or generated 2D images.

4.16.4.2.2.1.3.7 Partial View Option

Image Displays supporting the Partial View Option in the Digital Breast Tomosynthesis Profile shall fulfill all requirements listed in Section 4.16.4.2.2.1.1 for tomosynthesis slices, projection

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images (if the For Presentation Breast Projection X-Ray Images Option is supported), and generated 2D images.

4.16.4.2.2.1.3.8 Accidental Reading of Prior Studies

Requirements defined in Section 4.16.4.2.2.1.1.10 shall apply to Image Displays in the Digital Breast Tomosynthesis Profile as well. The Acquisition DateTime (0008,002A) attribute in the Contributing Sources Sequence (0018,9506) (see Table 4.8.4.1.2.7-3) shall be used to determine the display of a warning message, if no studies are within a configurable period from the current real time.

4.16.4.2.2.1.3.9 Scrolling through Multi-frame Tomosynthesis Images

Image Displays shall be able to present tomosynthesis images in the viewport as a similar conventional 2D mammography view might be displayed. The tomosynthesis images are multi-frame. Accordingly, the user shall be provided with a means to scroll through the frames (such as one might scroll through a set of CT or MR slices).

Two modes of scrolling, manual and automatic (cine), shall be provided. For the automatic mode, the user shall be provided with control over the cine speed (frame rate) and the initial speed shall be configurable.

Note: It is recommended that the maximum speed of scrolling be rapid so as to take advantage of the human visual system's sensitivity to motion in order to detect subtle abnormalities. It is beyond the scope of this transaction to specify a hardware performance target, but a maximum scrolling rate of at least 25 frames per second for an entire 5 MP display is desirable.

The user shall have control over the cine playback sequencing such that they may choose looping, sweeping or stopping (see definitions in DICOM PS3.3 C.7.6.5 Preferred Playback Sequencing (0018,1244), even though this attribute is not used).

The Image Display shall not skip slices during manual or automatic scrolling.

Note: I.e., if the Image Display is unable to keep up with the user's requested frame rate, then the display will show all slices rather than scrolling faster.

Scrolling between tomosynthesis frames shall be available regardless of the arrangement of the display and the combination with other views, whether the other views are tomosynthesis slices, conventional 2D mammography images or generated 2D images.

Scrolling shall be in spatial sequence according to Image Position (Patient) (0020,0032).

Scrolling shall be controllable using both a pointing device and the keyboard.

Vertical movement of a conventional pointing device (such as a mouse) upward shall scroll toward the paddle (i.e., away from the detector). Touch screen pointing devices should scroll in the opposite direction.

4.16.4.2.2.1.3.10 For Presentation Breast Projection X-Ray Images Option

Image Displays supporting the For Presentation Breast Projection X-Ray Images Option shall fulfill the requirements defined in the following subsections for breast projection X-Ray images:

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- Section 4.16.4.2.2.1.3.1 Background Air Suppression
- Section 4.16.4.2.2.1.3.2 Image Orientation and Justification
  For breast projection X-Ray images, the Image Display shall use the View Code Sequence (0054,0220), View Modifier Code Sequence (0054,0222) and Frame Laterality (0020,9072) in the Frame Anatomy Sequence (0020,9071) of the Shared Functional Groups Sequence (5200,9229) together with Image Orientation (Patient) (0020,0037) in the Plane Orientation Sequence (0020,9116) of the Shared Functional Groups Sequence (5200,9229) to display images according to the preferred hanging protocol of the current user.
- Section 4.16.4.2.2.1.3.3 Image Size
  For breast projection X-Ray images, size information shall be obtained from Imager Pixel Spacing (0018,1164) and Estimated Radiographic Magnification Factor (0018,1114).
- Section 4.16.4.2.2.1.3.4 Image Contrast Adjustments
- Section 4.16.4.2.2.1.3.5 Annotation of Image Information including Section 4.16.4.2.2.1.3.5.3 Annotation of View Information
- Section 4.16.4.2.2.1.1.5.1 Annotation of Identification Information, using Acquisition DateTime (0008,002A)
- Section 4.16.4.2.2.1.1.5.2 Annotation of Technical Factor Information using the attributes defined in Table 4.16.4.2.2.1.3.10-1:

Table 4.16.4.2.2.1.3.10-1: Technique Attributes for Display

Attribute	Tag	Note
KVP	(0018,0060)	
X-Ray Acquisition Dose Sequence	(0018,9542)	Located either in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229)
>Exposure in mAs	(0018,9332)	
>Exposure Time in ms	(0018,9428)	
>Entrance Dose in mGy	(0040,8302)	
>Organ Dose	(0040,0316)	
X-Ray Filter Sequence	(0018,9556)	Located either in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229)
>Filter Material	(0018,7050)	
Anode Target Material	(0018,1191)	
Compression Force	(0018,11A2)	
Body Part Thickness	(0018,11A0)	

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Attribute	Tag	Note
Positioner Position Sequence	(0018, 9405)	Located either in Per-frame Functional Groups Sequence (5200,9230) or in Shared Functional Groups Sequence (5200,9229)
>Positioner Primary Angle	(0018,1510)	
>Positioner Primary Angle Direction	(0018,9559)	
Image Type	(0008,0008)	Used to display a human readable value of Value 3 to indicate projection images.

- Section 4.16.4.2.2.1.3.5.4 Annotation of Frame Information
- Section 4.16.4.2.2.1.3.6 Annotation of Size Information
  For breast projection X-Ray images, size information shall be obtained from Imager Pixel Spacing (0018,1164) in the Frame Pixel Data Properties Sequence (0018,9443) of the Shared Functional Groups Sequence (5200,9229) or Per-frame Functional Groups Sequence (5200,9230) and Estimated Radiographic Magnification Factor (0018,1114) in the X-Ray Geometry Sequence (0018,9476) of the Shared Functional Groups Sequence (5200,9229) or Per-frame Functional Groups Sequence (5200,9230).

Breast projection X-Ray images are multi-frame rather than single-frame and therefore the user shall be provided with manual scrolling as defined in Section 4.16.4.2.2.1.3.9 Scrolling through Multi-frame Tomosynthesis Images; automatic scrolling (cine) is not required. Scrolling through breast projection X-Ray images shall be independent from scrolling through tomosynthesis frames.

4.16.4.2.2.1.3.11 Display of DBT Images by the Viewer on the Media (Media Creation Option)

The Media Creation Option of the Digital Breast Tomosynthesis (DBT) Profile groups an Acquisition Modality or Image Display with a Portable Media Creator in the Portable Data for Imaging (PDI) Profile, and allows for a viewer to be recorded on the media. That viewer is considered an Image Display for the purposes of this section and, the contents of this section are required for all such viewers recorded on media by actors claiming the Media Creation Option of the Digital Breast Tomosynthesis (DBT) Profile.

The Image Display shall be capable of displaying all SOP instances recorded on the media that are of the SOP Classes specified in Section 4.16.4.1.3.7. In addition, the Key Object Selection Document Storage SOP Class and Grayscale Softcopy Presentation State Storage SOP Class shall be supported if such instances are present on the media.

The Media Creation Option of the Digital Breast Tomosynthesis (DBT) Profile defines a simplified set of functions for the Image Display to make available to the user with the intent of being able to perform basic review of individual or pairs of images encoded in any of the SOP

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Classes supported by the Digital Breast Tomosynthesis (DBT) Profile, as well as Key Image Notes and annotations, grayscale contrast and spatial transformations in Presentation States. Additional features may be present.

The Image Display shall provide a means of selecting a single patient to display when more than one patient's studies are recorded on the media. When only a single patient is recorded, there is no need for a patient selection mechanism.

The Image Display shall provide some means of selecting which images to display.

The Image Display shall allow at least two images of any of the supported SOP Classes for the same or different studies to be compared side by side in separate viewports (to allow for comparison of different images of the current or prior studies). The Image Display shall allow display of only a single image in a single viewport (in order to take advantage of limited screen space).

The Image Display shall fulfill all requirements listed in Section 4.16.4.2.2.1.1 related to the application of window/level and VOI LUTs present in the images and any Presentation States present on the media. Contrast adjustments as described in Section 4.16.4.2.2.1.3.4 shall be supported.

Background air suppression as defined in Section 4.16.4.2.2.1.3.1 shall be supported.

Image Displays shall apply image orientation and justification requirements as described in Section 4.16.4.2.2.1.3.2.

The physical size of pixels for the purpose of annotations and measurements shall be obtained as described in Sections 4.16.4.2.2.1.3.3 and 4.16.4.2.2.1.1.3.

There is no requirement for Same Size, True Size or View Actual Pixels display, but the Image Display shall provide continuous (not stepped) zooming and panning of an image displayed in a viewport.

The Image Display shall provide scrolling through multi-frame images as described in Section 4.16.4.2.2.1.3.9, except that only manual, not automatic, scrolling is required.

The Image Display shall provide annotation of the displayed images as described in Section 4.16.4.2.2.1.3.5 and its subsections, and annotation of size information as described in Section 4.16.4.2.2.1.3.6.

There is no requirement for specific behavior for partial view images.

The Image Display shall provide a tool to measure distance in a straight line between two user-defined points. There is no requirement to be able to save such measurements.

The Image Display shall provide the user with the ability to select Key Images if Key Image Notes are present on the media, as defined in the Key Image Note Profile.

The Image Display shall provide the user with the ability to select and apply Presentation States if Grayscale Softcopy Presentation State Storage instances are present on the media, as defined in the Consistent Presentation of Images (CPI) Profile, except that calibration of the display to

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the GSDF is not required since the Portable Media Creator that records the Image Display on the media has no control over the viewing environment in which the Image Display will be used.

4.16.4.2.2.2 Display of Localizer Lines

Image Display or Imaging Document Consumer Actors that want to show the localizer lines, if visible, will be able to calculate the position of these lines of intersection based on the information recorded in the images by the Acquisition Modality (see Section 4.8.4.1.2.1).

4.16.4.2.2.3 Display of NM Images

The contents of this section are required for Image Displays claiming the NM Image Profile.

The following requirements are intended to establish a baseline level of capabilities. Providing more intelligent and advanced capabilities is both allowed and encouraged. The intention is to focus on display capabilities, not to dictate implementation details.

Note that the NM Image Profile is undergoing revision, and vendors considering implementation are advised to include the modifications contained in the trial implementation version "NM Image Profile with Cardiac Option". For additional information please contact the IHE Radiology Technical Committee at ihe-rad-tech@googlegroups.com.

Some examples of display behaviors typical to NM are described in RAD TF-1x: Appendix E.5.3.

The NM Image IOD is a multi-frame image indexed by vectors as described in Section 4.8.4.1.2.2.1. "Image" will be used here to strictly refer to the IOD, while frame will be used to refer to the usual two-dimensional array of pixels.

The Image Display shall be able to display the frames in the order they are stored in the image.

The Image Display shall be able to perform the frame selections shown for each Image Type in the Table 4.16-1 and as described below in Section 4.16.4.2.2.3.1 Frame Selection Support. The result of a frame selection will be referred to as a "frameset" in this document. Note that a frameset only references frames from a single Image.

The Image Display shall be able to display simultaneously multiple framesets. These may be from the same Image, different Images, different Series, or different Studies.

The Image Display is not required to display simultaneously multiple framesets with different Image Types. (Note that two exceptions to this are identified in Section 4.16.4.2.2.3.5 Review Option).

The Image Display shall be able to display simultaneously at least the number of framesets indicated in Table 4.16-1.

All frames in the displayed frameset(s) are not required to be on the screen at once; if there are more frames than fit on the screen based on the current frame display size (see Section 4.16.4.2.2.3.4 Image Zoom), the ability to scroll through the frames is required.

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The Image Display shall be able to display, if present, the View Code Sequence (0054,0220), Acquisition Context Sequence (0040,0555), Series Description (0008,103E) and Acquisition Time (0008,0032) values for a given frameset.

The Image Display is required to support the display capabilities for each Image Type shown in Table 4.16-1.

Table 4.16-1: Selection, Sorting and Viewing Requirements for NM Images

Image Type (0008,0008) Value 3	Frame Increment Pointer (0028,0009) [i.e., vectors]	Required Frame Selection[1] E = single **E** = all	Display Capabilities (see 4.16.4.2.2.3.2)	# of Simultaneous Framesets	
				Basic	Review Option
STATIC	Energy Window (0054,0010) Detector (0054,0020)	**E D** E **D** **E** D *	Grid Display	1	1
			Fit Display	12	12
			Cine	-	1 (optional))
WHOLE BODY	Energy Window (0054,0010) Detector (0054,0020)	**E D** E **D** **E** D *	Whole body Display	2	4 [2]
DYNAMIC	Energy Window (0054,0010) Detector (0054,0020) Phase (0054,0100) Time Slice (0054,0030)	**E D P T** E D P **T** E D **P T**	Grid Display	1	1
			Comparison Display	1	2
			Cine	1	2
GATED	Energy Window (0054,0010) Detector (0054,0020) R-R Interval (0054,0060) Time Slot (0054,0070)	**E D I T**	Grid Display	1	1
			Comparison Display	3	6
			Cine	3	6
TOMO	Energy Window (0054,0010) Detector (0054,0020) Rotation (0054,0050) Angular View (0054,0090)	**E D R A**	Grid Display	1	1
			Comparison Display	3	3
			Cine	3	3
GATED TOMO	Energy Window (0054,0010) Detector (0054,0020) Rotation (0054,0050) R-R Interval (0054,0060) Time Slot (0054,0070) Angular View (0054,0090)	**E D R I T A** **E D R I T** A **E D R I** T **A** - any one of above three	Grid Display	1	1
			Cine	1	1
RECON TOMO	Slice (0054,0080)	**S**	Grid Display	1	1
			Comparison Display	3	6
			Cine	3	3
			MPR Display	-	1

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Image Type (0008,0008) Value 3	Frame Increment Pointer (0028,0009) [i.e., vectors]	Required Frame Selection[1] E = single **E** = all	Display Capabilities (see 4.16.4.2.2.3.2)	# of Simultaneous Framesets	
				Basic	Review Option
GATED RECON TOMO	R-R Interval (0054,0060) Time Slot (0054,0070) Slice (0054,0080)	**I T S** **I T** S **I** T **S** *	Grid Display	1	1
			Comparison Display	1	2
			Cine	-	2
			MPR Display	-	1

Note 1: The Frame Selection column refers to the Frame Increment Pointer vectors by their first letter (except for R-R Interval which uses "I" for Interval). A letter shown underlined and bold (e.g., **E**) indicates that all values for that vector are selected. A letter shown in plain text (e.g., E) indicates that a single value for that vector has been selected. So in the case of the TOMO Image Type, **E** R D A means that all frames of the image are selected; while E R D A means that the selected frames represent all Angular Views for a specific Energy Window, a specific Detector and a specific Rotation. An asterisk (*) indicates that it is required under the review option only, and not required under the basic NM Image Profile.

Note 2: The requirement for 4 framesets is to handle the case where the 4 frames are in separate framesets due to the anterior and posterior views being in separate images. It is not required to support 4 framesets with 2 frames each.

4.16.4.2.2.3.1 Frame Selection Support

A Frame Selection consists of either a single value, or "all values" being identified for each vector in the Image. In fact (except for the case of selecting "all frames" and the case of selecting all phases and time slices in a Dynamic Image) a single value will be identified for all but one of the available vectors.

It is not necessary to require the user to specify a value for single valued vectors, such as when, for example, only a single detector value is present. It is desirable for the application to provide a way to make a selection when a vector that is *typically* single valued unexpectedly has additional values.

When selecting values for certain vectors, the user shall be presented with meaningful terms, if available, rather than the underlying integer values from the DICOM vector. For example, in the case of the detector vector, if the View Code Sequence it present, the terms contained there (e.g., "Anterior", "Posterior") shall be used instead of the Detector Number from the vector.

The sources of selection terms in priority order (i.e., the first, if present shall be used, otherwise consider the next) are shown in the following table:

Table 4.16-2: Sources of Value Selection Terms for Vectors

Vector	Source of Selection Terms
Energy Window	1. Energy Window Name (0054,0018) 2. Energy Window Lower Limit (0054,0014) & Energy Window Upper Limit (0054,0015) 3. Energy Window Number
Detector	1. View Code Sequence (0054,0220) 2. Detector Number

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Vector	Source of Selection Terms
Phase	1. Phase Description (0054,0039) 2. Phase Number
Rotation	1. Rotation Number
R-R Interval	1. R-R Interval Number
Time Slot	1. Time Slot Number
Angular View	1. Angular View Number
Slice	1. Slice Number

One method of allowing the user to select a frameset by vectors might be to display a multi-vectored image to the user as if it were broken down into its components by vector. For example, a 2-phase dual-detector GI bleed study might be shown to the user as

GI-bleed Phase-1 Anterior

GI-bleed Phase-1 Posterior

GI-bleed Phase-2 Anterior

GI-bleed Phase-2 Posterior

This is acceptable as a means of frame selection support, provided the user has the option of selecting all the parts of the image for display as at the same time, should the user desire to do so, and provided that the multi-vectored image remains as a single image if it is sent via DICOM to another system.

4.16.4.2.2.3.2 Display Capabilities

Image Displays are required to support the following display formats as indicated above in Table 4.16-1.

Practical examples of the usage and appearance of these display capabilities can be found in RAD TF-1x: Appendix E.5 NM Display and in particular in RAD TF-1x: Appendix E.5.3 NM Display Examples.

4.16.4.2.2.3.2.1 Grid Display

For Grid Display, the Image Display shall display a single frameset arranged in a 2D grid of frames.

4.16.4.2.2.3.2.2 Fit Display

For Fit Display, the Image Display shall display several framesets simultaneously. Efficient use of screen space is encouraged. The Image Display is free to organize the frames any way that seems sensible. In the absence of other useful information, it is common to display them in order of acquisition time.

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4.16.4.2.2.3.2.3 Comparison Display

For Comparison Display, the Image Display shall display several framesets simultaneously in a fashion such that frames in the two framesets can be compared. For example, each frameset could be placed on an adjacent row.

Display of each frameset in a single row (i.e., the number of rows equals the number of framesets) is required. Support for more than one row per frameset is optional.

Comparison requires that the relationship between frames in the two framesets be maintained when navigating, and to be adjusted separately/established.

4.16.4.2.2.3.2.4 Whole Body Display

For Whole Body Display, the Image Display shall simultaneously display of both the anterior and posterior frames of an NM whole body image.

These images will typically be rectangular in shape (taller than wide) and are typically 256 x 1024 or 512 x 1024 in size. The display system should display them as rectangular frames (and not pad them to make them square).

4.16.4.2.2.3.2.5 MPR (Multi-Planar Reconstruction) Display

For MPR Display, the Image Display shall provide MPR capabilities for slice stack data. Typically, MPR involves displaying three orthogonal plane views at the same time along with a method of navigating the volume (i.e., controlling the specific sagittal, coronal and transaxial images shown).

The Image Display is not required to generate oblique slices from slice data, but is required to generate orthogonal slices even if the slice data is obliquely oriented.

In the NM Image Profile, MPR Display shall be supported when claiming the Review Option (see Section 4.16.4.2.2.3.5). When displaying NM Data, the Image Display shall be specifically capable of taking a frameset of slice data from a RECON TOMO or GATED RECON TOMO image and displaying all three orthogonal plane views (transaxial, saggital and coronal). PET transaxial data in the MPR display is strongly encouraged, but not required under the NM Profile.

Refer to DICOM documentation for details on how orientation and spatial information is encoded in the NM Image IOD.

4.16.4.2.2.3.2.6 Cine Display

The Image Display shall be able to display a cine of the selected frames as indicated by the order they are stored in the Image.

The Image Display shall be capable of displaying cines of multiple framesets simultaneously as indicated above in Table 4.16-1.

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When the framesets have the same number of frames, the Image Display shall be capable of displaying the cines in synchronization (i.e., the first frame of each frameset should display simultaneously, the second frame of each frameset should display simultaneously, etc.).

The Image Display shall provide the ability to adjust intensity (as described below in Section 4.16.4.2.2.3.3) for each frameset independently. The ability to adjust intensity while a cine is running is useful but not required.

4.16.4.2.2.3.3 Intensity and Color

NM clinical practice requires the ability to adjust the Upper and Lower Window Levels rather than the Window Center and Window Width. Refer to RAD TF-1x: Appendix E.5.1 for details on NM usage of intensity and color attributes.

For all images with a modality type of NM, the Image Display shall provide direct control over the Upper Window Level and the Lower Window Level display parameters independently from each other for both grayscale and pseudocolor display.

This control shall be available for all frames as a group and for each frameset individually. Optionally is it also useful to support adjustment of individual frames.

Window Level values shall be translated into equivalent Window Width and Center values when stored in the image attributes.

The Image Display shall be capable of effectively "inverting" the image (in the sense of switching between a MONOCHROME1 and MONOCHROME2 interpretation). The method is undefined. This requirement applies to grayscale image display only; it is not required for pseudo-color lookup tables.

If the Image Display supports a color screen, the following shall be supported:

The Image Display shall support display of frames of grayscale Images using a pseudo-color lookup table.

The Image Display shall allow the user to select from a configured set of pseudo-color lookup tables. Simultaneous display of both grayscale and pseudo-color presentations is not required. Thus, selecting a color lookup table may change all displayed frames on the screen.

The Image Display shall provide a method of adding new pseudo-color lookup tables. It is acceptable if this is only available to service engineers.

4.16.4.2.2.3.4 Image Zoom

The Image Display shall be capable of "zooming" the frames where zooming consists of resampling and displaying the frame at a larger or smaller matrix size. For example, re-sampling a 128x128 frame to create a 256x256 frame is referred to as a 2X zoom in this document.

All zooming of NM images shall preserve the aspect ratio (that is, the same zoom factor shall be applied in both the x and y dimensions). The Image Display is free to use pixel replication or interpolation to perform image zooming.

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Some guidelines on appropriate default display sizes and desirable zoom behaviors are provided in RAD TF-1x: Appendix E.5.2 NM Image Resizing.

4.16.4.2.2.3.5 Review Option

Image Displays claiming the Review Option shall support the following display capabilities and those indicated in Table 4.16-1.

The Image Display shall be capable of displaying both a Dynamic Image frameset and Static Image frameset(s) at the same time.

The Image Display shall be capable of displaying both a Whole body Image frameset and a Static Image frameset at the same time (i.e., anterior & posterior whole body and several static spot images).

The Image Display shall be capable of displaying the pixel value of a selected pixel.

4.16.4.2.2.4 Display of Result Screens

The contents of this section are required for Image Displays claiming the NM Image Profile. Refer to Table 4.18-2 for the specific SOP Class UIDs of the IODs referenced here for use as Result Screens.

The Image Display shall be able to display DICOM Secondary Capture images (including specifically 8 and 16 bit monochrome and 24 bit RGB).

The Image Display shall be able to display DICOM Multi-Frame Secondary Capture images (including specifically 8-bit monochrome and 24-bit True Color)

The Image Display shall be able to display result screens at their original pixel resolution. If the display size is equal to or greater than the size of the result screen, this should be done as the default. If the display size is less than the size of the result screen, this will require some sort of panning capability.

The Image Display shall be able to scale result screens using a fixed aspect ratio. If the display size is smaller than the size of the result screen, this should be done to fit the result screen onto the display as the default.

For Multi-Frame Secondary Capture images which contain a Cine module, the Image Display shall be able to cine the frames. The default cine rate shall be the value in the Cine module, or the maximum rate of the Image Display, whichever is slower.

4.16.4.2.2.5 Presentation of Mammography images based on Workflow information (Mammography Acquisition Workflow)

This section is currently in the Mammography Acquisition Workflow (MAWF) Trial Implementation Supplement.

4.16.4.2.3 Expected Actions

The Image Display or Imaging Document Consumer presents to the user a DICOM Image.

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The Image Display or Imaging Document Consumer may receive patient data inconsistent with those received from a previously issued query or retrieve operation. For example, in the event that a patient has been renamed, the Image Display or Imaging Document Consumer will receive images with the same Study Instance UID, Series Instance UID and SOP Instance UIDs, but with a different patient name. The Image Display or Imaging Document Consumer shall use the just queried information or the most recently received instances to ensure that the most recent patient data from the Image Manger/Archive or Imaging Document Source is displayed.

The Image Display or Imaging Document Consumer shall be able to display the Series Description for each series displayed.

4.16.4.2.3.1 NM Image Specifics

Actors claiming the NM Image Profile which have applications that accept re-sliced (reconstructed tomographic) cardiac data for viewing or further processing shall make use of the View Code Sequence (0054,0220), Slice Progression Direction (0054,0500), and Acquisition Context Sequence (0040,0555) attributes to aid in the selection of input data. However, the means by which these attributes are used to identify and/or process the data is unspecified.

Note: a means for identifying and processing cardiac input data that does not include the above-mentioned attributes will likely be useful due to the existence of Images without those attributes. Series Description may be useful in such cases.

Matching related studies or series (such as stress and rest images) is an important part of NM processing and display. When Image Displays are trying to do this, they shall look for the Patient State (0038,0500) to identify such things as stress and rest images and in the NM Acquisition Context Module, the Image Orientation in the Detector Sequence, and the View Code Sequence (0054,0220) to identify images with desired orientations. Since images may exist without those fields present, the Series Description may also be examined for relevant details by the software.

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4.17 Retrieve Presentation States [RAD-17]

4.17.1 Scope

This section describes the sequence of messages required for the Image Display or Imaging Document Consumer to retrieve Grayscale Softcopy Presentation State Instances from the Image Archive or Imaging Document Source. The Image Display or Imaging Document Consumer will query and then retrieve Presentation State objects. The transformations will be applied by the Image Display or Imaging Document Consumer to the image data to assure the image display is consistent with the device that originally created and stored the Presentation State. The Image Display or Imaging Document Consumer will be required to support all transformations defined in DICOM PS3.3: A.33.1 Grayscale Softcopy Presentation State IOD. In addition, multiple Presentation States may exist that reference the same image data.

4.17.2 Actor Roles

Actor: Image Display

Role: Retrieve Grayscale Softcopy Presentation State objects together with the referenced image data and apply the transformations specified by the Presentation State. This device will implement the Query/Retrieve SOP Classes in the role of an SCU.

Actor: Imaging Document Consumer

Role: Retrieve Grayscale Softcopy Presentation State objects together with the referenced image data and apply the transformations specified by the Presentation State. This actor must support pixel rendering according to the Grayscale Standard Display Function (GSDF) defined in DICOM PS3.14. This device will implement the Query/Retrieve SOP Classes in the role of an SCU.

Actor: Image Archive

Role: Respond to retrieve requests from the Image Display for Grayscale Softcopy Presentation States objects. Transmit requested Grayscale Softcopy Presentation State object(s) to the Image Display. This device will implement the Query/Retrieve SOP Classes in the role of an SCP.

Actor: Imaging Document Source

Role: Respond to retrieve requests from the Imaging Document Consumer for Grayscale Softcopy Presentation States objects. Transmit requested Grayscale Softcopy Presentation State object(s) to the Imaging Document Consumer. This device will implement the Query/Retrieve SOP Classes in the role of an SCP.

4.17.3 Referenced Standards

DICOM PS3.4 Annex C: Query/Retrieve Service Class

DICOM PS3.14: Grayscale Standard Display Function

DICOM PS3.3 A.33.1: Grayscale Softcopy Presentation State IOD

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4.17.4 Messages

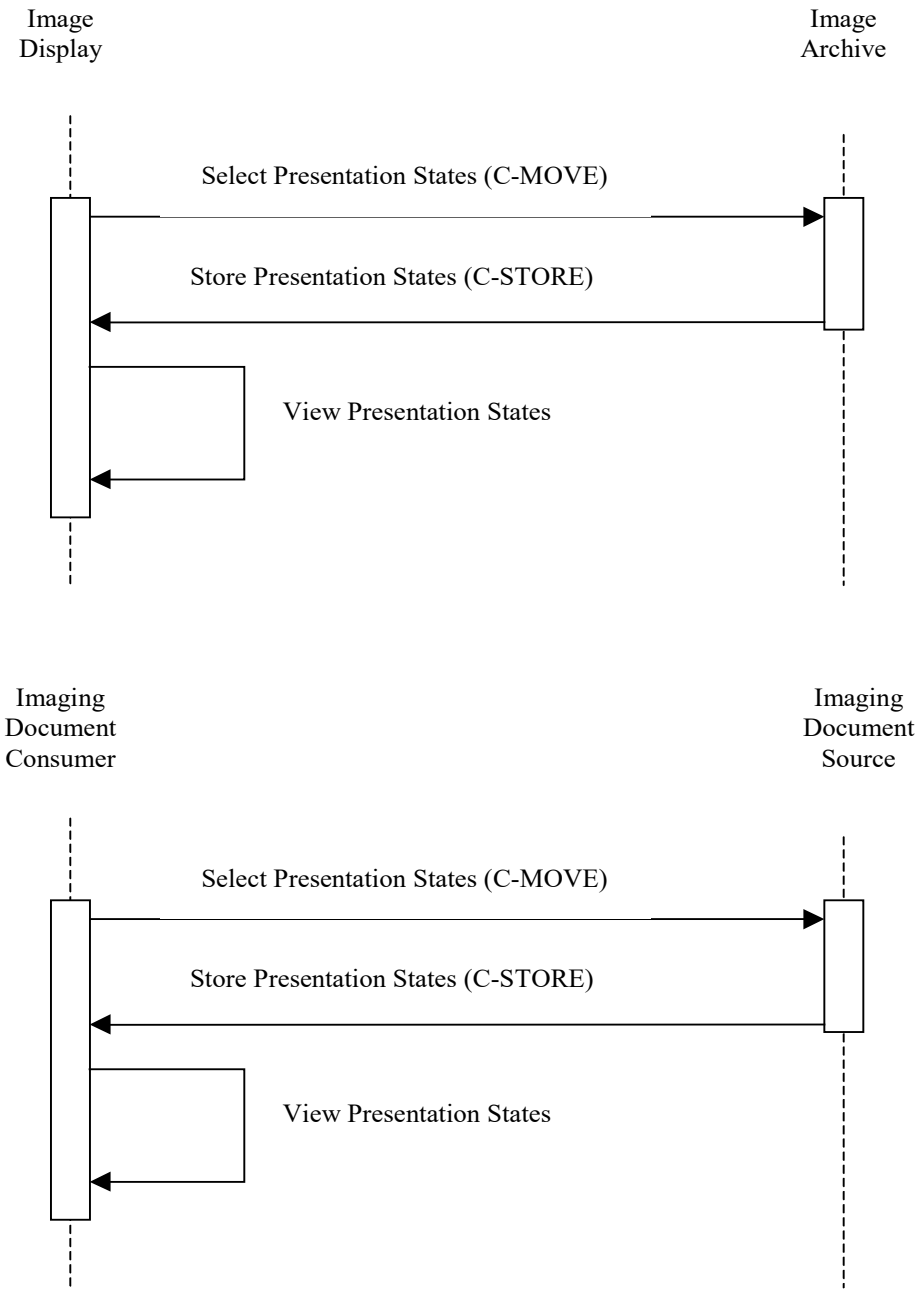

Figure 4.17.4-1: Interaction Diagrams

4.17.4.1 Retrieve Grayscale Softcopy Presentation State

This transaction refers to the “C-MOVE” and “C-STORE” messages between the Image Display and Image Archive or Imaging Document Consumer and Imaging Document Source in the above

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interaction diagram. The Retrieve (Study Root – MOVE and optionally Patient Root – MOVE) SOP Classes are supported. Refer to the DICOM PS3.4 for detailed descriptive semantics.

In the case of retrieving Grayscale Softcopy Presentation State in a Cross-Enterprise, imaging document sharing (XDS-I) network environment, a configuration of mapping the AE Titles to DICOM AE Network Addresses (IP Address and Port number) are needed to be exchanged between the Imaging Document Source and the Imaging Document Consumer. RAD TF-2x: Appendix G describes in detail the AE Title mapping to the DICOM AE Network Addresses.

4.17.4.1.1 Trigger Events

The Image Display or Imaging Document Consumer selects specific Grayscale Softcopy Presentation State objects to retrieve from the Image Archive.

4.17.4.1.2 Message Semantics

The message semantics are defined in the DICOM Query/Retrieve Service Class section of the DICOM PS3.4: Query/Retrieve Service Class. It is the responsibility of the Image Manager or Imaging Document Source to assure that the patient and procedure information is current in the images and Softcopy Presentation State objects when they are retrieved from the Image Archive or Imaging Document Source.

4.17.4.1.3 Expected Actions

The Image Archive or Imaging Document Source receives the C-MOVE request, establishes a DICOM association with the Image Display or Imaging Document Consumer, respectively, and uses the DICOM Grayscale Softcopy Presentation State Storage SOP Class to transfer the requested Presentation State objects.

4.17.4.2 View Presentation States

This transaction relates to the “View Presentation States” event in the above interaction diagram. Presentation States cannot be viewed separately, but must be applied to an image. Refer to Section 4.16 for a description of the transaction used to retrieve images to which Presentation States may be applied.

4.17.4.2.1 Trigger Events

The Image Display or Imaging Document Consumer receives Presentation State instances from the Image Archive or Imaging Document Source respectively.

4.17.4.2.2 Invocation Semantics

This is a local invocation of functions resident within the Image Display or Imaging Document Consumer. The method used by the Image Display or Imaging Document Consumer to present images for viewing by the user after the Presentation State transformations have been applied is outside the scope of the IHE Technical Framework.

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4.17.4.2.3 Expected Actions

The Image Display or Imaging Document Consumer applies the transferred Grayscale Softcopy Presentation State to image data and renders it for viewing. The Image Display shall support pixel rendering according to the Grayscale Standard Display Function (GSDF) defined in DICOM PS3.14. The Image Display or Imaging Document Consumer may receive patient data inconsistent with those received from a previously issued query or retrieve operation. For example, in the event that a patient has been renamed, the Image Display or Imaging Document Consumer will receive Softcopy Presentation State objects with the same Study Instance UID, Series Instance UID and SOP Instance UIDs, but with a different patient name. The Image Display or Imaging Document Consumer shall use the just queried information or the most recently received instances to ensure that the most recent patient data from the Image Manger/Archive or Imaging Document Source is displayed. If the number of frames (0028,0008) attribute is set to 1, then the Reference Frame Number (0008,1160) shall be ignored.

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4.18 Creator Images Stored [RAD-18]

4.18.1 Scope

In the Creator Images Stored transaction, the Evidence Creator sends the newly generated images for a study to the Image Archive.

4.18.2 Actor Roles

Actor: Evidence Creator

Role: Transmit generated image data to Image Archive.

Actor: Image Archive

Role: Accept and store images from Evidence Creators.

4.18.3 Referenced Standards

DICOM PS3.4 Annex B: Storage Service Class.

4.18.4 Messages

Figure 4.18.4-1: Interaction Diagram

4.18.4.1 Images Stored

4.18.4.1.1 Trigger Events

The Evidence Creator transfers images to the Image Archive sequentially within one or more DICOM associations, as the images become available or collectively.

Details about when it is appropriate to trigger the creation of a new Study/Series/Image Instance are described in Section 4.8.4.1.1.1 “Study UIDs and Series UIDs”.

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4.18.4.1.2 Message Semantics

The Evidence Creator uses the DICOM C-STORE message to transfer the images. The Evidence Creator is the DICOM Storage SCU and the Image Archive is the DICOM Storage SCP.

Per the DICOM Standard, the Evidence Creator shall create a new series for its created images and not extend series containing source images.

The Evidence Creator derives images from source images, and the derived images may or may not have the same Image SOP Class as the source images.

The source images may include Performed Procedure Step relationship information. This information will include Scheduled Procedure Step information for the procedure performed at an Acquisition Modality. When present in the source images, the Evidence Creator shall extract appropriate Scheduled Procedure Step information and include it with PPS information produced by the Evidence Creator.

See RAD TF-2x: Appendix A for rules on how to use the source image information in the derived image objects.

4.18.4.1.2.1 Storage of Localizer Images (MR and CT)

In addition to these general mapping requirements, in MR and CT images, the relationship between localizer or plan images and axial images shall be recorded when such a relationship exists. In such a case the attribute Referenced Image Sequence (0008,1140) of the axial image shall refer to the related localizer or plan image(s). The coordinate space for the set of related images shall be the same, which is indicated by having a single value for the attribute Frame of Reference UID (0020,0052). For CT images the axial images shall have the value AXIAL in the attribute Image Type, and the localizer image the value LOCALIZER. For MR images no specific value for image type is used to further qualify the relationship between plan and axial images. If the Evidence Creator wants to show the location of the axial images on the localizer or plan image, a Presentation State object may be created for this purpose.

4.18.4.1.2.2 Storage of NM Images (NM)

Systems supporting the NM Image Profile must support the requirements described in the Modality Images Stored transaction [RAD-8], Section 4.8.4.1.2.2 “Storage of NM Images and Section 4.8.4.1.2.2.1 NM Image IOD: Multi-Frames & Vectors”.

An Image Creator that processes cardiac tomographic images (Image Type RECON TOMO or RECON GATED TOMO) and creates new cardiac tomographic images shall copy the Acquisition Context Sequence (0040,0555) and its contents into the created images.

4.18.4.1.2.3 Storage of Cardiac Images (NM)

Evidence Creators, Acquisition Modalities or Image Displays creating reconstructed tomographic datasets shall incorporate Image Orientation [Patient] (0020,0037) (inside the Detector Information Sequence (0054,0022)), and Spacing Between Slices (0018,0088).

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In addition, Evidence Creators creating a reconstructed tomographic dataset representing standard cardiac views (e.g., Short Axis) shall include the View Code Sequence (0054,0220), Slice Progression Direction (0054,0500), and Acquisition Context Sequence (0040,0555) attributes, as appropriate.

These requirements are defined in Section 4.8.4.1.2.2 Storage of NM Images (NM), Table 4.8-2.

4.18.4.1.2.4 Result Screen Export Option

Evidence Creators claiming support of the Result Screen Export Option shall be capable of storing Result Screens as described in this section.

Result Screens refer to a presentation of result elements on the display, potentially including graphics, images and text, typically found on clinical analysis software such as NM cardiac packages.

This option is intended to provide a way of exporting snapshots of Result Screens as DICOM objects so they can be viewed elsewhere on generic DICOM display systems. As things like DICOM SR Templates for various clinical results become available, such coded data formats provide a more robust solution and should be used in preference to the Result Screen Export Option. This Option is not intended to be used for transferring the clinical data for processing or database purposes.

This option will refer to result screens which include moving images or graphics, such as a beating heart or rotating image, as Dynamic Result Screens. Result screens which do not include moving components will be referred to as Static Result Screens.

Result screens which are completely presented in shades of grey will be referred to as Greyscale Result Screens. Result screens which use color presentation will be referred to as Color Result Screens. Result screens which present images in greyscale and only use small amounts of color for the graphics may optionally be considered Greyscale Result Screens.

The Evidence Creator shall be capable of storing result screens it presents as described in this section. Note that if an Evidence Creator does not present Dynamic Result Screens, it is not required to implement the dynamic features described, and if an Evidence Creator does not present Color Result Screens, it is not required to implement the color features described.

The Evidence Creator shall use DICOM Secondary Capture (SC) IODs or Multi-Frame Secondary Capture (MFSC) IODs for storing Static Result Screens (see DICOM PS3.3 Section A.8 Secondary Capture Image IOD). The use of MFSC IODs is preferred over the use of simple SC IODs due to the lack of attributes to indicate the content of the image, derivation and source of inputs, and other ambiguities in the SC IODs.

Static Result Screens may be stored using the DICOM SC Image and a set of Static Result Screens may be stored one at a time in DICOM SC Images, however it is strongly recommended that the DICOM MFSC Image IODs be used both for sets of Static Result Screens and individual Static Result Screens.

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When multiple Static Result Screens are stored in a DICOM MFSC object, the Cine module shall not be included. The order of the Static frames in the MFSC shall represent the intended display order of the result screens.

The Evidence Creator shall use DICOM MFSC IODs for storing Dynamic Result Screens. The cine module shall be included as described in Table 4.18-1. The frames shall be ordered to present a cine of the Dynamic Result Screen. The number of frames is not specified here. If there are several cine regions in the result screen and the length of their cine "cycle" is not the same, it is acceptable if there is a "jump" in the playback when the MFSC cycle loops back to the beginning.

The Evidence Creator shall support export of Color Result Screens as 24-bit RGB. Dynamic Color Result Screens shall be stored using Multi-frame True Color Secondary Capture Image Storage.

The system shall also support export of result screens as 8-bit grayscale. It will sometimes be useful to export a given result screen in both color and greyscale formats. Evidence Creators that only present grayscale results are not required to export them as 24-bit RGB.

Multiple SC and/or MFSC objects may be created in the same series to collect result screens which are associated by processing run as long as doing so doesn't violate the Series rules outlined in RAD TF-1x: Appendix E.4.1 Study UIDs and Series UIDs.

The image Instance Numbers shall be set/incremented to reflect the intended display order.

Each time processing is repeated to create new Result Screens, it shall generate a new series.

Conversion Type (0008,0064) in the SC Equipment module shall have a value of "WSD" (indicating images generated by a Workstation).

Series Description (0008,103E) in the General Series module shall include an indication that these are result screens.

Derivation Description (0008,2111) shall contain a description of the nature of the results and/or the processing that generated them.

Modality (0008,0060) shall reflect the modality of the data used to generate the Result Screens.

To ensure maximum compatibility with a variety of display systems, the Frame Time, Recommended Display Frame rate, and Cine Rate attributes in the Cine Module shall all be set to reflect the same frame rate.

These values reflect the display rate of the stored result cine. It is not necessary to set the value to reflect "real world values" such as the actual patient heart rate.

Table 4.18-1: Required Attributes for Multiframe Secondary Capture Cine Module

Attribute	Tag	Type	Attribute Description
Preferred Playback Sequencing	(0018,1244)	R+	Describes the preferred playback sequencing for a multi-frame image. Shall have a value of 0 (which indicates Looping (1,2,..n,1,2,..n))

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Attribute	Tag	Type	Attribute Description
Cine Rate	(0018,0040)	R+	Number of frames per second at which the Evidence Creator intends the results to be presented.
Frame Time	(0018,1063)	R	Nominal time (in msec) per individual frame. Equals 1000/CineRate
Recommended Display Frame Rate	(0008,2144)	R+	Same as Cine Rate

4.18.4.1.2.5 Storage of DBT Reconstructions

Evidence Creators that support the Digital Breast Tomosynthesis (DBT) Profile shall support all of the attribute requirements in Section 4.8.4.1.2.7 for Acquisition Modalities supporting the Breast Tomosynthesis Image Storage SOP Class.

Evidence Creators shall store derived tomosynthesis reconstructions (e.g., slabs) using the Breast Tomosynthesis Image Storage SOP Class.

4.18.4.1.2.6 Enterprise Identity Option

An Evidence Creator supporting the Enterprise Identity Option shall include values for the following Patient Context-critical attributes in the generated SOP instances that are copied from the corresponding source attribute in the originating SOP instance, if available:

Table 4.18-2: Enterprise Identity Option – Patient context-critical attributes

Patient Context-critical Attributes	Tag
Issuer of Patient ID	(0010,0021)
Issuer of Patient ID Qualifiers Sequence	(0010,0024)
>Universal Entity ID	(0040,0032)
>Universal Entity ID Type	(0040,0033)
Other Patient IDs Sequence	(0010,1002)
>Patient ID	(0010,0020)
>Issuer of Patient ID	(0010,0021)
>Issuer of Patient ID Qualifiers Sequence	(0010,0024)
>>Universal Entity ID	(0040,0032)
>>Universal Entity ID Type	(0040,0033)
>Type of Patient ID	(0010,0022)

In the case where Issuer of Patient ID and Issuer of Patient ID Qualifiers Sequence attributes are not explicitly supplied in the SOP Instances received, the Evidence Creator shall not include values for these attributes in the generated SOP Instances sent.

Note: this requirement is intended to reduce complexity of information reconciliation on the Image Manager and Order Filler. An implementation that supports configuration of default values for these attributes will need to be configured, so that these defaults contain no value.

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An Evidence Creator supporting the Enterprise Identity Option shall include values for the following Accession Context-critical attributes in the generated SOP instances that are copied from the corresponding source attribute in the originating SOP instance, if available:

Table 4.18-3: Enterprise Identity Option – Accession context-critical attributes

Accession Context-critical Attributes	Tag
Issuer of Accession Number Sequence	(0008,0051)
>Local Namespace Entity ID	(0040,0031)
>Universal Entity ID	(0040,0032)
>Universal Entity ID Type	(0040,0033)

An Evidence Creator shall send values for the following Institution Context-critical attributes in the generated SOP Instances describing where the SOP Instances were created:

Table 4.18-4: Enterprise Identity Option – Institution context-critical attributes

Institution Context-critical Attributes	Tag
Institution Name	(0008,0080)
Institution Address	(0008,0081)
Institution Code Sequence	(0008,0082)
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)
>Code Meaning	(0008,0104)

These institution values shall be configurable as part of the Evidence Creator's default setup parameters. Note that the original images may not be acquired at the same institution where the evidence documents are created.

For mobile devices which create Evidence Documents at multiple locations, there may be multiple default values, one for each institution the device is used.

4.18.4.1.2.7 View correction in Mammography Images (MAWF)

This section is currently in the Mammography Acquisition Workflow (MAWF) Trial Implementation Supplement.

4.18.4.1.3 Expected Actions

The Image Archive will store the received DICOM objects.

The DICOM objects shall be stored such that they can be later retrieved (see Section 4.16 Retrieve Images) in a fashion meeting the requirements defined for a DICOM Level 2 Storage SCP (refer to DICOM PS3.4 Section B.4.1).

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4.18.4.1.3.1 DICOM Image Storage SOP Classes

Image Archives that support the NM Image Profile are required to support all of the SOP classes listed in Table 4.8-5. Evidence Creators that support the NM Image Profile are required to support at least one of the SOP classes listed in Table 4.8-5.

Evidence Creators shall be capable of providing all created Nuclear Medicine image types using the Nuclear Medicine Image SOP class.

Image Archives and Evidence Creators that support the Digital Breast Tomosynthesis (DBT) Profile are required to support the Breast Tomosynthesis Image Storage SOP Class.

Evidence Creators that support the Result Screen Export Option are required to support all the SOP classes listed in Table 4.18-5 that are dictated by the Evidence Creators result presentation capabilities, as described in Section 4.18.4.1.2.4.

Table 4.18-5: Result Screen Export SOP Classes

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.7	Secondary Capture Image Storage
1.2.840.10008.5.1.4.1.1.7.2	Multi-frame Grayscale Byte Secondary Capture Image Storage
1.2.840.10008.5.1.4.1.1.7.4	Multi-frame True Color Secondary Capture Image Storage

4.18.4.1.3.2 Enterprise Identity Option

An Image Manager supporting the Enterprise Identity Option shall support the requirements from Section 4.8.4.1.3.2 Enterprise Identity Option.

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4.19 Creator Presentation State Stored [RAD-19]

4.19.1 Scope

This section describes DICOM Grayscale Softcopy Presentation States Storage requests issued by the Evidence Creator to the Image Archive. The Evidence Creator sends Presentation States for storage along with the images so they could be later used for support of consistent display of imaging data. The Evidence Creator is the DICOM Store SCU and the Image Archive is the DICOM Store SCP. DICOM PS3.3: A.33.1 Grayscale Softcopy Presentation State IOD defines the transformations supported by this transaction.

4.19.2 Actor Roles

Actor: Evidence Creator

Role: Generate Grayscale Softcopy Presentation States to be applied to image data. This actor will support the ability to send Presentation State data to an Image Archive.

Actor: Image Archive

Role: Accept and store Grayscale Softcopy Presentation State Instances received from the Evidence Creator. This transaction describes the role related only to storage of the Presentation State information.

4.19.3 Referenced Standards

DICOM PS3.4 Annex B: Storage Service Class

DICOM PS3.4 Annex N: Softcopy Presentation State Storage SOP Classes

DICOM PS3.14: Grayscale Standard Display Function

4.19.4 Messages

Figure 4.19.4-1: Interaction Diagram

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4.19.4.1 Creator Presentation State Stored

4.19.4.1.1 Trigger Events

The Evidence Creator generates a Grayscale Softcopy Presentation State Instance and sends it to the Image Archive for storage.

4.19.4.1.2 Message Semantics

The Evidence Creator uses the DICOM C-STORE message to store Grayscale Softcopy Presentation States. All grayscale processing operations, and all spatial and graphical operations, that are relevant to the resulting presentation of the referenced image have to be recorded in the presentation state. This will preserve the "as-last-seen" view of the image, with for example the contrast setting, rotation, flip and text annotation. The image operations in the presentation state override whatever is recorded in the image itself, even in the case that no attributes for a specific operation (e.g., Window Width/Window Level operation) are present in the presentation state. The latter case by definition specifies an identity operation. The full message semantics are defined in the Grayscale Softcopy Presentation State Storage SOP Class behavior section of DICOM PS3.4.

The Evidence Creator derives images and Grayscale Softcopy Presentation State objects from source images that may include Modality Performed Procedure Step relationship information. This information will include Scheduled Procedure Step information for the procedure performed at an Acquisition Modality. When present in the source images, the Evidence Creator shall extract appropriate Scheduled Procedure Step information and include it with PPS information produced by the Evidence Creator.

Grayscale Softcopy Presentation States that reference multi-frame images shall populate the Referenced Frame Number (0008,1160) in each applicable occurrence of the Referenced Image Sequence (0008,1140) in the Grayscale Softcopy Presentation State, unless the presentation state applies to all the frames in the image.

4.19.4.1.3 Expected Actions

The Image Archive will store the received Grayscale Softcopy Presentation State objects.

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4.20 Creator Procedure Step In Progress [RAD-20]

4.20.1 Scope

This Performed Procedure Step of the Evidence Creator will be appended to the Modality Performed Procedure Steps done at the Acquisition Modality for the same Scheduled Procedure Step. It includes a message from the Evidence Creator to the Performed Procedure Step Manager, which in turn issues the messages to the Department System Scheduler/Order Filler and the Image Manager. The Performed Procedure Step Manager must support forwarding messages to two different destinations. It shall start issuing messages to the configured destinations immediately after it accepts the corresponding messages from the Evidence Creator.

For the details on the Performed Procedure Step Manager refer to Section 4.6.1.

4.20.2 Actor Roles

Actor: Department System Scheduler/Order Filler

Role: Receives the PPS information forwarded by the Performed Procedure Step Manager

Actor: Image Manager

Role: Receives the PPS information forwarded by the Performed Procedure Step Manager

Actor: Evidence Creator

Role: Informs the Performed Procedure Step Manager that a particular Performed Procedure Step has started

Actor: Performed Procedure Step Manager

Role: Accepts Performed Procedure Step information from an Evidence Creator and transmits it to the Department System Scheduler/Order Filler and Image Manager

4.20.3 Referenced Standards

DICOM PS3.4 Annex F: Modality Performed Procedure Step SOP Class.

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4.20.4 Messages

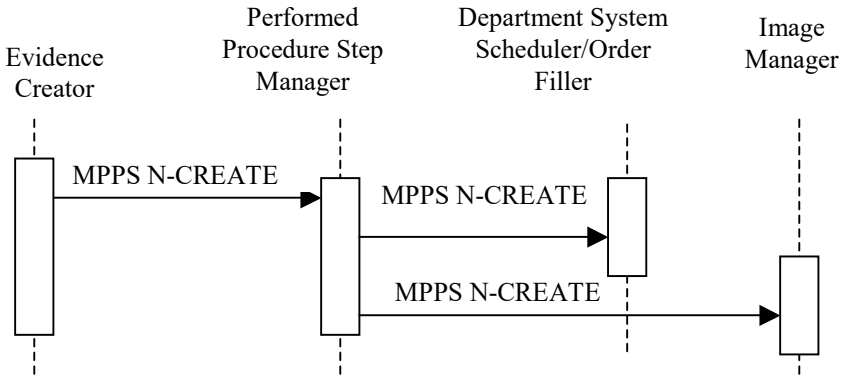

Figure 4.20.4-1: Interaction Diagram

4.20.4.1 Procedure Step Started Message

4.20.4.1.1 Trigger Event

Technologist begins with the generation of DICOM objects such as images, Key Image Notes or Presentation States at the Evidence Creator station.

4.20.4.1.2 Message Semantics

The Evidence Creator uses the Modality Performed Procedure Step SOP Class (N-CREATE Service) to inform the Performed Procedure Step Manager that a specific image generation Procedure Step has been started and is in progress. In turn, the Performed Procedure Step Manager uses the N-CREATE Service to forward the information to the Department System Scheduler/Order Filler and Image Manager. The SOP Instance UID value of the Performed Procedure Step shall be conveyed in the Affected SOP Instance UID (0000,1000) during this interchange (see also corresponding notes in RAD TF-2x: Appendix A.1). The following aspects shall be taken into the account during implementation of this step.

4.20.4.1.2.1 Patient/Procedure/Procedure Step Information

The Evidence Creator shall ensure that the Patient/Procedure/Procedure Step information it has is valid and current. In this case a Modality Worklist does not provide the identification and relationship information, but the Evidence Creator extracts the Scheduled Procedure Step information from the images it uses as originals. If those images satisfied several Scheduled Procedure Steps, information about all of them may be recorded in the resulting PPS messages and image headers.

4.20.4.1.2.2 Required Attributes

RAD TF-2x: Appendix A lists a number of attributes that have to be properly handled by the Evidence Creator to ensure consistency between Performed Procedure Step object attributes and information included into the generated images.

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4.20.4.1.2.3 Relationship between Scheduled and Performed Procedure Steps

In this case the Scheduled Procedure Step is specified in the relationship part of the MPPS information in the source images. Therefore, we have the Append Case relationship between Scheduled and Performed Steps. Refer to RAD TF-2x: Appendix A for details of forming attributes (Study Instance UID, Procedure ID, Accession Number, etc.) in this case.

4.20.4.1.2.3.1 Append Case

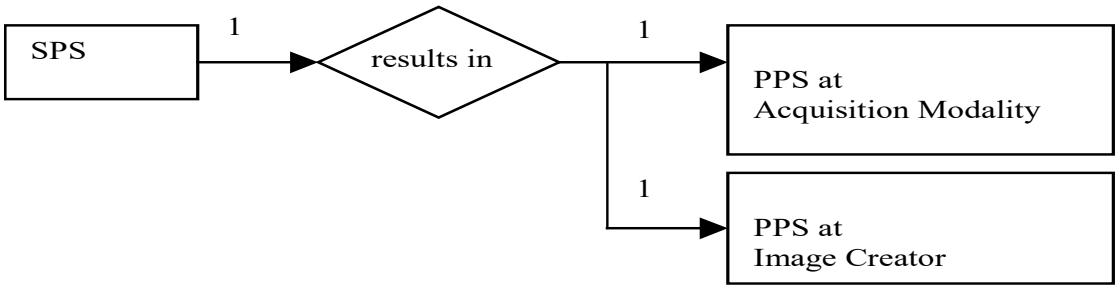

Figure 4.20.4.1.2.3.1-1: Append to a Normal Case

This is a special case of 1-to-N relationship between SPS and PPS where the first PPS is generated at the Acquisition Modality in response to an SPS. The new Performed Procedure Step is added at the Evidence Creator at a later time. The Performed Procedure Step will refer back to the same Requested Procedure and to the original SPS. All Requested Procedure and Scheduled Procedure Step attributes contained in the source images shall be copied to the Performed Procedure Step Relationship Module and the image Request Attribute Sequence (see RAD TF-2x: Appendix A).

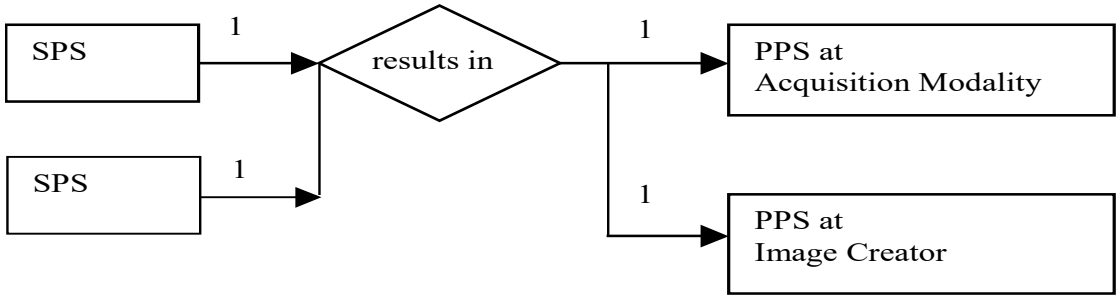

Figure 4.20.4.1.2.3.1-2: Append to a Group Case

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When the first PPS generated at the Acquisition Modality results from a Group Case (see Section 4.6.4.1.2.3.4 or 4.6.4.1.2.3.6), the Performed Procedure Step appended by the Evidence Creator may refer back to any one or more of the original SPSs and related Requested Procedure(s) which were grouped, using information from the Request Attribute Sequence in the original images. The corresponding attributes shall be copied from the images to the Performed Procedure Step Relationship Module and the image Request Attribute Sequence (see RAD TF-2x: Appendix A).

Note: For example, following a PPS performed on an MR Modality in response to the grouping of a "neck" SPS and a "head" SPS, a 3D analysis on the MR head images is performed on the Image Display/Creator. This Display/Creator application may choose to link the appended PPS associated with the 3D secondary captures images resulting from the 3D analysis with both the head and the neck SPSs.

4.20.4.1.2.4 Enterprise Identity Option

An Evidence Creator supporting the Enterprise Identity Option shall send values for the following Patient Context-critical attributes as specified in RAD TF-2x: Appendix A to ensure consistency between Performed Procedure Step object attributes, Scheduled Procedure Step information, and the information included in MPPS objects that are copied from the corresponding source attribute in the originating SOP Instance, if available:

Table 4.20-1: Enterprise Identity Option – Patient context-critical attributes

Patient Context-critical Attributes	Tag
Issuer of Patient ID	(0010,0021)
Issuer of Patient ID Qualifiers Sequence	(0010,0024)
>Universal Entity ID	(0040,0032)
>Universal Entity ID Type	(0040,0033)
Other Patient ID Sequence	(0010, 1002)
>Patient ID	(0010,0020)
>Issuer of Patient ID	(0010,0021)
>Issuer of Patient ID Qualifiers Sequence	(0010,0024)
>>Universal Entity ID	(0040,0032)
>>Universal Entity ID Type	(0040,0033)

An Evidence Creator shall send values for the following Accession Context-critical attributes as specified in RAD TF-2x: Appendix A to ensure consistency between the Performed Procedure Step object attributes, Scheduled Procedure Step information from the originating SOP Instances, and the information included in the generated MPPS objects, if available:

Table 4.20-2: Accession Identity Option – Patient context-critical attributes

Accession Context-critical Attributes	Tag
Issuer of Accession Number Sequence	(0008,0051)
>Local Namespace Entity ID	(0040,0031)

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Accession Context-critical Attributes	Tag
>Universal Entity ID	(0040,0032)
>Universal Entity ID Type	(0040,0033)

4.20.4.1.3 Expected Actions

The DSS/Order filler receives information from the Performed Procedure Step Manager and links it with the Requested Procedure. If the Requested Procedure ID is transmitted empty, the Department System Scheduler/Order Filler and the Image Manager will create an exception that must be manually resolved to link the Performed Procedure Step to the appropriate procedure.

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4.21 Creator Procedure Step Completed [RAD-21]

4.21.1 Scope

This transaction includes a message from the Evidence Creator to the Performed Procedure Step Manager, which in turn issues the messages to the DSS/Order Filler and the Image Manager that the Performed Procedure Step has been completed. Information is not being released for billing at this point but a code may be assigned. The Image Manager may need the information to co-locate SOP instances of the same study. The Performed Procedure Step Completed message does not necessarily mean that the set of images is complete or available for retrieval.

4.21.2 Actor Roles

Actor: Departmental System Scheduler/Order Filler

Role: Receives the PPS information forwarded by the Performed Procedure Step Manager

Actor: Image Manager

Role: Receives the PPS information forwarded by the Performed Procedure Step Manager

Actor: Evidence Creator

Role: Informs the Performed Procedure Step Manager that a particular Performed Procedure Step is completed

Actor: Performed Procedure Step Manager

Role: Accepts Performed Procedure Step information from an Evidence Creator and transmits it to the Department System Scheduler/Order Filler and the Image Manager

4.21.3 Referenced Standards

DICOM PS3.4 Annex F: Modality Performed Procedure Step SOP Class.

4.21.4 Messages

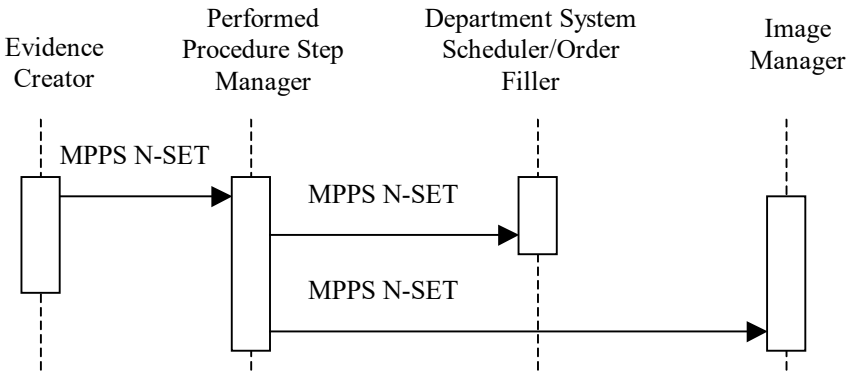

Figure 4.21.4-1: Interaction Diagram

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Note: The diagram above shows the sequencing of messages for the Performed Procedure Step SOP Class. Evidence Creators will also implement the Storage and Storage Commitment classes. The timing relationship between MPPS messages and Storage and Storage Commitment messages is not specified. That is, MPPS messages may occur before or after storage requests.

4.21.4.1 Procedure Step Completed/Discontinued

4.21.4.1.1 Trigger Event

Technologist completes the procedure step from the Evidence Creator station.

4.21.4.1.2 Message Semantics

The Evidence Creator uses the Modality Performed Procedure Step SOP Class (N-SET Service) to inform the Performed Procedure Step Manager that a specific Procedure Step has been completed or discontinued. For further details on the message semantics refer to Section 4.7.4.1.2.

The Evidence Creator derives images and Grayscale Softcopy Presentation State objects from source images that include Performed Procedure Step information. This information will include scheduled step information for the procedure performed at an Acquisition Modality. When present in the source images, the Evidence Creator shall extract appropriate PPS information and include it with the PPS messages and the images produced by the Evidence Creator.

Note: DICOM specifies that when attributes are allowed to be set by an N-SET, the value provided by the last N-SET overrides any value set by an earlier N-CREATE or N-SET.

4.21.4.1.2.1 PPS Exception Management Option

When an Evidence Creator supports the PPS Exception Management Option, it shall provide the appropriate reason codes (often selected by the operator) in the final N-SET sent with the status of DISCONTINUED.

When the Modality Procedure Step is sent with the Status DISCONTINUED, the Modality Procedure Step Discontinuation Reason Code Sequence (0040,0281) shall be sent with one of the values defined DICOM PS3.16 Annex B CID 9301 Modality PPS Discontinuation Reasons.

The Reason Code when communicated to the DSS/Order Filler and Image Manager/Archive may imply canceling an order. It may also facilitate more accurate charge posting.

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4.22 Intentionally Left Blank

This transaction was defined in earlier versions of the Radiology Technical Framework. It is now combined with Storage Commitment in transaction [RAD-10].

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4.23 Print Request with Presentation LUT [RAD-23]

4.23.1 Scope

This transaction supports the capability of the Print Composer to ensure display consistency for images rendered by the Print Server. The Print Composer sends a DICOM Print Request to the Print Server. The request includes the specification of a Presentation Look Up Table (LUT) to be applied to the image data at the Film Box level. The Print Composer will be the DICOM Print SCU and the Print Server will be the DICOM Print SCP.

4.23.2 Actor Roles

Actor: Print Composer

Role: Generate DICOM Print Requests as a DICOM Print SCU. Systems which include display capability must support pixel rendering according to the DICOM Grayscale Standard Display Function (GSDF) as defined in DICOM PS3.14. The Print Requests must specify and reference Presentation LUTs to be applied by the SCP to the image data to maintain desired image perception.

Actor: Print Server

Role: Process DICOM Print Requests as a DICOM Print SCP. The system must support pixel rendering according to the DICOM Grayscale Standard Display Function (GSDF) as defined in DICOM PS3.14 and be able to transform the image data using the specified Presentation LUT to produce the desired image perception.

4.23.3 Referenced Standards

DICOM PS3.4 Annex H: Print Management Service Class

DICOM PS3.4 Section H.4.9: Presentation LUT SOP Class

DICOM PS3.14: Grayscale Standard Display Function

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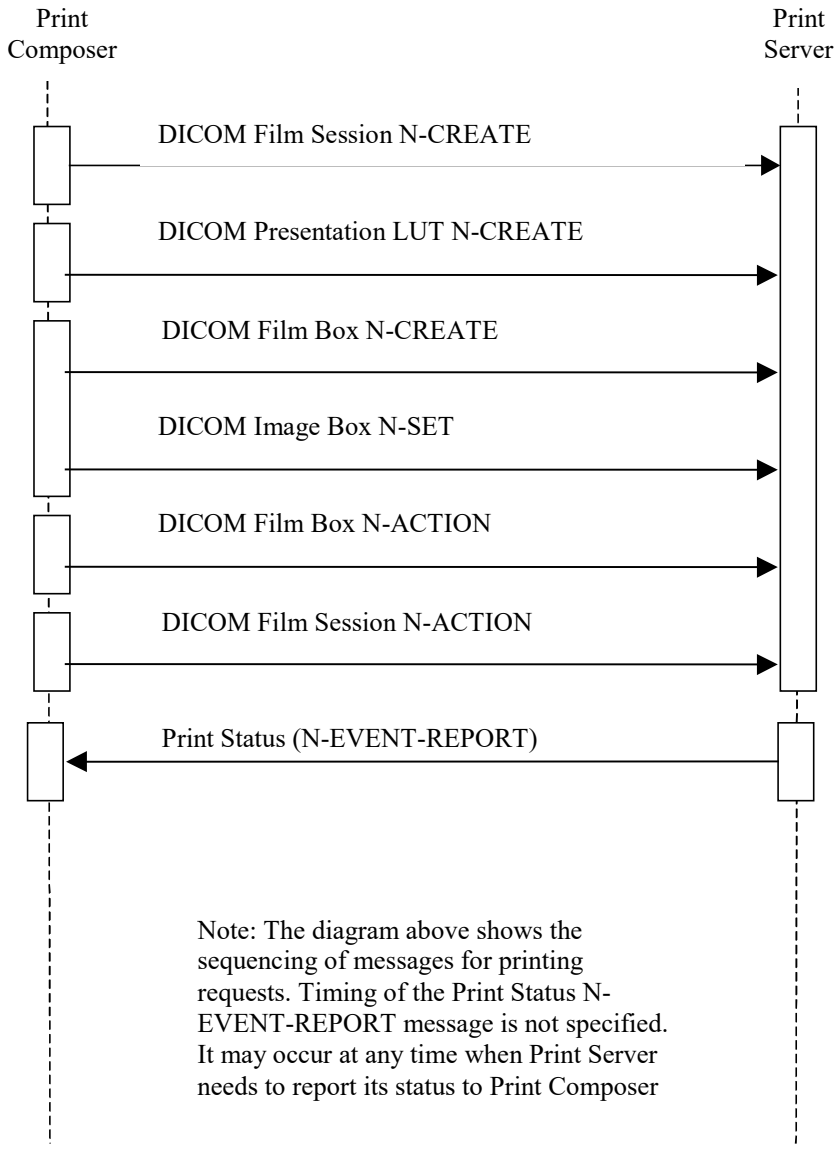
4.23.4 Messages



6805 **Figure 4.23.4-1: Interaction Diagram**

4.23.4.1 DICOM Film Session N-CREATE

Support of this message is required for the Print Composer and Print Server in the IHE Technical Framework. The Film Session N-CREATE message describes the presentation parameters

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common to all sheets of film in a film session. Implementation of this message will be according to the DICOM Basic Print Management Meta SOP Class.

4.23.4.1.1 Trigger Events

The Print Composer initiates a Print Request to the Print Server.

4.23.4.1.2 Message Semantics

The DICOM Print Management Service Class Behavior defines the message semantics for the Basic Film Session SOP Class.

4.23.4.1.3 Expected Actions

The Print Server shall create the Film Session SOP Instance and initialize attributes as specified in the N-CREATE. The Print Server shall return the status code of the requested SOP Instance creation as defined for the Basic Film Session SOP Class.

4.23.4.2 DICOM Presentation LUT N-CREATE

The Presentation LUT data specified by this N-CREATE will be used to transform the image data at the film box level to realize specific image display characteristics suitable to the Print Composer. In addition, this message can use the Presentation LUT Shape Attribute to specify a pre-defined Presentation LUT Shape (The Presentation LUT Shape value of "LIN OD" will not be supported for the IHE Radiology Technical Framework, except for the Mammography Image Profile (see Section 4.23.4.8). Presentation LUT information will only be specified and applied at the Film Box level.

Note: In the event a Print Composer chooses to specify a Presentation LUT Shape of IDENTITY instead of a Presentation LUT then the image data will be sent to the Print Server in the form of P-values for interpretation by the Print Server according to the GSDF.

Note: Print composers are encouraged to refer to DICOM PS3.14 Annex B for calibration measurements requirements. Where these data are not available or when it is uncertain on which viewbox the film will be viewed, Print Composers may use the suggested default values specified in DICOM PS3.14 for the attributes of Illumination (2010,015E) and Reflected Ambient Light (2010,0160) for conventional images (for Mammography Image Requirements, see Section 4.23.4.8). For transmissive hardcopy printers the standard recommends 2000 cd/m² for Illumination and 10 cd/m² for reflected ambient light. For reflective hardcopy printers the standard recommends 150 cd/m² for Illumination (maximum luminance obtainable from diffuse reflection of the illumination present.) These values are also consistent with those used in the illustrative examples in DICOM PS3.14 Annex D.

4.23.4.2.1 Trigger Events

This message will be triggered when the Print Composer receives a successful status response from the Print Server following transmission of the Film Session N-CREATE message.

4.23.4.2.2 Message Semantics

The DICOM Print Management Service Class Behavior defines the message semantics for the Presentation LUT SOP Class. Presentation LUTs supplied by the Print Composer will be required to have a number of entries corresponding to the bit depth of the image data (e.g., 256 entries for 8 bit image data, 4096 entries for 12 bit image data).

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4.23.4.2.3 Expected Actions

The Print Server shall create a Presentation LUT SOP Instance and initialize attributes as specified in the N-CREATE. The Print Server shall return the status code of the requested SOP Instance creation as defined for the Presentation LUT SOP Class.

4.23.4.2.4 User Specifiable Lighting Condition Option

When a Print Composer supports the User Specifiable Lighting Condition Option, it shall provide the means to override the default values for the attributes of Illumination (2010,015E) and Reflected Ambient Light (2010,0160).

The suggested default values specified in DICOM PS3.14 for the attributes of Illumination (2010,015E) and Reflected Ambient Light (2010,0160) are clinical practice guidelines for average viewing conditions which are sufficient in cases where the clinical user does not know on which light box the film will be viewed (see also the Consistent Presentation of Images whitepaper by Marco Eichelberg, et. al. entitled Consistency of Softcopy and Hardcopy: Preliminary Experiences with the new DICOM Extensions for Image Display, Proceedings of SPIE 2000.).

4.23.4.3 DICOM Film Box N-CREATE

Per the DICOM standard support of this message is required by the Print Composer and Print Server in the IHE Radiology Technical Framework. The Film Box N-CREATE message describes the presentation parameters common to a single sheet of film in a film session.

4.23.4.3.1 Trigger Events

This message will be triggered when the Print Composer receives a successful status response from the Print Server following transmission of the Presentation LUT N-CREATE message.

4.23.4.3.2 Message Semantics

The DICOM Print Management Service Class Behavior defines the message semantics for the Basic Film Box SOP Class. A Film Box N-CREATE will be issued for each sheet of film in a multi-film session. The Print Composer, behaving as a DICOM Print SCU, may use default values for Illumination (2010,015E), Reflective Ambient Light (2010,0160), Min Density (2010,0120), and Max Density (2010,0130) as specified in DICOM PS3.14. In addition, the Film Box N-CREATE message will reference Presentation LUT SOP instances created by the Presentation LUT N-CREATE message. Table 4.23-1 below specifies the Basic Film Box Attribute values required to be supported by the SCU.

Table 4.23-1: Film Box Module Attributes Supported by the Print Composer

Tag	Attribute Name	Supported Values
(2010,0010)	Image Display Format	STANDARD\C, R (C = columns, R = rows)

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Tag	Attribute Name	Supported Values
(2010,0040)	Film Orientation	PORTRAIT LANDSCAPE
(2010,0050)	Film Size ID	8INX10IN 11INX14IN 14INX17IN
(2010,0060)	Magnification Type	REPLICATE BILINEAR CUBIC NONE

4.23.4.3.3 Expected Actions

The Print Server shall create the Film Box SOP Instance and initialize attributes as specified in the N-CREATE. The Print Server will create an Image Box SOP Instance for each image box defined by the Image Display Format attribute (2010,0010) at the time the Basic Film Box SOP Instance is created. The Print Server shall return the status code of the requested SOP Instance creation as defined for the Basic Film Box SOP Class. Additional behavior is defined in the description of the Basic Film Box SOP Class for the DICOM Print Management Service Class within the DICOM Standard.

4.23.4.4 DICOM Image Box N-SET

Per the DICOM standard support of this message is required by Print Composer and Print Server in the IHE Technical Framework. The Image Box N-SET message describes the presentation parameters and image pixel data specific to a single image box on a single sheet of film within a film session.

4.23.4.4.1 Trigger Events

This message will be triggered when the Print Composer receives a successful status response from the Print Server following transmission of the Film Box N-CREATE message.

4.23.4.4.2 Message Semantics

The DICOM Print Management Service Class Behavior defines the message semantics for the Image Box SOP Classes. An Image Box N-SET will be issued for each Image Box defined by the Display Format attribute (2010,0010) of the Film Box N-CREATE message.

4.23.4.4.3 Expected Actions

The Print Server will apply the specified image box attributes to the Image Box SOP Instance. The Print Server shall return the status code of the requested SOP Instance update as defined for the Image Box SOP Class.

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4.23.4.5 DICOM Film Box N-ACTION

Support of this message is required by the Print Composer and Print Server in the IHE Technical Framework. The Film Box N-ACTION message is used to print a single sheet of film in the film session.

4.23.4.5.1 Trigger Events

This message will be triggered when the Print Composer receives a successful status response from the Print Server following transmission of the last Image Box N-SET message for the specified Film Box.

4.23.4.5.2 Message Semantics

The DICOM Print Management Service Class Behavior defines the message semantics for the Film Box SOP Classes.

4.23.4.5.3 Expected Actions

The Print Server prints the sheet of film described by the film box. Presentation LUT SOP Instances referenced at the Film Box or Image Box levels will be applied to the image data. The Print Server shall return the appropriate status code as defined for the Film Box N-ACTION DIMSE Service of the DICOM Print Management Service Class.

4.23.4.6 DICOM Film Session N-ACTION

Support of this message is optional by the Print Composer and Print Server in the IHE Technical Framework. The Film Session N-ACTION message is used to print all sheets of film in the film session.

4.23.4.6.1 Trigger Events

This message will be triggered when the Print Composer receives a successful status response from the Print Server following transmission of the last Image Box N-SET message for the specified Film Session.

4.23.4.6.2 Message Semantics

The DICOM Print Management Service Class Behavior defines the message semantics for the Film Session SOP Classes.

4.23.4.6.3 Expected Actions

The Print Server prints the film session. Presentation LUT SOP Instances referenced at the Film Box or Image Box levels will be applied to the image data. The Print Server shall return the appropriate status code as defined for the Film Session N-ACTION Service of the DICOM Print Management Service Class.

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4.23.4.7 Print Status (N-EVENT-REPORT)

Per the DICOM standard, support of this message is required by the Print Composer and Print Server in the IHE Radiology Technical Framework. The N-EVENT-REPORT is used to report Print Server status to the Print Composer in an asynchronous manner. That is, a print SCP may send an N-EVENT-REPORT message while the SCU is transmitting additional print commands. The SCU and SCP are required to accommodate these asynchronous messages.

4.23.4.7.1 Trigger Events

This message will be triggered when the Print Server senses a change in the status related to the Print Request that is worthy of notification to the Print Composer.

4.23.4.7.2 Message Semantics

The DICOM Print Management Service Class Behavior defines the message semantics for the Printer SOP Class.

4.23.4.7.3 Expected Actions

The Print Composer will return the confirmation of the N-EVENT-REPORT operation to the Print Server.

4.23.4.8 Mammography Image and Digital Breast Tomosynthesis Profile

Requirements specific to print are specified for mammography since there are regulatory requirements in many jurisdictions with respect to the need to provide the patient with images of primary diagnostic quality that are appropriately annotated.

Print Composers participating in the Mammography Image Profile or the Digital Breast Tomosynthesis Profile shall:

- Be capable of true size printing of all the pixels of a single view per sheet of film based on the value stored in Imager Pixel Spacing (0018,1164) in the Mammography Image SOP Instances being printed, so that distance measurements made optically on the printed film will be approximately equivalent to those made on a film-screen mammography exposure, and shall use Requested Image Size (2020,0030) to command the Print Server to use the correct image size. Note that the Imager Pixel Spacing (0018, 1164) should not be corrected by Estimated Radiographic Magnification Factor (0018,1114), since doing so for magnified views would not only exceed the size of the available print area, but would deviate from the accepted film-screen practice.
- For Breast Tomosynthesis Image SOP Instances, be capable of true size printing of all the pixels of a selected frame per sheet of film based on the value stored in Pixel Spacing (0020,0030), and shall use Requested Image Size (2020,0030) to command the Print Server to use the correct image size. When printing selected frames of a magnified view, if printing the entire field of view, the Print Composer shall not send Requested Image Size (2020,0030).

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- Be capable of justifying the images in the print request such that the chest wall will be printed as close to the edge of the film as the Print Server is capable.
- Be capable of sending the Maximum Density attribute (2010,0130).
- For Digital Mammography X-Ray Image SOP instances, be capable of burning into the pixel data sent to the Print Server all the annotations defined in the clinical set for Image Displays in Section 4.16.4.2.2.1.1.5.1 Annotation of Identification Information, and additionally Institution Address (0008,0081), Section 4.16.4.2.2.1.1.5.2 Annotation of Technical Factor Information, and Section 4.16.4.2.2.1.1.5.3 Annotation of View Information.
- For Breast Tomosynthesis Image SOP instances, be capable of burning into the pixel data sent to the Print Server all the annotations defined in the clinical set for Image Displays in Section 4.16.4.2.2.1.3.5.1 Annotation of Identification Information and additionally Institution Address (0008,0081), Section 4.16.4.2.2.1.3.5.2 Annotation of Technical Factor Information and Section 4.16.4.2.2.1.3.5.3 Annotation of View Information.
- Be capable of burning a ruler, caliper or other form of distance scale into the pixel data sent to the Print Server
- Be capable of transmitting a pixel data bit depth of 12 bits to the Print Server (i.e., an 8 bit path is not sufficient for mammography)
- Be capable of burning into the pixel data sent to the Print Server a VOI LUT transformation (linear, sigmoid or tabular) as selected by the user from those available in the original image or as otherwise provided by the user

Print Servers participating in the Mammography Image Profile or the Digital Breast Tomosynthesis Profile shall:

- Print on transmissive media
- Be capable of true size printing based on the Requested Image Size (2020,0030) and shall attain the requested size with a precision of a maximum 2% error in linear distance (this precision requirement is chosen based not any implied or required accuracy of measurements from film or projection radiography, but rather because current electrical, mechanical and optical technology readily allows for this precision, and deviation beyond this value indicates a fundamental flaw in the implementation of the protocol or logic)
- Be capable of printing with a border between the chest wall edge of the digital mammography image and the physical edge of the film no greater than 5mm, so that the printed films can be hung on a light box with the chest wall edges of corresponding views directly abutted.
- Be capable of applying the Maximum Density attribute (2010,0130) in the request, and printing with a maximum optical density no less than 3.5
- Be capable of receiving a pixel data bit depth of 12 bits from the Print Composer (i.e., an 8 bit path is not sufficient for mammography).

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- Be capable of using a Presentation LUT Shape value of "IDENTITY" and "LIN OD" and the Presentation LUT Sequence (2050,0010)

Note that support for a Presentation LUT Shape value of "LIN OD" by Print Servers is specified for Mammography since the expected transmitted illumination of mammography view boxes on which printed film may be hung exceeds the range of illumination for which the Barten model is defined, and hence it may be difficult to achieve consistency between prints, and between prints and displays. It allows the Print Composer to use "LIN OD" to have greater control over the optical density of the printed film, and to take what action is necessary to result in consistency of appearance for the anticipated viewing conditions.

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4.24 Report Submission [RAD-24]

4.24.1 Scope

In the Report Submission transaction, the Report Creator transmits a DICOM Structured Report (SR) object in an initial draft or final state to the Report Manager. The Structured Report object is required minimally to conform to the template TID 2000. Creators may introduce increased complexity as long as it conforms to the SOP class.

A final report is defined as one where the Completion Flag (0040,A491) attribute is set to "COMPLETE" and the Verified Flag (0040,A493) attribute is set to "VERIFIED". Reports with any other values for the Completion Flag (0040,A491) or the Verified Flag (0040,A493) attributes are considered draft reports.

4.24.2 Actor Roles

Actor: Report Creator

Role: Transmit draft or final DICOM Structured Reports to Report Manager.

Actor: Report Manager

Role: Accept draft and final DICOM Structured Reports for management.

4.24.3 Referenced Standards

DICOM PS3.4 Annex B: Storage Service Class

DICOM PS3.16: Content Mapping Resource

4.24.4 Messages

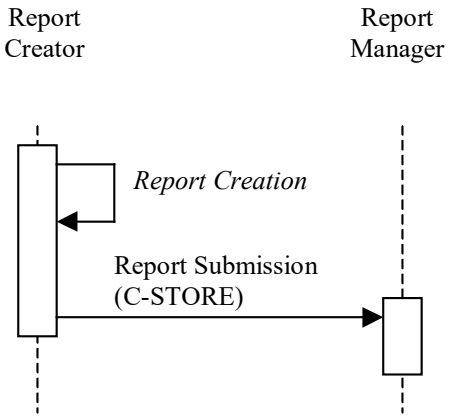

Figure 4.24.4-1: Interaction Diagram

4.24.4.1 Report Creation

This transaction relates to the "Report Creation" event in the above interaction diagram.

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4.24.4.1.1 Trigger Events

The user at the Report Creator wishes to create a DICOM Structured Report.

4.24.4.1.2 Invocation Semantics

This is a local invocation of functions at the Report Creator, and the method used by the Report Creator to obtain report data and create a DICOM Structured Report object is outside the scope of the IHE Technical Framework. The Report Creator shall create a report that conforms to the DICOM Basic Text SR Information Object Definition (IOD). If numeric values are required in the report, then the Report Creator shall create a report that conforms to the DICOM Enhanced SR IOD. A single Report Creator may support both SR IODs if this is deemed desirable by the implementers, but must at least support the Basic Text SR IOD. Reports created by the Report Creator shall also conform to the DCMR template in DICOM PS3.16 TID 2000.

4.24.4.1.2.1 Coded Entries

All Reporting actors (Report Creator, Report Manager, Report Repository, and External Report Repository Access) must be able to load configurable code tables. The DICOM Structured Report objects are dependent on coded entries to define the concepts being conveyed. Codes specified in DCMR (DICOM PS3.16) shall be. In the absence of standard codes, the IHE Committee may define necessary codes for use in demonstrations.

The types of reports created by the Report Creator are defined in RAD TF-1: 9.4. At a minimum, the Report Creator shall be able to generate reports based on the Simple Image Report (RAD TF-1: 9.4.1). If the Report Creator supports the Enhanced SR Information Object Definition then it shall also support the creation of Simple Image and Numeric Reports (RAD TF-1: 9.4.2).

4.24.4.1.2.2 Retrieve AE Title

Whenever references to DICOM Composite objects are made within a DICOM Structured Report, it is possible to include the Retrieve AE Title attribute (0008,0054). In the case of the Report Creator, these references shall be contained in the Current Requested Procedure Evidence Sequence attribute (0040,A375), or the Pertinent Other Evidence Sequence attribute (0040,A385). If the Report Creator is a standalone actor it is optional for the Retrieve AE Title attribute (0008,0054) to be sent and it is up to the implementation to determine what value to send. If the Report Creator is combined with an Image Display, then it is recommended that the Retrieve AE Title attribute (0008,0054) be set to the AE Title of the device from which the Image Display retrieved the referenced DICOM Composite objects.

4.24.4.1.2.3 Study Identification and Identical Documents Sequence

A Study Instance UID is required to identify the study to which the report belongs. It is recommended to use the Study Instance UID of the images reported on as the Study Instance UID of the created Structured Report. The mechanism by which the Report Creator will receive this information is defined in the IHE Technical Framework. Sometimes a single report refers to multiple studies. For example, a trauma patient may require X-rays of both the wrist and leg. These may be ordered as separate studies, but the Radiologist may report on both studies at the

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same time. To handle this situation in the DICOM Hierarchical Model, it is necessary to duplicate the report within each study. If a Report Creator is generating a single report for multiple studies, it shall create multiple copies of the report, with different SOP Instance UIDs for each study and use the Identical Documents Sequence attribute (0040,A525) in each report. The Identical Documents Sequence attribute (0040,A525) in each report shall reference each of the other identical reports in the other studies. The actual content of the report, that is, the SR Document General Module attributes (except the Identical Documents Sequence attribute) and the SR Document Content Module attributes shall be the same in each report instance.

The Retrieve AE Title attribute (0008,0054) in the Identical Documents Sequence Items shall not be sent.

4.24.4.1.3 Expected Actions

Creation of DICOM Structured Report objects ready for storage to the Report Manager.

4.24.4.2 Report Submission

This transaction relates to the “DICOM C-STORE” event between the Report Creator and Report Manager in the above interaction diagram.

4.24.4.2.1 Trigger Events

When report authoring is completed and the Report Creator creates new DICOM Structured Reports, the Report Creator shall transfer DICOM Structured Reports to the Report Manager within one or more DICOM associations.

4.24.4.2.2 Message Semantics

The Report Creator uses the DICOM C-STORE message to transfer DICOM Structured Reports. The Report Creator is the DICOM Storage SCU of the Basic Text SR Storage SOP Class or the Enhanced SR Storage SOP Class or both. The Report Manager is the DICOM Storage SCP of at least the Basic Text SR Storage SOP Class and optionally the Enhanced SR Storage SOP Class. In accordance with the DICOM Standard for SR the Report Manager must support Level 2 (Full) storage, which means all DICOM Type 1, 2 and 3 attributes are stored.

4.24.4.2.3 Expected Actions

The Report Manager will store the received DICOM Structured Report objects. At this point the Report Creator relinquishes any responsibility for the report objects and may not change them in any way without creating a new object with a new SOP Instance UID.

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4.25 Report Issuing [RAD-25]

4.25.1 Scope

In the Report Issuing transaction, the Report Manager transmits either an unchanged draft DICOM Structured Report (created by a Report Creator) or a new modified DICOM Structured Report to the Report Repository or both. The Report Manager handles all state and content changes to DICOM Structured Reports, and with each change new DICOM Structured Report objects are created and may be stored in the Report Repository.

4.25.2 Actor Roles

Actor: Report Manager

Role: Process report changes and transmit reports to Report Repository. This involves the ability to handle content and state changes to DICOM Structured Reports and create new DICOM Structured Reports based on these changes. Examples of the types of changes the Report Manager needs to process are as follows:

- Verifying a draft report and setting the verification attributes in the newly created verified report;
- Creating a new unverified report based on one or more previous draft or verified reports;
- Creating a new verified report based on one or more previous draft or verified reports; and
- Creating a new report that is the result of merging multiple previous reports.
- Generating a new version of an existing report with updated patient demographics based on receiving a Patient Update transaction.

Actor: Report Repository

Role: Accept and store DICOM Structured Reports from Report Managers.

4.25.3 Referenced Standards

DICOM PS3.4 Annex B: Storage Service Class

DICOM PS3.16: Content Mapping Resource

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4.25.4 Messages

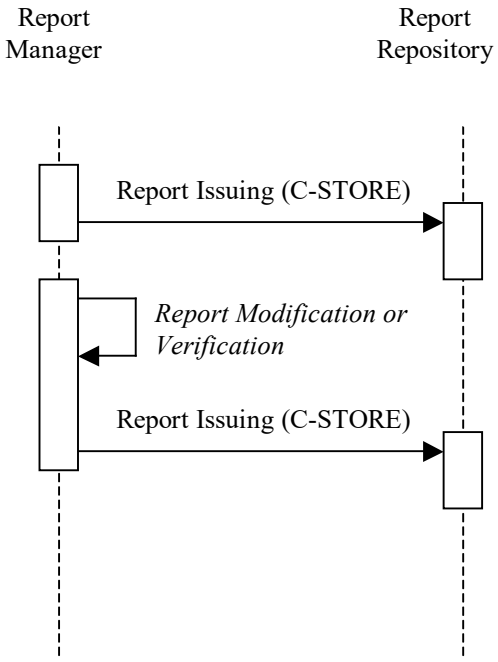

Figure 4.25.4-1: Interaction Diagram

4.25.4.1 Report Issuing (Step 1)

This transaction relates to the top "DICOM C-STORE" event between the Report Manager and Report Repository in the above interaction diagram.

4.25.4.1.1 Trigger Events

When DICOM Structured Reports are received from the Report Creator, the Report Manager can transfer the DICOM Structured Reports to the Report Repository within one or more DICOM associations. This capability may be configurable as it may enable access to reports before they are verified and finalized. Some sites may require this feature, while others may find it undesirable.

4.25.4.1.2 Message Semantics

The Report Manager uses the DICOM C-STORE message to transfer DICOM Structured Reports. The Report Manager is the DICOM Storage SCU of at least the Basic Text SR Storage SOP Class and optionally the Enhanced SR Storage SOP Class. It is required that if a Report Manager is an SCP of the Enhanced SR Storage SOP Class (see Section 4.24) then it shall also be an SCU of the Enhanced SR Storage SOP Class. The Report Repository is the DICOM Storage SCP of both the Basic Text SR Storage SOP Class and the Enhanced SR Storage SOP

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Class. In accordance with the DICOM Standard for SR, the Report Repository must support Level 2 (Full) storage, which means all DICOM Type 1, 2 and 3 attributes are stored.

4.25.4.1.3 Expected Actions

The Report Repository will store the received DICOM Structured Report objects.

4.25.4.2 Report Modification

This transaction relates to the "Report Modification or Verification" event in the above interaction diagram.

4.25.4.2.1 Trigger Events

The user at the Report Manager selects an existing report and decides to make some modification to this report.

4.25.4.2.2 Invocation Semantics

This is a local invocation of functions at the Report Manager, and the method used by the Report Manager to specify report state transitions or obtain modified report data and create a new DICOM Structured Report object is outside the scope of the IHE Technical Framework. The Report Manager shall create a report that conforms to the DICOM Basic Text SR Information Object Definition or the DICOM Enhanced SR Information Object Definition if numeric values are to be included in the report either by their addition by the Report Manager or numeric values appeared in the original report received from the Report Creator. It is required that if a Report Manager can receive Enhanced SR objects, that it can also manage such objects and generate new Enhanced SR objects. If the Report Manager removes numeric values from a report it may convert an Enhanced SR object into a Basic Text SR object. When the Report Manager creates a new modified report, it must be in a different series to the original report, unless the Report Manager and Report Creator are the same device. This is because the DICOM Standard requires that objects created by different devices must be in different series (i.e., different DICOM General Equipment Module attributes). In order to reference the original report, the new modified report must correctly contain the Predecessor Documents Sequence attribute (0040,A360).

The types of external state changes that the Report Manager shall handle are:

- Completing a partial report; and
- Verifying a report.

To complete a partial report, additional content may be added to the original report and the Completion Flag attribute (0040,A491) shall be set to "COMPLETE". To verify a report, the content of the original report is checked for correctness, and the Verification Flag attribute (0040,A493) shall be set to "VERIFIED". This also requires that the Verifying Observer Sequence attribute (0040,A073) be completed appropriately.

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The types of reports that at a minimum shall be handled by the Report Manager are defined in RAD TF-1: 9.4. The Report Manager shall be able to manipulate reports based on the Simple Image Report (RAD TF-1: 9.4.1). If the Report Manager supports the Enhanced SR Information Object Definition then it shall also support manipulation of Simple Image and Numeric Reports (RAD TF-1: 9.4.2). Even though the IHE Technical Framework sets boundaries on the complexity of SR objects, the Report Manager must still be able to receive and store any Basic Text SR object and optionally any Enhanced SR object in order to conform to the DICOM Standard. An implementation may restrict the modification capabilities for reports more complex than those specified in RAD TF-1: 9.4. When creating a new report, the Report Manager shall also conform to the DCMR template in DICOM PS3.16 TID 2000.

There are many reasons and methods for the Report Manager to modify the content of a report and these are outside the scope of the IHE Technical Framework. Examples of the types of changes, in addition to the state changes above, the Report Manager needs to be able to process are as follows:

- Creating a new report based on one or more previous draft or verified reports where data is changed or added;
- Creating a new report that is the result of merging multiple previous reports. This can also involve changing or adding report data; and
- Converting a Basic Text SR into an Enhanced SR if the Report Manager adds measurements. This also means that if a Basic Text SR is merged with an Enhanced SR then the resulting object will be an Enhanced SR.

It is recommended that amendments to DICOM Structured Reports are made by creating a new DICOM Structured Report object containing the original content as well as any amendments or additions. References to the original report are made by the Predecessor Document Sequence attribute (0040,A360).

In general report issuing requires that a new SR instance UID will be created as a result of the rules defined by DICOM PS3.4 Section O.3 - Modification of SR Document Content.

4.25.4.2.2.1 Retrieve AE Title

Whenever references to DICOM Composite objects are made within a DICOM Structured Report, it is possible to include the Retrieve AE Title attribute (0008,0054). In the case of the Report Manager, these references will be contained in the Predecessor Documents Sequence attribute (0040,A360), as well as the Current Requested Procedure Evidence Sequence attribute (0040,A375) and the Pertinent Other Evidence Sequence attribute (0040,A385) if the Report Creator uses these evidence sequence attributes.

The Report Creator may send reports to the Report Manager where the Retrieve AE Title attribute (0008,0054) in the Current Requested Procedure Evidence Sequence Items (0040,A375), or the Pertinent Other Evidence Sequence Items (0040,A385) is empty or not sent. In these cases, the Report Manager may add the AE Title of a configured Image Manager in the Retrieve AE Title attribute (0008,0054) of these sequence items.

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When the Report Manager creates a new report based on one or more previous reports that it has already stored in the Report Repository, then the AE Title of the Report Repository shall be used as the Retrieve AE Title attribute (0008,0054) in the Predecessor Documents Sequence Items (0040,A360). If the prior reports have not been stored in the Report Repository then the Retrieve AE Title attribute (0008,0054) shall not be sent.

4.25.4.2.2.2 Study Identification and Identical Documents Sequence

A Study Instance UID is required to identify the study to which the report belongs. It is recommended to use the Study Instance UID of the images reported on as the Study Instance UID of the created Structured Report. The mechanism by which the Report Creator will receive this information is currently undefined in the IHE Technical Framework. The expectation is that the DICOM General Purpose Worklist service will be used for this function when this service is finalized in DICOM and incorporated in the IHE Radiology Technical Framework.

When the Report Manager is modifying a report that contains items in the Identical Documents Sequence attribute (0040,A525) then a decision is needed as to the actions to occur upon the other identical documents. The user modifying the report may be asked as to whether the changes may only apply to the current report or to the other identical documents as well. If the changes are limited to one report, then no Identical Documents Sequence attribute (0040,A525) shall be included in the new report as it is no longer the same as the other documents. If the changes are to apply to multiple reports, then multiple new reports with new SOP Instance UIDs shall be created with the new report data and their Identical Documents Sequence attribute (0040,A525) shall refer to the appropriate new report objects. Also in this case each Predecessor Documents Sequence attribute (0040,A360) shall refer to all the original identical documents. This is shown in Figure 4.25-1.

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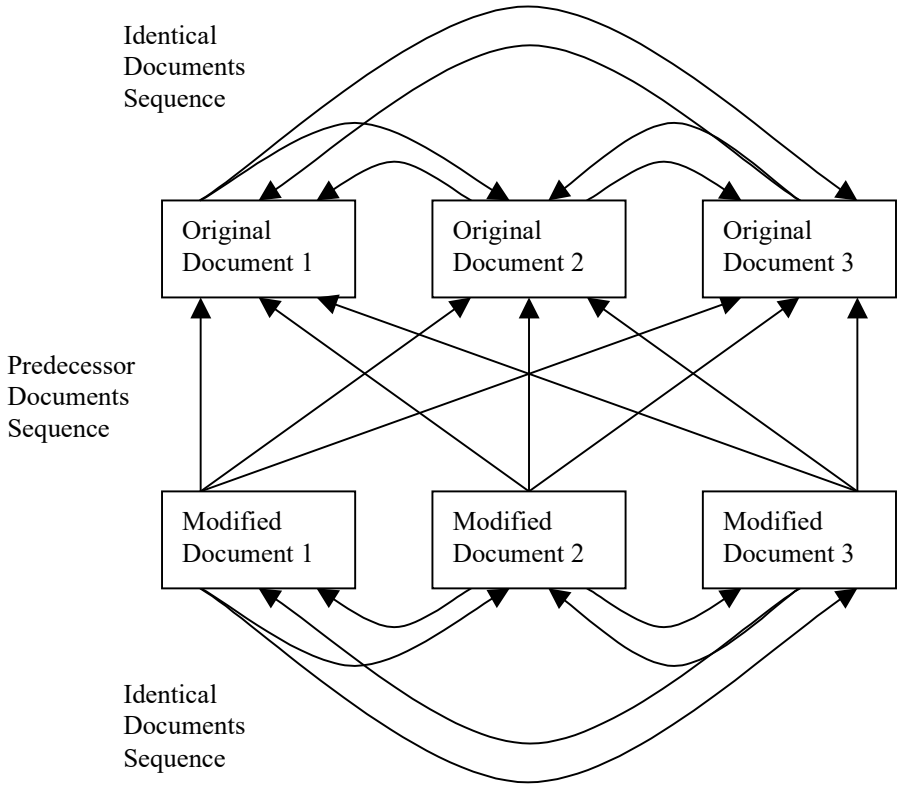

Figure 4.25-1: Identical and Predecessor Document Sequences

4.25.4.2.3 Expected Actions

Creation of a new modified DICOM Structured Report object ready for storage to the Report Repository.

4.25.4.3 Report Issuing (Step 2)

This transaction relates to the bottom "DICOM C-STORE" event between the Report Manager and Report Repository in the above interaction diagram.

4.25.4.3.1 Trigger Events

When reports are finalized (complete and verified) they shall be stored in the Report Repository. The Report Manager can transfer DICOM Structured Reports to the Report Repository within one or more DICOM associations. Internal reports shall be temporarily stored in the Report Manager until they are finalized, but may also be stored permanently in the Report Repository if the Report Manager decides to transfer them. The technique used by the Report Manager to finalize a report is outside the scope of the IHE Technical Framework.

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4.25.4.3.2 Message Semantics

The Report Manager uses the DICOM C-STORE message to transfer DICOM Structured Reports. The Report Manager is the DICOM Storage SCU of at least the Basic Text SR Storage SOP Class and optionally the Enhanced SR Storage SOP Class. It is required that if a Report Manager is an SCP of the Enhanced SR Storage SOP Class (see Section 4.24) then it shall also be an SCU of the Enhanced SR Storage SOP Class. The Report Repository is the DICOM Storage SCP of both the Basic Text SR Storage SOP Class and the Enhanced SR Storage SOP Class. In accordance with the DICOM Standard for SR the Report Repository must support Level 2 (Full) storage, which means all DICOM Type 1, 2 and 3 attributes are stored.

4.25.4.3.3 Expected Actions

The Report Repository will store the received DICOM Structured Report objects.

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4.26 Query Reports [RAD-26]

4.26.1 Scope

In the Query Reports Transaction, the Report Reader queries the Report Manager, Report Repository or External Report Repository Access for draft or final DICOM Structured Reports.

4.26.2 Actor Roles

Actor: Report Repository

Role: Responds to queries for DICOM Structured Reports.

Actor: External Report Repository Access

Role: Responds to queries for DICOM Structured Reports. This system provides storage of DICOM Structured Reports obtained from outside the Radiology department. Such a system may be required to convert reports of different formats (HL7) into DICOM Structured Reports (see RAD TF-2x: Appendix C).

Actor: Report Reader

Role: Queries Report Repository or External Report Repository Access for DICOM Structured Reports and makes them available for selection.

Actor: Report Manager

Role: Responds to queries for DICOM Structured Reports.

4.26.3 Referenced Standards

DICOM PS3.4 Annex C: Query/Retrieve Service Class

DICOM PS3.16: Content Mapping Resource

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4.26.4 Messages

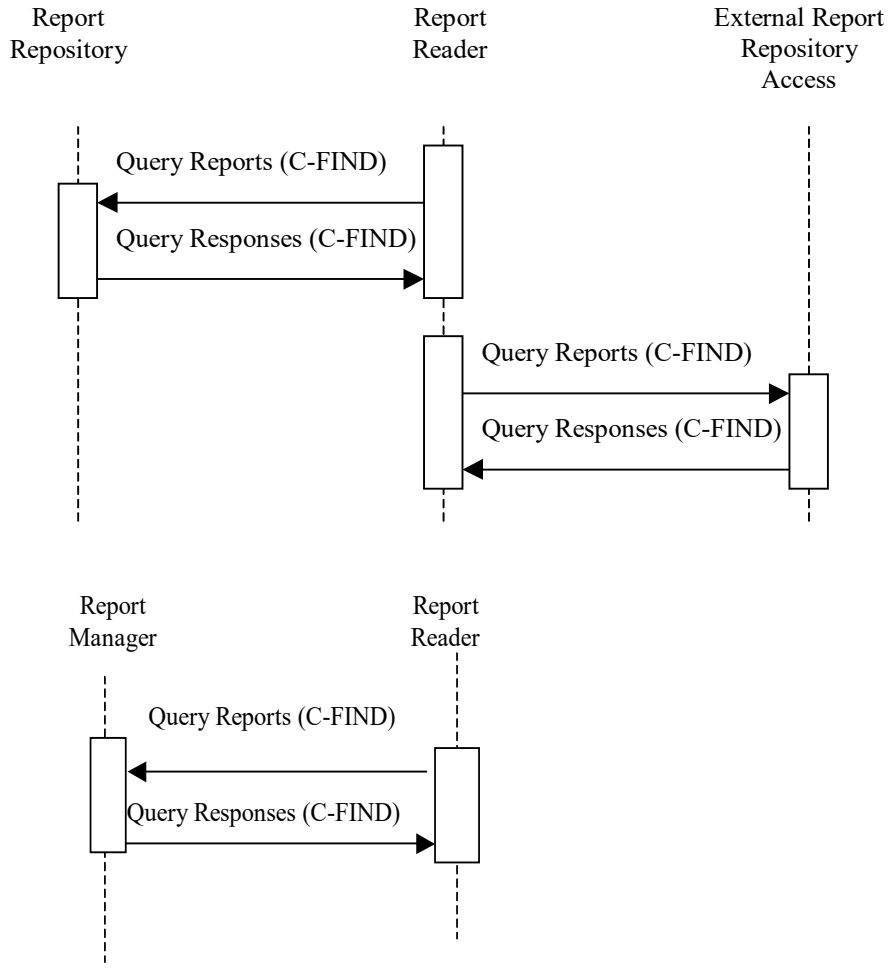

Figure 4.26.4-1: Interaction Diagram

4.26.4.1 Query Reports

This transaction relates to the query section of the above interaction diagram. The Query (Study Root – FIND and optionally Patient Root – FIND) SOP Classes will be supported. Refer to DICOM PS3.4: Query/Retrieve Service Class for detailed descriptive semantics.

4.26.4.1.1 Trigger Events

The user at the Report Reader wishes to view selected reports.

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4.26.4.1.2 Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes.

A C-FIND Request from the DICOM Study Root Query/Retrieve Information Model – FIND SOP Class or the DICOM Patient Root Query/Retrieve Information Model – FIND SOP Class shall be sent from the Report Reader to the Report Manager, Report Repository or External Report Repository Access.

The Report Reader uses one or more matching keys as search criteria to obtain the list of matching entries in the Report Manager, Report Repository or External Report Repository Access at the selected level (Patient & Study/Series/Instance).

In addition to the required and unique keys defined by the DICOM Standard, the IHE Technical Framework has defined matching and return keys to be supported by query SCUs and SCPs. The keys are defined in Section 4.14.4.1.2 and Table 4.14-1, except that Report Manager and Report Repository are not required to support PPS Start Date and PPS Start Time. The conventions for key usage are defined in Section 2.2. For the Report Reader (SCU) and the Report Manager, Report Repository and External Report Repository Access (SCP) the additional SR Instance specific keys are defined in Table 4.26-1.

Table 4.26-1: SR Instance Specific Query Matching and Return Keys

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
SR Instance Specific Level					
Completion Flag	(0040,A491)	R+	R+	R+	R+
Verification Flag	(0040,A493)	R+	R+	R+	R+
Content Date	(0008,0023)	O	O	O	R+
Content Time	(0008,0033)	O	O	O	R+
Observation DateTime	(0040,A032)	O	O	O	R+
Verifying Observer Sequence	(0040,A073)				
>Verifying Organization	(0040,A027)	O	O	R+	R+
>Verification DateTime	(0040,A030)	R+	R+	R+	R+
>Verifying Observer Name	(0040,A075)	R+	R+	R+	R+
>Verifying Observer Identification Code Sequence	(0040,A088)				
>> Code Value	(0008,0100)	O	O	R+	R+
>> Coding Scheme Designator	(0008,0102)	O	O	R+	R+
>> Coding Scheme Version	(0008,0103)	O	O	R+	R+
>> Code Meaning	(0008,0104)	O	O	R+	R+
Referenced Request Sequence	(0040,A370)				
>Study Instance UID	(0020,000D)	O	O	R+*	R+
>Accession Number	(0008,0050)	O	O	R+	R+
>Requested Procedure ID	(0040,1001)	O	O	R+	R+

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Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
>Requested Procedure Code Sequence	(0032,1064)				
>>Code Value	(0008,0100)	O	O	O	R+
>>Coding Scheme Designator	(0008,0102)	O	O	O	R+
>>Coding Scheme Version	(0008,0103)	O	O	O	R+
>>Code Meaning	(0008,0104)	O	O	O	R+
Concept Name Code Sequence	(0040,A043)				
>Code Value	(0008,0100)	R+	R+	R+	R+
>Coding Scheme Designator	(0008,0102)	R+	R+	R+	R+
>Coding Scheme Version	(0008,0103)	O	O	O	R+
>Code Meaning	(0008,0104)	O	O	R+	R+

4.26.4.1.3 Expected Actions

The Report Manager, Report Repository or External Report Repository Access receives the C-FIND request, performs the matching on the provided keys and sends the list of matching records back to the Report Reader via C-FIND responses.

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4.27 Retrieve Reports [RAD-27]

4.27.1 Scope

In the Retrieve Reports Transaction, the requested DICOM Structured Reports are transferred from the Report Manager, Report Repository, Imaging Document Source, or External Report Repository Access to the Report Reader or Imaging Document Consumer for viewing.

4.27.2 Actor Roles

Actor: Report Repository

Role: Sends requested DICOM Structured Reports to Report Reader.

Actor: Imaging Document Source

Role: Sends requested DICOM Structured Reports to the Imaging Document Consumer.

Actor: External Report Repository Access

Role: Sends requested DICOM Structured Reports to Report Reader. Such a system may be required to convert reports of different formats (HL7) into DICOM Structured Reports (see RAD TF-2x: Appendix C).

Actor: Report Reader

Role: Retrieves DICOM Structured Reports from Report Repository or External Report Repository Access and makes them available for viewing.

Actor: Imaging Document Consumer

Role: Retrieves DICOM Structured Reports from the Imaging Document Source and makes them available for viewing.

Actor: Report Manager

Role: Sends requested DICOM Structured Reports to Report Reader.

4.27.3 Referenced Standards

DICOM PS3.4 Annex C: Query/Retrieve Service Class

DICOM PS3.4 Annex B: Storage Service Class

DICOM PS3.16: Content Mapping Resource

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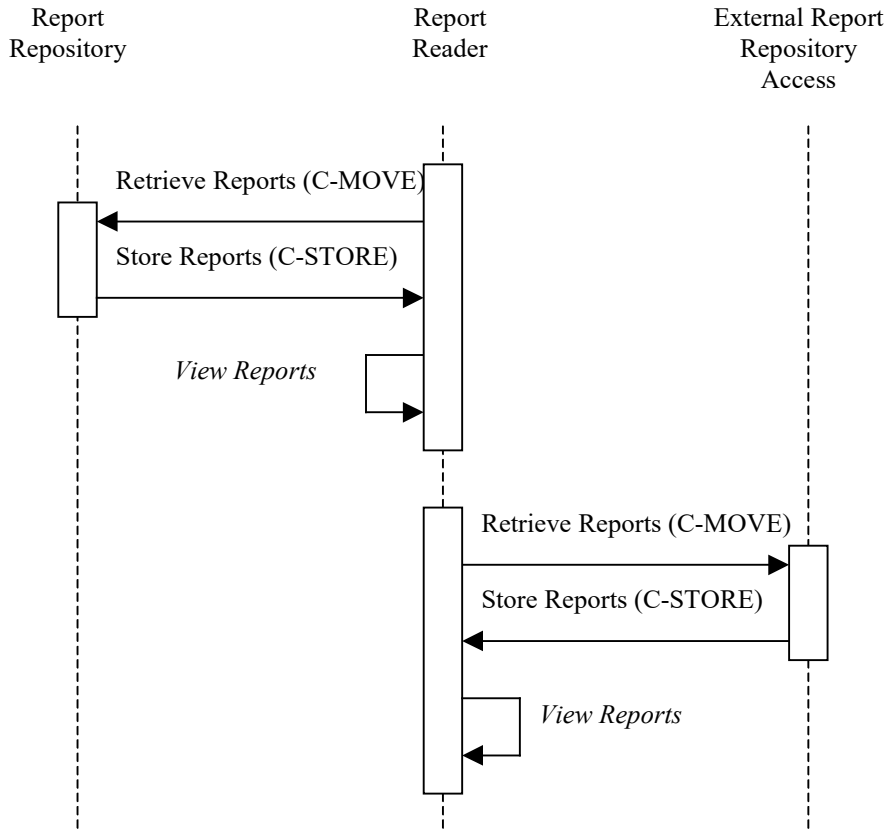
4.27.4 Messages



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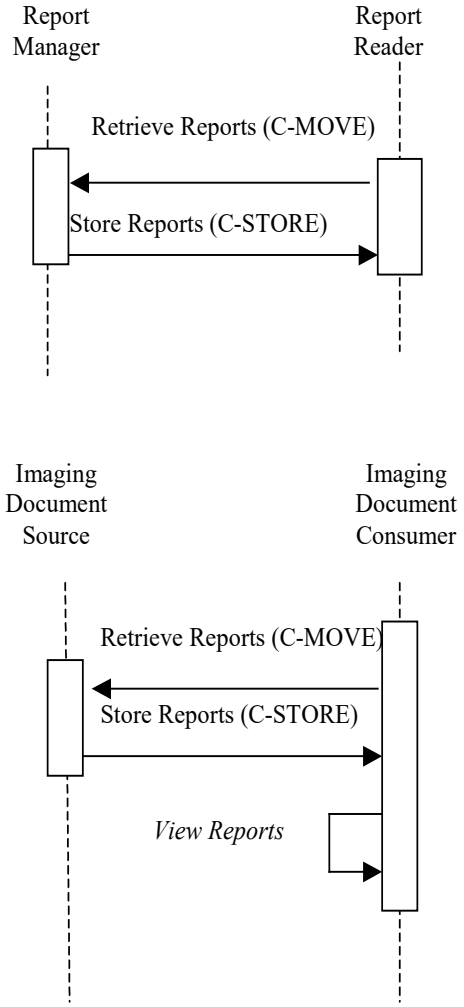

Figure 4.27.4-1: Interaction Diagrams

4.27.4.1 Retrieve Reports

This transaction relates to the retrieve section of the above interaction diagram. The Retrieve (Study Root – MOVE and optionally Patient Root – MOVE) SOP Classes shall be supported. The Report Reader and Imaging Document Consumer as an SCP shall support the DICOM Basic Text SR Storage SOP Class and optionally the DICOM Enhanced SR Storage SOP Class. The Report Manager, Imaging Document Source and the Report Repository as an SCU shall support both the DICOM Basic Text SR Storage SOP Class and the DICOM Enhanced SR Storage SOP Class. The External Report Repository Access as an SCU shall support the DICOM Basic Text SR Storage SOP Class and optionally the DICOM Enhanced SR Storage SOP Class. Refer to DICOM PS3.4 Annex C, for detailed descriptive semantics.

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4.27.4.1.1 Trigger Events

The user at the Report Reader or Imaging Document Consumer selects specific reports to view.

4.27.4.1.2 Message Semantics

The DICOM Query/Retrieve SOP Classes and the DICOM Structured Report Storage SOP Classes define the message semantics.

A C-MOVE Request from the DICOM Study Root Query/Retrieve Information Model – MOVE SOP Class or the DICOM Patient Root Query/Retrieve Information Model – MOVE SOP Class shall be sent from the Report Reader to the Report Manager, Report Repository or External Report Repository Access, or from the Imaging Document Consumer to the Imaging Document Source.

4.27.4.1.3 Expected Actions

The Report Manager, Report Repository, Imaging Document Source or External Report Repository Access receives the C-MOVE request, establishes a DICOM association with the Report Reader or Imaging Document Consumer and uses the appropriate DICOM Structured Report Storage SOP Classes (Basic Text SR Storage SOP Class and/or Enhanced SR Storage SOP Class) to transfer the requested reports.

Report Repository responds to the queries with the information from the DICOM instances it received from the Report Manager. Typically, Report Manager will apply information updates to the instances of reports it holds and re-issue the reports to the Report Repository. To properly update the content of instances that are no longer present on the Report Manager, the update shall be performed by retrieval and re-submission of the report through the Report Manager. It may also be done by grouping the Report Repository and Report Manager.

4.27.4.2 View Reports

This transaction relates to the “View Reports” event of the above interaction diagram.

4.27.4.2.1 Trigger Events

The Report Reader or Imaging Document Consumer receives reports from the Report Repository, Imaging Document Source or External Report Repository Access.

4.27.4.2.2 Invocation Semantics

This is a local invocation of functions at the Report Reader or Imaging Document Consumer, and the method used by the Report Reader or Imaging Document Consumer to interpret and display the report data in a meaningful way is outside the scope of the IHE Radiology Technical Framework. At a minimum the Report Reader or Imaging Document Consumer shall be able to correctly display reports defined in RAD TF-1: 9.4. The Report Reader or Imaging Document Consumer shall be able to display reports based on the Simple Image Report (RAD TF-1: 9.4.1). If the Report Reader or Imaging Document Consumer supports the Enhanced SR Information Object Definition then it shall also support display of Simple Image and Numeric Reports (RAD

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TF-1: 9.4.2). Even though the IHE Technical Framework sets boundaries on the complexity of SR objects, the Report Reader or Imaging Document Consumer must still be able to receive, store and view any Basic Text SR object and optionally any Enhanced SR object in order to conform to the DICOM Standard. An implementation may not be able to render, in a meaningful way, reports more complex than those specified in RAD TF-1: 9.4.

If a DICOM Structured Report references other DICOM composite objects, such as images, and softcopy presentation states, it is optional for the Report Reader or Imaging Document Consumer to actually retrieve and display/apply these objects, but the Report Reader or Imaging Document Consumer must convey to the user that such references exist in the report.

4.27.4.2.2.1 Retrieve AE Title

If the Report Reader is grouped with an Image Display and capable of retrieving objects referenced in a DICOM Structured Report then the Report Reader shall retrieve these objects from the device matching the appropriate Retrieve AE Title attribute (0008,0054) included in the DICOM Structured Report. If the Retrieve AE Title attribute is not specified or configured, then the Report Reader may use some other configurable Retrieve AE Title.

In the case of retrieving reports in a Cross-Enterprise, imaging document sharing (XDS-I) network environment, a configuration of mapping the AE Titles to DICOM AE Network Addresses (IP Address and Port number) are needed to be exchanged between the Imaging Document Source and the Imaging Document Consumer. RAD TF-2x: Appendix G describes in detail the AE Title mapping to the DICOM AE Network Addresses.

4.27.4.2.3 Expected Actions

The Report Reader or Imaging Document Consumer presents to the user a DICOM Structured Report.

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4.28 Structured Report Export [RAD-28]

4.28.1 Scope

In the Structured Report Export transaction, the Report Manager transmits verified Structured Reports as unsolicited HL7 observations to the Enterprise Report Repository. The Report Manager is responsible for mapping DICOM SR to HL7. The Structured Report mapping to the Structured Report Export is defined later in this section.

The report data transmitted in the HL7 message shall be simple ASCII text. The Report Manager shall provide a presentation of the Structured Report consistent with the semantics of the content of the Structured Report and the limitations of ASCII-based rendering.

Due to a wide variety of output devices at the final destination of the HL7 message, special formatting characters shall be avoided. For proper column alignment, the Report Manager shall use space characters as appropriate, since "tab" and other special characters may not be valid, or have inconsistent meaning on the eventual display device.

4.28.2 Actor Roles

Actor: Report Manager

Role: Export verified text results to Enterprise Report Repository. This involves mapping DICOM SR terminology to HL7 terminology.

Actor: Enterprise Report Repository

Role: Accept and store HL7 results transmitted by the Report Manager.

4.28.3 Messages

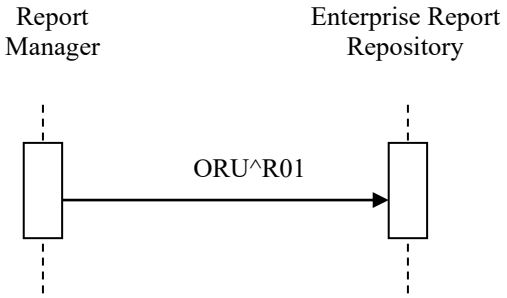

Figure 4.28.3-1: Interaction Diagram

4.28.3.1 Structured Report Export

This transaction relates to the ORU event between the Report Manager and the Enterprise Report Repository in the above interaction diagram.

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4.28.3.1.1 Trigger Events

When DICOM Structured Reports are verified and finalized by the Report Manager, the Report Manager sends unsolicited ORU transactions to the Enterprise Report Repository.

4.28.3.1.2 Message Semantics

Refer to the HL7 2.3.1 Standard, Chapter 7 ORU message, for general message semantics.

ORU	Structured Report Export	Chapter in HL7 2.3.1
MSH	Message Header	2
PID	Patient Identification	3
[PV1]	Patient Visit	3 (see Note)
OBR	Order detail	7
{OBX}	Observation Results	7

Note: PV1 is required if use of PV1-19 Visit Number is required per the applicable regional or national extensions to the IHE Technical Framework (see RAD TF-4)

The following tables provide field-by-field definitions of the required segments of the ORU message of the Structured Report Export transaction. These tables shall be interpreted according to the HL7 Standard unless otherwise specified in notes beneath the tables.

Table 4.28-1: IHE Profile - MSH segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	1	ST	R		00001	Field Separator
2	4	ST	R		00002	Encoding Characters
3	180	HD	R		00003	Sending Application
4	180	HD	R		00004	Sending Facility
5	180	HD	R		00005	Receiving Application
6	180	HD	R		00006	Receiving Facility
9	7	CM	R		00009	Message Type
10	20	ST	R		00010	Message Control ID
11	3	PT	R		00011	Processing ID
12	60	VID	R	0104	00012	Version ID
18	6	ID	C	0211	00692	Character Set

Adapted from the HL7 Standard, version 2.3.1

The IHE Technical Framework requires that applications support HL7-recommended values for the fields MSH-1 Field Separator and MSH-2 Encoding Characters.

Field MSH-9 Message Type shall have at least two components. The first component shall have a value of “ORU”; the second component shall have the value of “R01”. Implementations

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supporting sequence number protocol shall be configurable to allow them to perform this transaction without such protocol.

Table 4.28-2: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	20	CX	R		00106	Patient Identifier List
5	48	XPN	R		00108	Patient Name
7	26	TS	R2		00110	Date/Time of Birth
8	1	IS	R2	0001	00111	Sex
10	80	CE	R2	0005	00113	Race
11	106	XAD	R2		00114	Patient Address
18	20	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.3.1

Table 4.28-3: IHE Profile – PV1 segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	20	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.3.1

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued. Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF- 4).

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

Table 4.28-4: IHE Profile - OBR Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	4	SI	R		00237	Set ID - OBR
2	22	EI	R		00216	Placer Order Number
3	22	EI	R		00217	Filler Order Number
4	200	CE	R		00238	Universal Service ID
7	26	TS	R		00241	Observation Date/Time
25	1	ID	R	0123	00258	Result Status

Adapted from the HL7 Standard, version 2.3.1

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Table 4.28-5: IHE Profile - OBX Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	R		00569	Set ID - OBX
2	3	ID	R	0125	00570	Value Type
3	80	CE	R		00571	Observation Identifier
4	20	ST	C		00572	Observation Sub-ID, See Note.
5	65536[2]	*	R		00573	Observation Value – may be image directory reference
11	1	ID	R	0085	00579	Observe Result Status

Adapted from the HL7 Standard, version 2.3.1

Note: OBX-4 is conditional based on the OBX segment being populated. See Table 4.28-8 for conditions on the OBX-4 field.

4.28.4 DICOM SR to Structured Report Export Mapping

This section defines the mapping of the content of a DICOM SR object (which is the DICOM Enhanced SR Service class) to the HL7 Report Observation message. This message is the HL7 ORU message.

Mappings between HL7 and DICOM are illustrated in the following manner:

- Element Name (HL7 item # - DICOM tag)
- Only required, R, conditionally required, R2, and conditional, C, fields are mapped in the tables below.

Table 4.28-6: DICOM SR Mapping to Structured Report Export MSH Segment

SEQ	OPT	TBL#	ITEM#	ELEMENT NAME	DICOM Description / Module	DICOM Tag	Notes
18	C		00693	Character Set	Specific Character Set	0008,0005	

Table 4.28-7: DICOM SR Mapping to Structured Report Export PID Segment

SEQ	OPT	TBL#	ITEM#	ELEMENT NAME	DICOM Description / Module	DICOM Tag	Notes
3	R		00106	Patient Identifier List	Patient's ID	(0010,0020)	
5	R		00108	Patient Name	Patient's Name	(0010,0010)	
7	R2		00110	Date/Time of Birth	Patient's Birth Date	(0010,0030)	
8	R2	0001	00111	Sex	Patient's Sex	(0010,0040)	
10	R2	0005	00113	Race	Ethnic Group	(0010,2160)	

[2] The length of the observation value field is variable, depending upon value type. See *OBX-2-value type*.

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SEQ	OPT	TBL#	ITEM#	ELEMENT NAME	DICOM Description / Module	DICOM Tag	Notes
18	R		00121	Patient Account Number			See note IHE-1

IHE-1: The Report Manager shall supply the Patient Account Number. It is assumed that the Report Manager is able to obtain the Patient Account Number value.

Table 4.28-8: DICOM SR Mapping to Structured Report Export OBR Segment

SEQ	OPT	TBL#	ITEM #	ELEMENT NAME	DICOM Description / Module	DICOM Tag	Notes
1	R		00237	Set ID – OBR			See note IHE-2
2	R		00216	Placer Order Number	SR Document General, Referenced Request Sequence	(0040,2016)	See Note IHE-4
3	R		00217	Filler Order Number	SR Document General, Referenced Request Sequence	(0040,2017)	See Note IHE-4
4	R		00238	Universal Service ID			See Note IHE-3
7	R		00241	Observation DateTime	SR Content Observation DateTime if present, otherwise use the SR Document General, Content Date, Content Time	(0040,A032) or (0008,0023) (0008,0033)	
25	R		00258	Result Status = F			
32	O		00264	Principal Results Interpreter	Person Name value of the Content item that is related to the root of the SR document with the relationship HAS OBS CONTEXT and whose Concept Name Code is (121008,DCM, “Person Observer Name”)	(0040,A123)	

IHE-2: If the SR has multiple items in the Referenced Request sequence, the Report Manager will generate separate ORU messages for each item.

IHE-3: The Report Manager shall supply the Universal Service ID from the original order (Placer). It is assumed that the Report Manager is able to obtain the Universal Service ID value.

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IHE-4: If the Placer and/or Filler order number are not provided by the Referenced Request Sequence, it is assumed that the Report Manager is able to obtain values.

Table 4.28-9: DICOM SR Mapping to Structured Report Export OBX Segments

SEQ	OPT	TBL#	ITEM#	ELEMENT NAME	DICOM Description / Module	DICOM Tag	Notes
The first OBX segment carries the Structured Report Instance UID							
1	R			Set-ID-OBX = 1			
2	R	0125	00070	Value Type = HD			
3	R		00571	Observation Identifier = ^SR Instance UID			
5	R		00573	Observation Value	SR Instance UID	(0008,0018)	
11	R		0085	Observe Result Status=F			
The next set of four OBX segments repeats for each IMAGE type Content Item present in the SR content. Each OBX set provides the external report repository the ability to lookup the relevant image references. *The Content Items only provide the Referenced SOP Class UID (0008,1150) and Referenced SOP Instance UID (0008,1155). The Study Instance UID (0020,000D) and Series Instance UID (0020,000E) are found in the corresponding item in the Current Requested Procedure Evidence Sequence (0040,A375) or the Pertinent Other Evidence Sequence (0040,A385). Use the SOP Instance UID to find the correct sequence item. For further details, see Table C.17-2 (SR Document General Module Attributes) and Table C.17-3 (SOP Instance Reference Macro Attributes) in Part 3 of the DICOM Standard.* *Each set of four OBX segments that make up an UID reference will have the same unique Observation Sub-ID (OBX 4). The Sub-ID for the first set shall have a value of 1. The Sub-ID shall increment for each subsequent OBX set in the message.*							
1	R			Set-ID-OBX			
2	R	0125	00070	Value Type = HD			
3	R		00571	Observation Identifier = ^Study Instance UID			
5	R		00573	Observation Value	Current/Pertinent Evidence Sequence, matching item's Study Instance UID	(0020,000D)	
11	R		0085	Observe Result Status=F			
1	R			Set-ID-OBX			
2	R	0125	00070	Value Type = HD			
3	R		00571	Observation Identifier = ^Series Instance UID			
5	R		00573	Observation Value	Current/Pertinent Evidence Sequence, matching item's Series Instance UID	(0020,000E)	

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SEQ	OPT	TBL#	ITEM#	ELEMENT NAME	DICOM Description / Module	DICOM Tag	Notes
11	R		0085	Observe Result Status=F			
1	R			Set-ID-OBX			
2	R	0125	00070	Value Type			
3	R		00571	Observation Identifier = ^SOP Instance UID			
5	R		00573	Observation Value	IMAGE Content Item, Referenced SOP Instance UID	(0008,1155)	
11	R		0085	Observe Result Status=F			
1	R			Set-ID-OBX			
2	R	0125	00070	Value Type = HD			
3	R		00571	Observation Identifier = ^SOP Class ID			
5	R		00573	Observation Value	Image Content Item, Referenced SOP Class UID	(0008,1150)	
11	R		0085	Observe Result Status=F			
The report text generated by the Report manager is sent in the next OBX segment(s). No contextual information shall be assumed if multiple OBX segments are used.							
1	R			Set-ID-OBX			
2	R	0125	00070	Value Type = TX			
3	R		00571	Observation Identifier = ^SR Text			
5	R		00573	Observation Value	Report Text from SR Object		
11	R		0085	Observe Result Status=F			

4.28.5 Expected Actions

The Enterprise Report Repository accepts the message. The usage of the result by the Enterprise Report Repository is beyond the scope of the IHE Radiology Technical Framework.

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4.29 Key Image Note Stored [RAD-29]

4.29.1 Scope

In the Key Image Note Stored transaction, the Acquisition Modality or the Evidence Creator transmits a DICOM Key Image Note, which is stored in the Image Archive.

4.29.2 Actor Roles

Actor: Acquisition Modality

Role: Flag significant images by creating Key Image Notes and issuing Key Image Note Stored Transactions to the Image Archive.

Actor: Evidence Creator

Role: Flag significant images by creating Key Image Notes and issuing Key Image Note Stored Transactions to the Image Archive.

Actor: Image Archive

Role: Accepts and Stores Key Image Note Instances received from the Acquisition Modality or Evidence Creator. This transaction describes the role related only to storage of the Key Image Note.

4.29.3 Referenced Standards

DICOM PS3.3 Section A.35.4: Key Object Selection Document IOD

DICOM PS3.4 Annex B: Storage Service Class

4.29.4 Messages

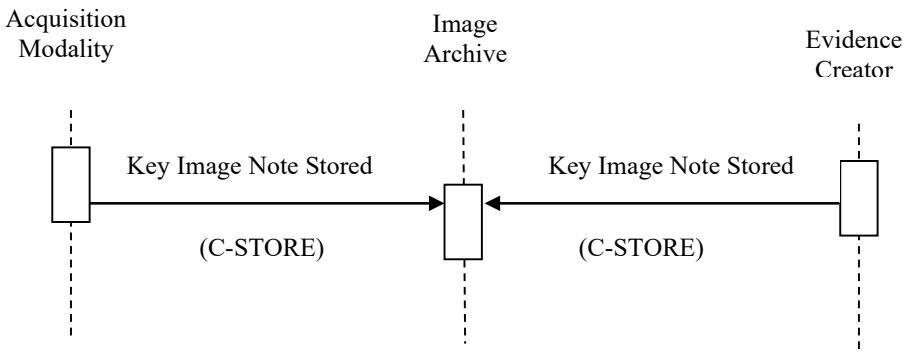

Figure 4.29.4-1: Interaction Diagram

4.29.4.1 Key Image Note Stored

This transaction relates to the “DICOM C-STORE” event between the Acquisition modality or the Evidence Creator and the Image Archive in the above interaction diagram.

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4.29.4.1.1 Trigger Events

The Acquisition Modality or the Evidence Creator generates a Key Image Note and sends it to the Image Archive for storage.

4.29.4.1.2 Message Semantics

The Acquisition Modality or the Evidence Creator uses the DICOM C-STORE message to store Key Image Notes. Message semantics are defined in the Key Object Selection Storage SOP Class definition and Behavior section of DICOM PS3.3 and PS3.4.

Key Object Selection Documents that reference multi-frame images shall populate the Referenced Frame Number (0008,1160) in each applicable occurrence of the Referenced SOP Sequence (0008,1199) in the Key Object Selection Document, unless the Key Object Selection Document applies to all the frames in the image.

4.29.4.1.3 Expected Actions

The Image Archive will store the received Key Image Note objects.

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4.30 Query Key Image Notes [RAD-30]

4.30.1 Scope

This section describes the sequence of Transactions required for the Image Display to query the Image Archive for instances of Key Image Notes. The Image Display will query (in order to later retrieve) for Key Image Note objects together with the image objects referenced in the return keys supplied in the response from the Image Archive.

Multiple Key Image Notes may exist that reference the same image data.

4.30.2 Actor Roles

Actor: Image Display

Role: Query for Key Image Notes objects together with the referenced image data and provides a means to indicate that images are flagged as significant. This device will implement the Query/Retrieve SOP Classes in the role of SCU.

Actor: Image Archive

Role: Respond to queries from the Image Display for Key Image Notes objects. This device will implement the Query/Retrieve SOP Classes in the role of SCP.

4.30.3 Referenced Standards

DICOM PS3.4 Annex C: Query/Retrieve Service Class

DICOM PS3.3 Section A.36.4: Key Object Selection Document IOD

4.30.4 Messages

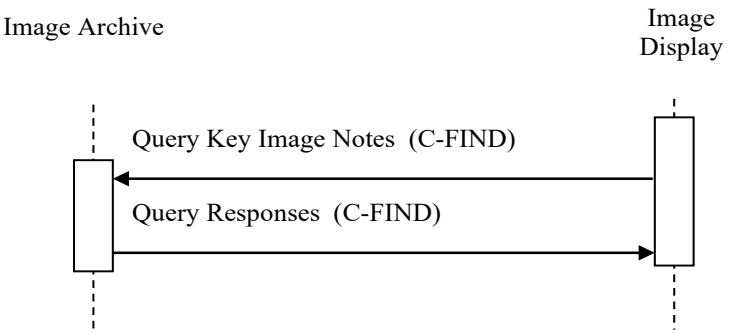

Figure 4.30.4-1: Interaction Diagram

4.30.4.1 Query Key Image Notes

This transaction relates to the query section of the above interaction diagram. The Query (Study Root – FIND and optionally Patient Root – FIND) SOP Classes shall be supported. Refer to DICOM PS3.4: Query/Retrieve Service Class for detailed descriptive semantics.

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4.30.4.1.1 Trigger Events

The user at the Image Display wishes to view Key Image Notes to use as a guide to find significant images. An Image Display may query for Key Image Notes when a new patient is loaded in order to perform internal logic.

4.30.4.1.2 Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes.

A C-FIND Request from the DICOM Study Root Query/Retrieve Information Model – FIND SOP Class or the DICOM Patient Root Query/Retrieve Information Model – FIND SOP Class shall be sent from the Image Display to the Image Archive.

The Image Display uses one or more matching keys as search criteria to obtain the list of matching entries in the Image Archive at the selected level (Patient & Study/Series/Instance).

In addition to the required and unique keys defined by the DICOM Standard, the IHE Technical Framework has defined matching and return keys to be supported by query SCUs and SCPs. The keys are defined in Section 4.14.4.1.2 and Table 4.14-1. The conventions for key usage are defined in Section 2.2. For the Image Display (SCU) and the Image Archive (SCP) the additional Key Image Note Instances specific keys are defined in Table 4.30-1.

Table 4.30-1: Key Image Note Instance Specific Query Matching and Return Keys

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
Key Instance Note Instance Specific Level					
Content Date	(0008,0023)	O	O	O	R+
Content Time	(0008,0033)	O	O	O	R+
Observation DateTime	(0040,A032)	O	O	O	R+
Referenced Request Sequence	(0040,A370)				
>Study Instance UID	(0020,000D)	O	O	R+*	R+
>Accession Number	(0008,0050)	O	O	R+	R+
>Requested Procedure ID	(0040,1001)	O	O	R+	R+
>Requested Procedure Code Sequence	(0032,1064)				
>>Code Value	(0008,0100)	O	O	O	R+
>>Coding Scheme Designator	(0008,0102)	O	O	O	R+
>>Coding Scheme Version	(0008,0103)	O	O	O	R+
>>Code Meaning	(0008,0104)	O	O	O	R+
Concept Name Code Sequence (Note 1)	(0040,A043)				
>Code Value	(0008,0100)	R+	R+	R+	R+
>Coding Scheme Designator	(0008,0102)	R+	R+	R+	R+
>Coding Scheme Version	(0008,0103)	O	O	O	R+

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Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
>Code Meaning	(0008,0104)	O	O	R+	R+

Note1: The Concept Name Code Sequence of the root content item conveys the Key Image Note Title. The list of applicable codes can be found in CID 7010 (Key Object Selection Document Title) in DICOM PS3.16.

4.30.4.1.3 Expected Actions

The Image Archive receives the C-FIND request, performs the matching on the provided keys and sends the list of matching records back to the Image Display via C-FIND responses.

The Image Archive participating in the Mammography Acquisition Workflow Integration Profile or Imaging Object Change Management Integration Profile shall include or not include matching records related to specific KOS instances that mark rejected or corrected images as defined in Sections 4.66.4.1.3 and 4.66.4.2.3.

Note: The Mammography Acquisition Workflow Profile is currently in Trial Implementation. Please refer to the supplement for details.

The Image Archive participating in the Imaging Object Change Management Integration Profile shall also include or not include matching records related to specific KOS instances that mark rejected or corrected images as defined in Sections 4.66.4.3.3 and 4.66.4.4.3.

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4.31 Retrieve Key Image Notes [RAD-31]

4.31.1 Scope

In the Retrieve Key Image Notes Transaction, the requested DICOM Key Image Notes are transferred from the Image Manager or Imaging Document Source to the Image Display or Imaging Document Consumer for viewing along with the images flagged by the Key Image Note.

4.31.2 Actor Roles

Actor: Image Archive

Role: Sends requested Key Image Notes to the Image Display.

Actor: Imaging Document Source

Role: Sends requested Key Image Notes to the Imaging Document Consumer.

Actor: Image Display

Role: Receives requested Key Image Notes from the Image Archive.

Actor: Imaging Document Consumer

Role: Receives requested Key Images Notes from the Imaging Document Source.

4.31.3 Referenced Standards

DICOM PS3.4 Annex C: Query/Retrieve Service Class

DICOM PS3.3 Section A.36.4: Key Object Selection Document IOD

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4.31.4 Messages

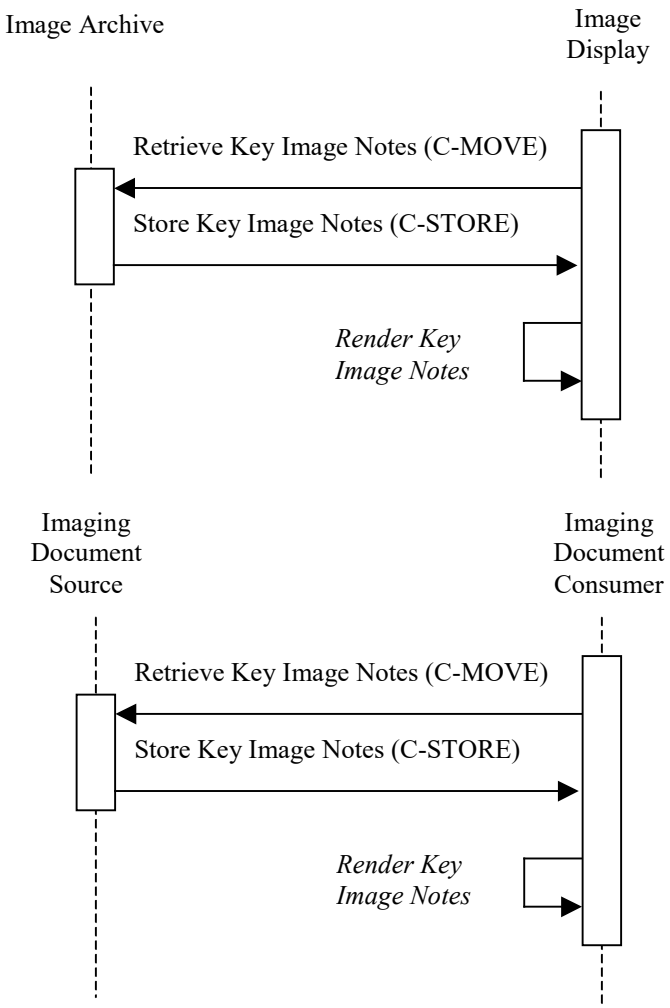

Figure 4.31.4-1: Interaction Diagrams

4.31.4.1 Retrieve Key Image Notes

The Retrieve (Study Root – MOVE and optionally Patient Root – MOVE) SOP Classes will be supported. The Image Archive and Imaging Document Source as an SCU shall support DICOM Image Storage SOP Classes. Refer to DICOM PS3.4 Annex C, for detailed descriptive semantics.

4.31.4.1.1 Trigger Events

The Image Display or Imaging Document Consumer selects specific Key Image Note objects to retrieve from the Image Archive or Imaging Document Source.

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4.31.4.1.2 Message Semantics

The message semantics are defined in the DICOM Query/Retrieve Service Class. It is the responsibility of the Image Manager to assure that the patient and procedure information is current in the images and Key Image Note objects when they are retrieved from the Image Archive. It is the responsibility of the Imaging Document Source to assure that the patient and procedure information is current in the Key Image Note objects when they are retrieved from this actor.

4.31.4.1.3 Expected Actions

The Image Archive or Imaging Document Source receives the C-MOVE request, establishes a DICOM association with the Image Display or Imaging Document Consumer, and uses the DICOM Key Image Note Storage SOP Class to transfer the requested Key Image Note objects.

The Image Archive participating in the Mammography Acquisition Workflow Integration Profile or Imaging Object Change Management Integration Profile shall include or not include specific KOS instances that mark rejected images as defined in Section 4.66.4.1.3.

Note: The Mammography Acquisition Workflow Profile is currently in Trial Implementation. Please refer to the supplement for details.

4.31.4.2 Render Key Image Notes

This transaction relates to the “Render Key Image Notes” event of the above interaction diagram. Key Image Notes cannot be rendered separately, but must be applied to images. Refer to Section 4.16 for a description of the transaction used to retrieve images to which Key Image Notes may be applied.

The Image Display or Imaging Document Consumer is not required to, but may choose to, support retrieval and display of images from other studies than the one to which the Key Image Note belongs.

4.31.4.2.1 Trigger Events

The Image Display or Imaging Document Consumer receives Key Image Note instances from the Image Archive or Imaging Document Source.

4.31.4.2.2 Invocation Semantics

This is a local invocation of functions resident within the Image Display or Imaging Document Consumer. The method used by the Image Display or Imaging Document Consumer to present images for viewing by the user flagged by the Key Image Notes is outside the scope of the IHE Radiology Technical Framework.

4.31.4.2.2.1 Retrieve AE Title

If the Image Display is capable of retrieving objects referenced in a DICOM Key Image Note then it shall retrieve these objects from the device matching the appropriate Retrieve AE Title attribute (0008,0054) included in the DICOM Key Image Note. If the Retrieve AE Title attribute

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is not specified or configured, then the Image Display shall use some other configurable Retrieve AE Title.

In the case of retrieving DICOM Key Image Notes in a Cross-Enterprise, imaging document sharing (XDS-I) network environment, a configuration of mapping the AE Titles to DICOM AE Network Addresses (IP Address and Port number) are needed to be exchanged between the Imaging Document Source and the Imaging Document Consumer. RAD TF-2x: Appendix G describes in detail the AE Title mapping to the DICOM AE Network Addresses.

4.31.4.2.3 Expected Actions

The Image Display or Imaging Document Consumer flags the images and renders the Key Image Note.

Note: It is recommended to use the just retrieved instance of the Key Image Note to ensure that the most recent patient data be displayed to reflect possible patient merge and patient update in the Image Manager/Image Archive or Imaging Document Source. This patient data may be inconsistent with patient data contained in a previously retrieved copy of the same Key Image Note instance.

4.31.4.2.3.1 Presentation of rejected or incorrect images in Mammography Acquisition Workflow

This section is currently in the Mammography Acquisition Workflow (MAWF) Trial Implementation Supplement.

4.31.4.2.3.2 Presentation of rejected or incorrect images in Imaging Object Change Management

An Image Display participating in the Imaging Object Change Management Integration Profile may receive Key Image Notes.

When an Image Display receives a Key Image Note with Key Object Selection (KOS) Document Title valued (113001, DCM, "Rejected for Quality Reasons"). The Image Display shall support the three behaviors listed below. The behavior shall be configurable as one of the following:

- Suppress from presentation the rejected instances referenced in this KOS and this KOS itself
- Present the rejected instances referenced in this KOS and this KOS itself
- Ignore this KOS and present the rejected instances.
- When an Image Display receives a Key Image Note with the Key Object Selection (KOS) Document Title valued (113037, DCM, "Rejected for Patient Safety Reasons"), (113038, DCM, “Incorrect Modality Worklist Entry”), or (113039, DCM, “Data Retention Policy Expired”), it shall suppress the KOS and its referenced rejected instances from presentation.

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4.32 Authenticate Node - Deprecated

This transaction is identical to, and has been superseded by, the Authenticate Node [ITI-19] (ITI TF-2: 3.19) transaction as part of the ITI Audit Trail and Node Authentication Profile.

4.33 Maintain Time - Deprecated

This transaction is identical to, and has been superseded by, the Maintain Time [ITI-1] (ITI TF-2: 3.1) transaction as part of the ITI Consistent Time Profile (ITI TF-2: 3.1).

4.34 Record Audit Event - Deprecated

This transaction has been superseded by the Record Audit Event [ITI-20] (ITI TF-2: 3.20) transaction as part of the ITI Audit Trail and Node Authentication Profile and the Radiology Audit Trail Option described in RAD TF-3: 5.1. While the Record Audit Event [ITI-20] transaction extends this deprecated transaction, it is still backward compatible.

4.35 Charge Posted [RAD-35]

4.35.1 Scope

The Charge Posted Transaction specifies a message from the Department System Scheduler/Order Filler to the Charge Processor. This HL7 Financial Transaction message contains procedure data typically needed to generate a claim.

The Department System Scheduler/Order Filler provides the procedure data that is used by the Charge Processor. The Charge Processor may or may not expect the actual transaction fees associated with the procedures included in the transaction. In some situations, the Department System Scheduler/Order Filler is best able to match the procedure details to the appropriate fees. In other situations, the Charge Processor performs this function. In either case, the Charge Processor can override the fees provided by the Department System Scheduler/Order Filler.

The ways and means of ensuring the required data is complete is the responsibility of the Charge Processor and is outside the scope of IHE.

Note: although IHE specifies real-time charge posted transactions, batch processing can be accommodated as per the batch specifications defined in HL7 v2.3.1 Chapter 2, sec. 2.23.2 or HL7 v2.5.1 Chapter 2, sec 2.10.2.

4.35.2 Actor Roles

Actor: Department System Scheduler/Order Filler

Role: Collects information relevant to the posting of charges and submits it to the Charge Processor.

Actor: Charge Processor

Role: Receives the information from the Department System Scheduler/Order Filler. Processes and combines charges in order to issue an insurance claim or patient's billing statement.

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4.35.3 Referenced Standards

HL7, Version 2.3.1: Chapter 6 - Financial Management

HL7, Version 2.5.1: Chapter 6 – Financial Management

DICOM PS3.4 Section F.7: Modality Performed Procedure Step SOP Class

4.35.4 Messages

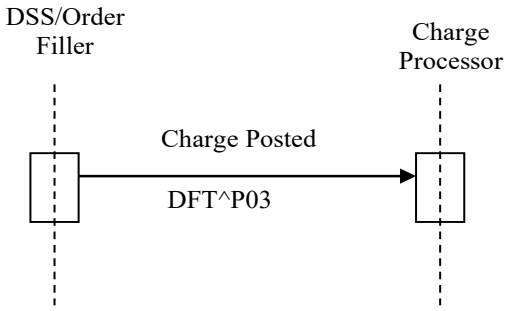

Figure 4.35.4-1: Interaction Diagram

4.35.4.1 Financial Transaction Message

The Detailed Financial Transaction (DFT) message is used to describe a financial transaction transmitted between the Department System Scheduler/Order Filler and the Charge Processor.

Note that sometimes the DFT does not actually result in a financial transaction.

4.35.4.1.1 Trigger Events

The Department System Scheduler/Order Filler determines when the charge posted transactions are to be sent to the Charge Processor. There are two types of financial billing transactions – Technical and Professional. Each can be triggered at a separate time or both can be sent at the same time - depending on the site configuration.

- Technical Billing

  Charge posting of the Technical Billing for a procedure is typically triggered when the procedure is completed. The Performed Procedure Step Manager sends the MPPS Completed message to the Department System Scheduler/Order Filler. The Department System Scheduler/Order Filler is now aware that the procedure has been completed and sends the technical charge information to the Charge Processor.

  Technical Billing for certain post-processing operations, such as Mammography CAD, is triggered when the Department System Scheduler/Order Filler receive confirmation from the Post-processing Manager that the step has been completed. The Department System Scheduler receives this confirmation by grouping with Post-Processing Manager; if Post-Processing Manager is grouped with Image Manager, Charge Posting of the Professional Billing will be triggered by the Performed Work

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Status Update message to the Department System Scheduler/Order Filler that specifies completion of the post-processing operation.

- Professional Billing

  Charge posting of the Professional Billing is triggered when a report is completed/verified by the radiologist. When the Department System Scheduler/Order Filler is aware that the report is completed it sends the professional charge information to the Charge Processor.

  The Department System Scheduler/Order Filler may receive confirmation from the Report Manager that the report has been completed and verified. Department System Scheduler receives this confirmation by grouping with Report Manager. If Report Manager implements the Reporting Workflow Profile, Charge Posting of the Professional Billing will be triggered by the Performed Work Status Update transaction that specifies completion of the report.

4.35.4.1.2 Message Semantics

This transaction defines both HL7 v2.3.1 Message Semantics and HL7 v2.5.1 Message Semantics. Except for the certain references and segment tables (which are labeled as "HL7 v2.3.1" or "HL7 v2.5.1"), all requirements in this section apply to both HL7 v2.3.1 and HL7 v2.5.1. Profiles using this transaction will specify which message semantics its actors are required to support.

The Department System Scheduler/Order Filler uses the DFT message to convey necessary charge posting information to the Charge Processor. The Charge Processor shall obtain the related Patient Demographic information from the ADT Patient Registration transaction generally received earlier.

The Department System Scheduler/Order Filler uses information from the Modality Performed Procedure Step Completed/Discontinued transaction to verify the procedure has been completed. This information can also include the DICOM Billing and Material Management Code Module which provides procedure, materials and devices information.

The Charge Posted Transaction will transmit Detailed Financial Transactions (DFT) messages using the P03 event.

One or more PR1 segments shall be present if additional procedures, materials or devices are present. It may be absent otherwise.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.3.

Required segments are defined below. Other segments are optional

DFT Segment	Detailed Financial Transaction Message	Chapter in HL7
MSH	Message Header	2
EVN	Event Type	3

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DFT Segment	Detailed Financial Transaction Message	Chapter in HL7
PID	Patient Identification	3
[PV1]	Patient Visit	3 (see note)
{FT1	Financial Transaction	6
[{PR1}]}	Procedure	6

Note: PV1 is required if use of PV1-19 Visit Number is required per the applicable regional or national extensions to the IHE Radiology Technical framework (see RAD TF-4).

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of the DFT message to its sender. See Section 2.4.3 "Acknowledgement Modes" (HL7 v2.3.1) or Section 2.4.4.1 "Acknowledgement Message" (HL7 v2.5.1) for definition and discussion of the ACK message.

4.35.4.1.2.1 MSH Segment

The MSH segment shall be constructed as defined in Section 2.4.2.2.2 (HL7 v2.3.1) or 2.4.4.2 (HL7 v2.5.1) "Message Control".

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of "DFT"; the second component shall have value of P03.

4.35.4.1.2.2 EVN Segment

The EVN segment is used to communicate necessary trigger event information to receiving applications. See Section 4.1.4.1.2.1.2 (HL7 v2.3.1) or Section 4.1.4.1.2.2.2 (HL7 v2.5.1) for required and optional fields of the EVN segment.

4.35.4.1.2.3 PID Segment

All of the fields in PID segment are optional, except those listed in Table 4.35-1 (HL7 v2.3.1) or Table 4.35-1a (HL7 v2.5.1).

Table 4.35-1: IHE Profile - PID segment - HL7 v2.3.1

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	20	CX	R		00106	Patient Identifier List
5	48	XPN	R		00108	Patient Name
18	20	CX	C		00121	Patient Account Number
19	16	ST	O		00122	SSN Number - Patient

Adapted from the HL7 standard, version 2.3.1

Table 4.35-1a: IHE Profile - PID segment – HL7 v2.5.1

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	250	CX	R		00106	Patient Identifier List
5	250	XPN	R		00108	Patient Name

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SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
18	250	CX	C		00121	Patient Account Number
19	16	DT	O		01222	SSN Number - Patient

Adapted from the HL7 standard, version 2.5.1

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued.

4.35.4.1.2.4 PV1 Segment

All of the fields in PV1 segment are optional, except those listed in Table 4.35-2 (HL7 v2.3.1) or Table 4.35-2a (HL7 v2.5.1).

Table 4.35-2: IHE Profile - PV1 Segment – HL7 v2.3.1

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	20	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.3.1

Table 4.35-2a: IHE Profile - PV1 Segment – HL7 v2.5.1

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	250	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.5.1

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued.

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

4.35.4.1.2.5 FT1 Segment

The FT1 segment is used to post charges, credits, payments, and adjustments to patient accounting records. The DSS/OF shall map values from ADT and ORM messages into the FT1 segment as defined in Table 4.35-3 (HL7 v2.3.1) or Table 4.35-3a (HL7 v2.5.1).

Table 4.35-3: IHE Profile - FT1 Segment – HL7 v2.3.1

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	O		00355	Set ID - FT1
2	12	ST	O		00356	Transaction ID

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SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	10	ST	O		00357	Transaction Batch ID
4	26	TS	R		00358	Transaction Date
5	26	TS	R		00359	Transaction Posting Date
6	8	IS	R	0017	00360	Transaction Type
7	80	CE	R	0132	00361	Transaction Code
8	40	ST	O		00362	Transaction Description
9	40	ST	O		00363	Transaction Description - Alt
10	6	NM	O		00364	Transaction Quantity
11	12	CP	O		00365	Transaction Amount - Extended
12	12	CP	O		00366	Transaction Amount - Unit
13	60	CE	O	0049	00367	Department Code
14	60	CE	O	0072	00368	Insurance Plan ID
15	12	CP	O		00369	Insurance Amount
16	80	PL	O		00133	Assigned Patient Location
17	1	IS	O	0024	00370	Fee Schedule
18	2	IS	O	0018	00148	Patient Type
19	60	CE	O	0051	00371	Diagnosis Code - FT1
20	120	XCN	R	0084	00372	Performed By Code
21	120	XCN	R		00373	Order By Code
22	12	CP	O		00374	Unit Cost
23	22	EI	R		00217	Filler Order Number
24	120	XCN	O		00765	Entered By Code
25	80	CE	R	0088	00393	Procedure Code
26	80	CE	O	0340	01316	Procedure Code Modifier

Adapted from the HL7 standard, version 2.3.1

Table 4.35-3a: IHE Profile - FT1 Segment - HL7 v2.5.1

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	O		00355	Set ID - FT1
2	12	ST	O		00356	Transaction ID
3	10	ST	O		00357	Transaction Batch ID
4	53	DR	R		00358	Transaction Date
5	26	TS	R		00359	Transaction Posting Date
6	8	IS	R	0017	00360	Transaction Type
7	250	CE	R	0132	00361	Transaction Code
8	40	ST	O		00362	Transaction Description
9	40	ST	O		00363	Transaction Description - Alt
10	6	NM	O		00364	Transaction Quantity
11	12	CP	O		00365	Transaction Amount - Extended

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SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
12	12	CP	O		00366	Transaction Amount - Unit
13	250	CE	O	0049	00367	Department Code
14	150	CE	O	0072	00368	Insurance Plan ID
15	12	CP	O		00369	Insurance Amount
16	80	PL	O		00133	Assigned Patient Location
17	1	IS	O	0024	00370	Fee Schedule
18	2	IS	O	0018	00148	Patient Type
19	250	CE	O	0051	00371	Diagnosis Code - FT1
20	250	XCN	R	0084	00372	Performed By Code
21	250	XCN	R		00373	Order By Code
22	12	CP	O		00374	Unit Cost
23	427	EI	R		00217	Filler Order Number
24	120	XCN	O		00765	Entered By Code
25	250	CE	R	0088	00393	Procedure Code
26	250	CE	O	0340	01316	Procedure Code Modifier
27	250	CE	O	0339	01310	Advanced Beneficiary Notice Code
28	250	CWE	O	0476	01646	Medically Necessary Duplicate Procedure Reason
29	250	CWE	O	0549	01845	NDC Code
30	250	CX	O		01846	Payment Reference ID
31	4	SI	O		01847	Transaction Reference Key

Adapted from the HL7 standard, version 2.5.1

4.35.4.1.2.6 PR1 Segment – Procedures

The PR1 segment contains information relative to various types of procedures that can be performed on a patient. The PR1 segment can be used to send procedure information, for example: Surgical, Nuclear Medicine, X-Ray with contrast, etc. The PR1 segment is used to send multiple procedures, for example, for medical records encoding or for Charge Processors. The DSS/OF shall map values from ADT and ORM messages into the PR1 segment as defined in Table 4.35-4 (HL7 v2.3.1) or Table 4.35-4a (HL7 v2.5.1).

Table 4.35-4: PR1 Attributes – HL7 v2.3.1

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	R		00391	Set ID - PR1
2	2	IS	R	0089	00392	Procedure Coding Method
3	80	CE	R	0088	00393	Procedure Code (see note)
4	40	ST	O		00394	Procedure Description
5	26	TS	R		00395	Procedure Date/Time
6	2	IS	R	0230	00396	Procedure Functional Type
7	4	NM	O		00397	Procedure Minutes

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SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
8	120	XCN	O	0010	00398	Anesthesiologist
9	2	IS	O	0019	00399	Anesthesia Code
10	4	NM	O		00400	Anesthesia Minutes
11	120	XCN	O	0010	00401	Surgeon
12	230	XCN	O	0010	00402	Procedure Practitioner
13	60	CE	O	0059	00403	Consent Code
14	2	NM	O		00404	Procedure Priority
15	80	CE	O	0051	00772	Associated Diagnosis Code
16	80	CE	O	0340	01316	Procedure Code Modifier (see note)

Adapted from the HL7 standard, version 2.3.1

Note: Each PR1 segment will contain only one procedure code or one modifier code.

7865 **Table 4.35-4a: PR1 Attributes – HL7 v2.5.1**

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	R		00391	Set ID - PR1
2	3	IS	R	0089	00392	Procedure Coding Method
3	250	CE	R	0088	00393	Procedure Code (see note)
4	40	ST	O		00394	Procedure Description
5	26	TS	R		00395	Procedure Date/Time
6	2	IS	R	0230	00396	Procedure Functional Type
7	4	NM	O		00397	Procedure Minutes
8	250	XCN	O	0010	00398	Anesthesiologist
9	2	IS	O	0019	00399	Anesthesia Code
10	4	NM	O		00400	Anesthesia Minutes
11	250	XCN	O	0010	00401	Surgeon
12	250	XCN	O	0010	00402	Procedure Practitioner
13	250	CE	O	0059	00403	Consent Code
14	2	NM	O		00404	Procedure Priority
15	250	CE	O	0051	00772	Associated Diagnosis Code
16	250	CE	O	0340	01316	Procedure Code Modifier (see note)
17	20	IS	O	0416	01501	Procedure DRG Type
18	250	CE	O	0417	01502	Tissue Type Code
19	427	EI	C		01848	Procedure Identifier
20	1	ID	C	0206	01849	Procedure Action Code

Adapted from the HL7 standard, version 2.5.1

Note: Each PR1 segment will contain only one procedure code or one modifier code.

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4.35.4.2 Sources of Information

The Charge Posted Transaction derives its data from three sources which are described below. Tables 4.35-5 and 4.35-6 describe the mapping of the fields in the FT1 segment and the PR1 segment.

- **Order Management – HL7 order messages [RAD-3] and [RAD-3]**

  The Order Placer General Order Message provides the Department System Scheduler/Order Filler with the required Charge Posted Transaction fields to be used in the PID Segment. See Sections 4.2 and 4.3 for required and optional fields.

- **Modality Performed Procedure Step [RAD-7]**

  The Modality General Order Message provides the Department System Scheduler/Order Filler with the required Charge Posted Transaction fields to be used in the FT1 segment and the PR1 segment. There may be additional procedures, or supplies information contained in the DICOM Billing Materials and Management message. See Section 4.7 (Modality Procedure Step Completed/Discontinued) for required and optional fields.

  The message semantics are defined in the DICOM Service Class Section of the DICOM Modality Performed Procedure Step SOP Class. It is the responsibility of the Acquisition Modality to ensure that the procedure information is sent to the Department System Scheduler/Order Filler.

- **Manual Posting/Department System Scheduler/Order Filler**

  Manual entry of Charge Posted Transaction information is also supported. This enables the Department System Scheduler/Order Filler to collect information that is not being provided by the Modality or the Order Placer and is required by the Charge Processor. This data can be manually entered into or is a function of the Department System Scheduler/Order Filler.

Table 4.35-5: Mapping of the FT1 Segment

FT1 Field	Field Definition	OPT	HL7 order messages – [RAD-2] and [RAD-3]	Modality Performed Procedure Step [RAD-7]	Manual Input/Department System Scheduler/Order Filler
Transaction Date	Date of the transaction. For example, this field would be used to identify the date a procedure, item, or test was conducted or used. It may be defaulted to today's date.	R		Performed Procedure Step End Date (0040,0004) + Performed Procedure Step End Time (0040,0005)	Generated by Department System Scheduler/Order Filler if there is no MPPS

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FT1 Field	Field Definition	OPT	HL7 order messages – [RAD-2] and [RAD-3]	Modality Performed Procedure Step [RAD-7]	Manual Input/Department System Scheduler/Order Filler
Transaction Posting Date	Date of the transaction that was sent to the financial system for posting.	R			Generated by Department System Scheduler/Order Filler Use today's date.
Transaction Type	Code that identifies the type of transaction. Values: CG – Charge CD – Credit PY – Payment AJ – Adjustment	R			Generated by Department System Scheduler/Order Filler
Transaction Code	Code assigned by the institution for the purpose of uniquely identifying the transaction. For example, this field would be used to uniquely identify a procedure, supply item, or test for charging purposes.	R		Billing Item Sequence (0040, 0296) Note: If the Billing Item Sequence is blank then use Procedure Code Sequence (0008, 1032)	
Transaction Quantity	Quantity of items associated with this transaction	O		Quantity Sequence (0040,0293)	Generated by Department System Scheduler/Order Filler if there is no MPPS.
Transaction Amount - Extended	The amount of a transaction. It may be left blank if the transaction is automatically priced. Total price for multiple items.	O			Generated by Department System Scheduler/Order Filler
Transaction Amount - Unit	Unit price of a transaction. Price of a single item.	O			Generated by Department System Scheduler/Order Filler.
Department Code	The department code that controls the transaction code described above.	O			Generated by Department System Scheduler/Order Filler.
Insurance Plan ID	The identifier of the primary insurance plan with which this transaction shall be associated	O			Generated by Department System Scheduler/Order Filler.
Insurance Amount	The amount to be posted to the insurance plan referenced above.	O			Generated by Department System Scheduler/Order Filler.

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FT1 Field	Field Definition	OPT	HL7 order messages – [RAD-2] and [RAD-3]	Modality Performed Procedure Step [RAD-7]	Manual Input/Department System Scheduler/Order Filler
Assigned Patient Location	This field contains the current patient location. This can be the location of the patient when the charge item was ordered or when the charged service was rendered.	O	PV1-3 – Assigned Patient Location (ADT)		
Fee Schedule	This field contains the code used to select the appropriate fee schedule to be used for this transaction posting.	O			
Patient Type	This field contains the type code assigned to the patient for this episode of care (visit or stay).	O			
Diagnosis Code – FT1	This field contains the primary diagnosis code for billing purposes. ICD9 CM is assumed for all diagnosis codes. This is the most current diagnosis code that has been assigned to the patient. ICD10 can also be used. The name of coding system (third component) indicates which coding system is used.	O			
Performed By Code	This field contains the composite number/name of the person/group that performed the test/procedure/transaction, etc. This is the service provider.	R		Performing Physician's Name (0008,1050) Note: May be repeated.	Generated by Department System Scheduler/Order Filler if there is no MPPS.
Order By Code	This field contains the composite number/name of the person/group that ordered the test/ procedure/transaction, etc.	R	ORC-12 Ordering Provider (ORM)		
Unit Cost	This field contains the unit cost of transaction. The cost of a single item.	O			Generated by Department System Scheduler/Order Filler.
Filler Order Number	This field is used when the billing system is requesting observational reporting justification for a charge. This is the number used by a filler to uniquely identify a result.	R	ORC-3 Filler Order Number (ORM)		

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FT1 Field	Field Definition	OPT	HL7 order messages – [RAD-2] and [RAD-3]	Modality Performed Procedure Step [RAD-7]	Manual Input/Department System Scheduler/Order Filler
Entered By Code	This field identifies the composite number/name of the person who entered the insurance information.	O	ORC-10 Entered By (ORM)		
Procedure Code	This field contains a unique identifier assigned to the procedure, if any, associated with the charge.	R		Procedure Code Sequence (0008, 1032)	
Procedure Code Modifier	This field contains the procedure code modifier to the procedure code reported in field 25, when applicable. Procedure code modifiers are defined by regulatory agencies such as HCFA and the AMA.	O			Generated by Department System Scheduler/Order Filler. Use "TC" for Technical Component. Use "26" for Professional Component Other modifiers may be included as repetitions of the field.

Table 4.35-6: Mapping of the PR1 Segment

PR1 Field	Field Definition	OPT	HL7 order messages – [RAD-2] and [RAD-3]	Modality Performed Procedure Step [RAD-7]	Manual Input/Department System Scheduler/Order Filler
Set ID - PR1	A number that identifies this transaction. For the first occurrence of the segment the sequence number shall be 1, for the second occurrence it shall be 2, etc.	R			Generated by Department System Scheduler/Order Filler
Procedure Code	This field contains a unique identifier assigned to the procedure.	R		Billing Procedure Step Sequence (0040,0320)	Generated by Department System Scheduler/Order Filler if there is no MPPS.
Procedure Date/Time	This field contains the date/time that the procedure was performed	R		Performed Procedure Step End Date (0040,0004) + Performed Procedure Step	Generated by Department System Scheduler/Order Filler if there is no MPPS.

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PR1 Field	Field Definition	OPT	HL7 order messages – [RAD-2] and [RAD-3]	Modality Performed Procedure Step [RAD-7]	Manual Input/Department System Scheduler/Order Filler
				End Time (0040,0005) Note: Use the last MPPS of the Procedure	
Procedure Functional Type	The optional code that further defines the type of procedure. Values: A – Anesthesia P – Procedure for treatment I – Invasive procedure not classified D – Diagnostic procedure	R			Generated by Department System Scheduler/Order Filler.
Procedure Code Modifier	This field contains the procedure code modifier to the procedure code reported in field 3, when applicable.	O			Generated by Department System Scheduler/Order Filler or Charge Processor. Use "TC" for Technical Component. Use "26" for Professional Component. Other modifiers may be included as repetitions of the field. Modifier may be absent in a case of global billing.

4.35.4.3 Expected Actions

The Charge Processor will receive and process the technical billing or professional billing details in the DFT message according to the capabilities of its application. This processing is not defined or constrained by IHE.

4.36 Account Management [RAD-36]

4.36.1 Scope

The Account Management Transaction specifies messages from the ADT Patient Registration to the Charge Processor. These messages are sent when the account for the patient is set-up, updated, or closed.

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Use of this transaction minimizes the information needed to be sent to the Department System Scheduler/Order Filler such as insurance or guarantor information. The Charge Processor receives this information directly from the ADT system.

4.36.2 Actor Roles

Actor: ADT Patient Registration

Role: Collects information relevant to the account patient and submits it to the Charge Processor.

Actor: Charge Processor

Role: Receives the information from Patient Registration. Processes and combines charges in order to issue an insurance claim or patient's billing statement.

4.36.3 Referenced Standards

HL7, Version 2.3.1: Chapter 6 - Financial Management

4.36.4 Messages

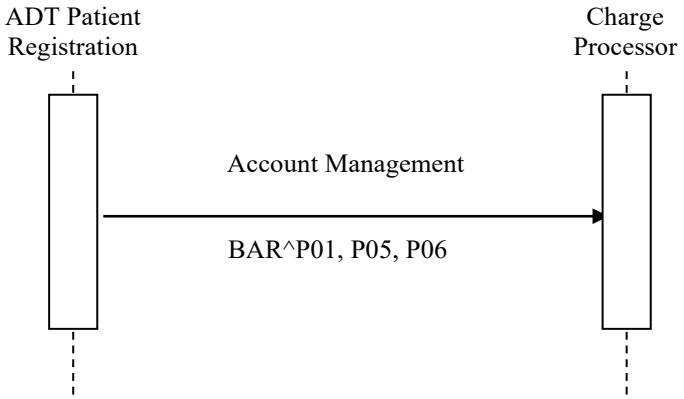

Figure 4.36.4-1: Interaction Diagram

4.36.4.1 Account Management - New Account

The Account Management message is used to describe a patient account information transaction transmitted between the ADT Patient Registration and the Charge Processor. Data is sent from the ADT Patient Registration application to the patient accounting or financial system to establish an account for a patient's billing/accounts receivable record. This message enables the Charge Processor to process the patient claim after the procedure charge is received.

4.36.4.1.1 Trigger Events

Creation of a new account will typically occur as a result of one of the following ADT Patient registration events:

- Admission of an in-patient into a facility
- Registration of an outpatient for a visit of the facility

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- Pre-admission of an in-patient (i.e., registration of patient information ahead of actual admission).

Creation of an account will result in the following Account Management message:

- P01 – Add Patient Account.

4.36.4.1.2 Message Semantics

The Account Management transaction is conducted by the HL7 BAR message. The ADT Actor shall generate the message whenever a patient is admitted, pre-admitted or registered. The P01 event shall only be used to add a new account that did not exist before, not to update an existing account. The new P05 (update account) event shall be used to update an existing account. The new P06 (end account) event shall be used to close an account.

One or more DG1 segments shall be present if patient's diagnosis is known at the time of Account creation. It may be absent otherwise.

One or more GT1 segments shall be present if Guarantor (even if it is patient itself) is known at the time of Account creation. It may be absent otherwise.

One or more IN1 segments shall be present if insurance information about patient is known at the time of Account creation. It may be absent otherwise.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.3.

The segments of the **Add Patient Account** message listed below are required, and the detailed description of messages is provided in the following subsections.

BAR Segment	Billing Account	Chapter in HL7 2.3.1
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
[PV1]	Patient Visit	3 (see Note)
[{DG1}]	Diagnosis	6
[{GT1}]	Guarantor	6
[{IN1}]	Insurance	6

Note: PV1 is required if use of *PV1-19 Visit Number* is required per the applicable regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of the BAR message to its sender. See Section 2.4.3 "Acknowledgement Modes" for definition and discussion of the ACK message.

4.36.4.1.2.1 MSH Segment

The MSH segment shall be constructed as defined in Section 2.4.2.2.2 "Message Control".

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Field MSH-9 Message Type shall have at least two components. The first component shall have a value of "BAR"; the second component shall have the value of P01.

4.36.4.1.2.2 EVN Segment

The EVN segment is used to communicate necessary trigger event information to receiving applications. See Section 4.1.4.1.2.1.2 for required and optional fields of the EVN segment.

4.36.4.1.2.3 PID Segment

All of the fields in PID segment are optional, except those listed in Table 4.36-1. See Section 4.1.4.1.2.1.3 for the list of all fields of the PID segment.

Table 4.36-1: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	20	CX	R		00106	Patient Identifier List
5	48	XPN	R		00108	Patient Name
18	20	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.3.1

4.36.4.1.2.4 PV1 Segment

Most of the fields in PV1 segment are optional, except those listed in Table 4.36-2. See Section 4.1.4.1.2.1.4 for the list of all fields of the PV1 segment.

Table 4.36-2: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	20	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.3.1

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued. Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

4.36.4.1.2.5 DG1 Segment

The DG1 segment contains patient diagnosis information of various types, for example, admitting, primary, etc. The DG1 segment is used to send multiple diagnoses (for example, for medical records encoding). It is also used when the FT1-19 Diagnosis Code does not provide sufficient information for a billing system. This diagnosis coding shall be distinguished from the

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clinical problem segment used by caregivers to manage the patient. Table 4.36-3 lists the required and optional attributes of the DG1 segment.

Table 4.36-3: IHE Profile - DG1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	R		00375	Set ID - DG1
2	2	ID	O	0053	00376	Diagnosis Coding Method
3	60	CE	O	0051	00377	Diagnosis Code - DG1
4	40	ST	O		00378	Diagnosis Description
5	26	TS	O		00379	Diagnosis Date/Time
6	2	IS	R	0052	00380	Diagnosis Type
7	60	CE	O	0118	00381	Major Diagnostic Category
8	60	CE	O	0055	00382	Diagnostic Related Group
9	2	ID	O	0136	00383	DRG Approval Indicator
10	2	IS	O	0056	00384	DRG Grouper Review Code
11	60	CE	O	0083	00385	Outlier Type
12	3	NM	O		00386	Outlier Days
13	12	CP	O		00387	Outlier Cost
14	4	ST	O		00388	Grouper Version And Type
15	2	ID	O		00389	Diagnosis Priority
16	60	XCN	O		00390	Diagnosing Clinician
17	3	IS	O	0228	00766	Diagnosis Classification
18	1	ID	O	0136	00767	Confidential Indicator
19	26	TS	O		00768	Attestation Date/Time

4.36.4.1.2.6 GT1 Segment

The GT1 segment contains guarantor (e.g., the person or the organization with financial responsibility for payment of a patient account) data for patient and insurance billing applications. Table 4.36-4 lists the required and optional attributes of the GT1 segment.

Table 4.36-4: IHE Profile - GT1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
1	4	SI	R		00405	Set ID - GT1
2	59	CX	O		00406	Guarantor Number
3	48	XPN	R		00407	Guarantor Name
4	48	XPN	O		00408	Guarantor Spouse Name
5	106	XAD	O		00409	Guarantor Address
6	40	XTN	O		00410	Guarantor Ph Num-Home
7	40	XTN	O		00411	Guarantor Ph Num-Business
8	26	TS	O		00412	Guarantor Date/Time Of Birth
9	1	IS	O	0001	00413	Guarantor Sex

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SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
10	2	IS	O	0068	00414	Guarantor Type
11	80	CE	O	0063	00415	Guarantor Relationship
12	11	ST	O		00416	Guarantor SSN
13	8	DT	O		00417	Guarantor Date - Begin
14	8	DT	O		00418	Guarantor Date - End
15	2	NM	O		00419	Guarantor Priority
16	130	XPN	O		00420	Guarantor Employer Name
17	106	XAD	O		00421	Guarantor Employer Address
18	40	XTN	O		00422	Guarantor Employer Phone Number
19	20	CX	O		00423	Guarantor Employee ID Number
20	2	IS	O	0066	00424	Guarantor Employment Status
21	130	XON	O		00425	Guarantor Organization Name
22	1	ID	O	0136	00773	Guarantor Billing Hold Flag
23	80	CE	O	0341	00774	Guarantor Credit Rating Code
24	26	TS	O		00775	Guarantor Death Date And Time
25	1	ID	O	0136	00776	Guarantor Death Flag
26	80	CE	O	0218	00777	Guarantor Charge Adjustment Code
27	10	CP	O		00778	Guarantor Household Annual Income
28	3	NM	O		00779	Guarantor Household Size
29	20	CX	O		00780	Guarantor Employer ID Number
30	80	CE	O	0002	00781	Guarantor Marital Status Code
31	8	DT	O		00782	Guarantor Hire Effective Date
32	8	DT	O		00783	Employment Stop Date
33	2	IS	O	0223	00755	Living Dependency
34	2	IS	O	0009	00145	Ambulatory Status
35	80	CE	O	0171	00129	Citizenship
36	60	CE	O	0296	00118	Primary Language
37	2	IS	O	0220	00742	Living Arrangement
38	80	CE	O	0215	00743	Publicity Code
39	1	ID	O	0136	00744	Protection Indicator
40	2	IS	O	0231	00745	Student Indicator
41	80	CE	O	0006	00120	Religion
42	48	XPN	O		00746	Mother’s Maiden Name
43	80	CE	O	0212	00739	Nationality
44	80	CE	O	0189	00125	Ethnic Group
45	48	XPN	O		00748	Contact Person’s Name
46	40	XTN	O		00749	Contact Person’s Phone Number

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SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
47	80	CE	O	0222	00747	Contact Reason
48	2	IS	O	0063	00784	Contact Relationship
49	20	ST	O		00785	Job Title
50	20	JCC	O	0327/ 0328	00786	Job Code/Class
51	130	XON	O		01299	Guarantor Employer's Organization Name
52	2	IS	O	0295	00753	Handicap
53	2	IS	O	0311	00752	Job Status
54	50	FC	O	0064	01231	Guarantor Financial Class
55	80	CE	O	0005	01291	Guarantor Race

4.36.4.1.2.7 IN1 Segment

The IN1 segment contains insurance policy coverage information necessary to produce properly pro-rated and patient and insurance bills. Table 4.36-5 lists the required and optional attributes of the IN1 segment.

Table 4.36-5: IHE Profile - IN1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
1	4	SI	R		00426	Set ID - IN1
2	60	CE	R	0072	00368	Insurance Plan ID
3	59	CX	R		00428	Insurance Company ID
4	130	XON	O		00429	Insurance Company Name
5	106	XAD	O		00430	Insurance Company Address
6	48	XPN	O		00431	Insurance Co Contact Person
7	40	XTN	O		00432	Insurance Co Phone Number
8	12	ST	O		00433	Group Number
9	130	XON	O		00434	Group Name
10	12	CX	O		00435	Insured's Group Emp ID
11	130	XON	O		00436	Insured's Group Emp Name
12	8	DT	O		00437	Plan Effective Date
13	8	DT	O		00438	Plan Expiration Date
14	55	CM	O		00439	Authorization Information
15	3	IS	O	0086	00440	Plan Type
16	48	XPN	O		00441	Name Of Insured
17	80	CE	O	0063	00442	Insured's Relationship To Patient
18	26	TS	O		00443	Insured's Date Of Birth
19	106	XAD	O		00444	Insured's Address
20	2	IS	O	0135	00445	Assignment Of Benefits

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SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
21	2	IS	O	0173	00446	Coordination Of Benefits
22	2	ST	O		00447	Coord Of Ben. Priority
23	1	ID	O	0136	00448	Notice Of Admission Flag
24	8	DT	O		00449	Notice Of Admission Date
25	1	ID	O	0136	00450	Report Of Eligibility Flag
26	8	DT	O		00451	Report Of Eligibility Date
27	2	IS	O	0093	00452	Release Information Code
28	15	ST	O		00453	Pre-Admit Cert (PAC)
29	26	TS	O		00454	Verification Date/Time
30	60	XCN	O		00455	Verification By
31	2	IS	O	0098	00456	Type Of Agreement Code
32	2	IS	O	0022	00457	Billing Status
33	4	NM	O		00458	Lifetime Reserve Days
34	4	NM	O		00459	Delay Before L.R. Day
35	8	IS	O	0042	00460	Company Plan Code
36	15	ST	O		00461	Policy Number
37	12	CP	O		00462	Policy Deductible
38	12	CP	O		00463	Policy Limit - Amount
39	4	NM	O		00464	Policy Limit - Days
40	12	CP	O		00465	Room Rate - Semi-Private
41	12	CP	O		00466	Room Rate - Private
42	60	CE	O	0066	00467	Insured’s Employment Status
43	1	IS	O	0001	00468	Insured’s Sex
44	106	XAD	O		00469	Insured’s Employer’s Address
45	2	ST	O		00470	Verification Status
46	8	IS	O	0072	00471	Prior Insurance Plan ID
47	3	IS	O	0309	01227	Coverage Type
48	2	IS	O	0295	00753	Handicap
49	12	CX	O		01230	Insured’s ID Number

4.36.4.1.3 Expected Actions

It is expected that after receiving Add Patient Account message the receiving system will create and maintain the account information for the patient for purpose of utilizing it when processing charges.

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4.36.4.2 Account Management – Update Account

4.36.4.2.1 Trigger Events

Changes to patient account information (e.g., change in patient name, patient address, guarantor, insurance, etc.) shall trigger the following Update Account message:

P05 – Update Account Information

4.36.4.2.2 Message Semantics

The Account Management transaction is conducted by the HL7 BAR message. The ADT Actor shall generate the message whenever patient account information changed. The P05 (update account) event shall only be used to update an existing account. The new P06 (end account) event shall be used to close an account.

All of the required (R and R2) information for a patient record shall be re-sent in a P05 message. Any information received as NULL (i.e., transmitted as two double quote marks "“) in the P05 message shall be removed from the receiving system's database for that patient record. If no value is sent (i.e., omitted) in the P05 message, the old value shall remain unchanged in the receiving system's database for that patient record.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.3.

The segments of the **Update Account Information** message listed below are required, and the detailed description of the message is provided in Section 4.36.4.1.2.5. One or more DG1 segments shall be present if a patient’s diagnosis is changed. One or more GT1 segments shall be present if Guarantor information is updated. One or more IN1 segments shall be present if insurance information is added or modified.

BAR Segment	Billing Account	Chapter in HL7 2.3.1
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
[PV1]	Patient Visit	3 (see note)
[{DG1}]	Diagnosis	6
[{GT1}]	Guarantor	6
[{IN1}]	Insurance	6

Note: PV1 is required if use of *PV1-19 Visit Number* is required per the applicable regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of the BAR message to its sender. See Section 2.4.3 “Acknowledgement Modes” for definition and discussion of the ACK message.

4.36.4.2.2.1 MSH Segment

The MSH segment shall be constructed as defined in Section 2.4.2.2.2 “Message Control”.

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Field MSH-9 Message Type shall have at least two components. The first component shall have a value of "BAR"; the second component shall have the value of P05.

4.36.4.2.2.2 EVN Segment

The EVN segment is used to communicate necessary trigger event information to receiving applications. See Section 4.1.4.1.2.1.2 for required and optional fields of the EVN segment.

4.36.4.2.2.3 PID Segment

All of the fields in PID segment are optional, except those listed in Table 4.36-6. See Section 4.1.4.1.2.1.3 for the list of all fields of the PID segment.

Table 4.36-6: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	20	CX	R		00106	Patient Identifier List
5	48	XPN	R		00108	Patient Name
18	20	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.3.1

4.36.4.2.2.4 PV1 Segment

Most of the fields in PV1 segment are optional, except those listed in Table 4.36-7. See Section 4.1.4.1.2.1.4 for the list of all fields of the PV1 segment.

Table 4.36-7: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	20	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.3.1

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued. Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

Field *PV1-51 Visit Indicator* shall be valued with value "V" if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

4.36.4.2.2.5 DG1 Segment

See Section 4.36.4.1.2.5 for required and optional fields of the DG1 segment.

4.36.4.2.2.6 GT1 Segment

See Section 4.36.4.1.2.6 for required and optional fields of the GT1 segment.

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4.36.4.2.2.7 IN1 Segment

See Section 4.36.4.1.2.7 for required and optional fields of the IN1 segment.

4.36.4.2.3 Expected Actions

It is expected that after receiving Update Account Information message the receiving system will update its local patient demographic, diagnosis, guarantor, and/or insurance information. Any information received as null in the new P05 message shall be removed locally.

4.36.4.3 Account Management – End Account

4.36.4.3.1 Trigger Events

Ending or closing of an account will typically occur as a result of patient discharge or visit end and will result in the following Account Management message:

P06 – End Account.

4.36.4.3.2 Message Semantics

The Account Management transaction is conducted by the HL7 BAR message. The ADT Actor shall generate the message whenever a patient is closed. The new P06 (end account) event shall be used to close an account.

Note: Additional qualifications to the level of specification and HL7 profiling are stated in Section 2.3.

The segments of the **End Account** message listed below are required, and the detailed description of messages is provided in the following subsections.

BAR Segment	Billing Account	Chapter in HL7 2.3.1
MSH	Message Header	2
EVN	Event Type	3
PID	Patient Identification	3
[PV1]	Patient Visit	3 (see Note)

Note: PV1 is required if use of *PV1-19 Visit Number* is required per the applicable regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of ADT message to its sender. See Section 2.4.3 “Acknowledgement Modes” for definition and discussion of the ACK message.

4.36.4.3.2.1 MSH Segment

The MSH segment shall be constructed as defined in Section 2.4.2.2.2 “Message Control”.

Field MSH-9 Message Type shall have at least two components. The first component shall have a value of “BAR”; the second component shall have value of P06.

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4.36.4.3.2.2 EVN Segment

The EVN segment is used to communicate necessary trigger event information to receiving applications. See Section 4.1.4.1.2.1.2 for required and optional fields of the EVN segment.

4.36.4.3.2.3 PID Segment

All of the fields in PID segment are optional, except those listed in Table 4.36-8. See Section 4.1.4.1.2.1.3 for the list of all fields of the PID segment.

Table 4.36-8: IHE Profile - PID segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
3	20	CX	R		00106	Patient Identifier List
5	48	XPN	R		00108	Patient Name
18	20	CX	C		00121	Patient Account Number

Adapted from the HL7 standard, version 2.3.1

4.36.4.3.2.4 PV1 Segment

Most of the fields in PV1 segment are optional, except those listed in Table 4.36-9. Section 4.1.4.1.2.1.4 for the list of all fields of the PV1 segment.

Table 4.36-9: IHE Profile - PV1 Segment

SEQ	LEN	DT	OPT	TBL#	ITEM#	ELEMENT NAME
2	1	IS	R	0004	00132	Patient Class
19	20	CX	C		00149	Visit Number
51	1	IS	C	0326	01226	Visit Indicator

Adapted from the HL7 standard, version 2.3.1

At least one of the fields *PID-18 Patient Account Number* or *PV1-19 Visit Number* shall be valued. Additional requirements for the presence of value in these fields may be documented in regional or national extensions to the IHE Radiology Technical Framework (see RAD TF-4).

Field *PV1-51 Visit Indicator* shall be valued with value “V” if the field *PV1-19 Visit Number* is present. May be omitted otherwise.

4.36.4.3.3 Expected Actions

It is expected that after receiving End Account message (P06) the receiving system will update its local patient account information to reflect the fact that the account has been closed.

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4.37 Query Post-Processing Worklist [RAD-37]

4.37.1 Scope

This transaction is used during post-processing by the Evidence Creator to find out what tasks have been scheduled by the Post-Processing Manager. The transaction describes generically the worklist being provided for post-processing related workitem codes for Image Processing, Computer Aided Diagnosis, and Computer Aided Detection.

The Post-Processing Manager is the provider of the worklist. It obtains the necessary information with either grouping with the Department System Scheduler or the Image Manager. The Evidence Creator retrieves the worklist and includes received information in the resulting instances, which are stored through instance stored transactions such as Evident Document Stored, Image Stored, etc.

4.37.2 Actor Roles

Actor: Evidence Creator

Role: Query the Post-Processing Manager for post-processing Scheduled Procedure Steps.

Actor: Post-Processing Manager

Role: Schedule post-processing procedure steps for the workitems of Image Processing, Computer Aided Diagnosis, and Computer Aided Detection; accept requests for Worklist items, perform the query and return response.

4.37.3 Referenced Standards

DICOM PS3.4: General Purpose Worklist SOP Class

4.37.4 Messages

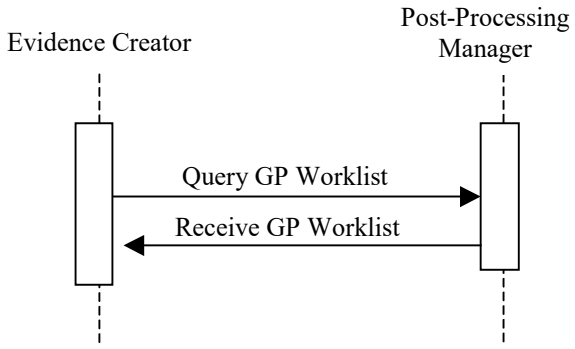

Figure 4.37.4-1: Interaction Diagram

4.37.4.1 Query General Purpose Worklist Message

This is the worklist query sent to the Post-Processing Manager.

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4.37.4.1.1 Trigger Events

A user or an automated function on the Evidence Creator queries for scheduled post-processing worklist items.

4.37.4.1.2 Message Semantics

C-FIND request of the DICOM General Purpose Worklist SOP Class is used to query for the general purpose worklist. Evidence Creator performs the SCU role, and the Post-Processing Manager performs the SCP role.

4.37.4.1.2.1 Matching Keys and Return Keys

The Evidence Creator is required to query for specific attributes (return keys) that will be inserted into the instances created as a result of post-processing. See Appendix D for more details.

The Evidence Creator shall support individually each one of the required query keys listed in Table 4.37-4 - Return and Matching Keys for Post-Processing Worklist Queries. In addition, at least one of the following three combinations shall be implemented by the Evidence Creator:

1. Patient Oriented Query: Query for a worklist for a specific patient/procedure. The SCU shall support all (31) combinations of the matching key attributes listed in Table 4.37-1 by including one or more keys. The sequence attributes denoted in the italics are not matching keys on their own but have to be included in a query to convey the value of the attributes contained within them. Thus, the SCU shall support any combination of Patient's Name, Patient ID, Accession Number, Requested Procedure ID, and Scheduled Workitem Code.

Table 4.37-1: GPWL Keys for Patient Oriented Query

Matching Key Attributes	Tag
Patient's Name	(0010,0010)
Patient ID	(0010,0020)
Referenced Request Sequence	*(0040,A370)*
>Accession Number	(0008,0050)
>Requested Procedure ID	(0040,1001)
Scheduled Workitem Code Sequence	*(0040,4018)*
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)

2. Station-oriented Query: Query for a broad worklist for particular workstation. The SCU shall support all (15) combinations of the matching key attributes listed in Table 4.37-2 by including 1 or more keys. The sequence attributes denoted in the italics are not matching keys on their own but have to be included in a query to convey the value of the attributes contained within them. Code Value of the Scheduled Station Name Code Sequence, if valued, shall be set to the AE Title of the workstation's General Purpose Worklist SCU.

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Table 4.37-2: GPWL Keys for Station-Oriented Queries

Matching Key Attributes	Tag
General Purpose Scheduled Procedure Step Status	(0040,4001)
Scheduled Station Name Code Sequence	*(0040,4025)*
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)
Scheduled Procedure Step Start Date and Time	(0040,4005)
Scheduled Workitem Code Sequence	*(0040,4018)*
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)

3. The Class-oriented Query: Query for a broad worklist for a particular class of workstations. The SCU shall support all (15) combinations of the matching key attributes listed in Table 4.37-3 by including 1 or more keys. The sequence attributes denoted in the italics are not matching keys on their own but have to be included in a query to convey the value of the attributes contained within them.

Table 4.37-3: GPWL Keys for Class-Oriented Worklist Queries

Matching Key Attributes	Tag
General Purpose Scheduled Procedure Step Status	(0040,4001)
Scheduled Station Class Code Sequence	*(0040,4026)*
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)
Scheduled Procedure Step Start Date and Time	(0040,4005)
Scheduled Workitem Code Sequence	*(0040,4018)*
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)

4.37.4.1.2.2 Examples for the Use of Matching Key Attributes

- Using the Scheduled Procedure Step Start Date and Time key: query for all the post-processing tasks scheduled for today.
- Using the Scheduled Workitem Code key: query for all computer-aided detection (CAD) tasks.
- Using Scheduled Station Name key: query for all the post-processing tasks that are scheduled for this workstation.
- Using the Scheduled Procedure Step Start Date and Time, Scheduled Workitem Code and Scheduled Station Class Code keys: query for all the Image Processing tasks that are scheduled for today on CT 3D reconstruction workstations.

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Note: Applications are recommended to append a wildcard "*" at the end of each component of the structured Patient Name to facilitate matching with both structured and unstructured Patient Names.

4.37.4.1.2.3 Matching Keys and Return Keys

The Evidence Creator is required to query for specific attributes (return keys), many of which will be required in the objects it creates. The requirements for the attributes in the stored objects are defined in Appendix C. There are additional attributes that may be queried.

Table 4.37-4 summarizes the matching key requirements and lists the optional and required attributes that may be requested and shall be returned in order to make these available to the user at the Evidence Creator. See Section 2.2 for more information on conventions used in this table.

Table 4.37-4: Matching and Return Keys for Post-Processing Worklist Queries

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
SOP Common					
Specific Character Set	(0008,0005)	O	O	O	R
SOP Class UID	(0008,0016)	O	O	R+*	R
SOP Instance UID	(0008,0018)	O	R	R+*	R
General Purpose Scheduled Procedure Step Information					
General Purpose Scheduled Procedure Step Status	(0040,4001)	R+	R	R+	R
Input Availability Flag	(0040,4020)	O	R	R+	R
General Purpose Scheduled Procedure Step Priority	(0040,4003)	O	R	R+	R
Scheduled Procedure Step ID	(0040,0009)	O	O	O	R
Scheduled Workitem Code Sequence	(0040,4018)				
>Code Value	(0008,0100)	R+	R	R+*	R
>Coding Scheme Designator	(0008,0102)	R+	R	R+*	R
>Code Meaning	(0008,0104)	-	-	R+	R
Scheduled Processing Applications Code Sequence	(0040,4004)				
>Code Value	(0008,0100)	O	R	R+*	R
>Coding Scheme Designator	(0008,0102)	O	R	R+*	R
>Code Meaning	(0008,0104)	-	-	R+	R
Scheduled Station Name Code Sequence	(0040,4025)				
>Code Value	(0008,0100)	R+	R	R+*	R
>Coding Scheme Designator	(0008,0102)	R+	R	R+*	R
>Code Meaning	(0008,0104)	-	-	R+*	R
Scheduled Station Class Code Sequence	(0040,4026)				

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Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
>Code Value	(0008,0100)	R+	R	R+*	R
>Coding Scheme Designator	(0008,0102)	R+	R	R+*	R
>Code Meaning	(0008,0104)	-	-	R+*	R
Scheduled Station Geographic Location Code Sequence	(0040,4027)				
>Code Value	(0008,0100)	O	R	O	R
>Coding Scheme Designator	(0008,0102)	O	R	O	R
>Code Meaning	(0008,0104)	-	-	O	R
Scheduled Procedure Step Start Date and Time	(0040,4005)	R+	R	R+	R
Expected Completion Date and Time	(0040,4011)	O	R	O	R
Scheduled Human Performers Sequence	(0040,4034)				
>Human Performer Code Sequence	(0040,4009)				
>>Code Value	(0008,0100)	O	R	O	R
>>Coding Scheme Designator	(0008,0102)	O	R	O	R
>>Code Meaning	(0008,0104)	-	-	O	R
>Human Performer's Name	(0040,4037)	O	O	O	R+
>Human Performer's Organization	(0040,4036)	O	O	O	R+
Referenced Study Component Sequence	(0008,1111)				
>Referenced SOP Class UID	(0008,1150)	O	O	O	R
>Referenced SOP Instance UID	(0008,1155)	O	O	O	R
Input Information Sequence	(0040,4021)				
>Study Instance UID	(0020,000D)	O	O	R+*	R
>Referenced Series Sequence	(0008,1115)				
>>Series Instance UID	(0020,000E)	O	O	R+*	R
>>Retrieve AE Title	(0008,0054)	O	O	O	R
>>Storage Media File-Set ID	(0088,0130)	O	O	O	O
>>Storage Media File-Set UID	(0088,0140)	O	O	O	O
>>Referenced SOP Sequence	(0008,1199)				
>>>Referenced SOP Class UID	(0008,1150)	O	O	R+*	R
>>>Referenced SOP Instance UID	(0008,1155)	O	O	R+*	R
Relevant Information Sequence	(0040,4022)				
>Study Instance UID	(0020,000D)	O	O	O	R
>Referenced Series Sequence	(0008,1115)				
>>Series Instance UID	(0020,000E)	O	O	O	R

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Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
>>Retrieve AE Title	(0008,0054)	O	O	O	O
>>Storage Media File-Set ID	(0088,0130)	O	O	O	O
>>Storage Media File-Set UID	(0088,0140)	O	O	O	R
>>Referenced SOP Sequence	(0008,1199)				
>>>Referenced SOP Class UID	(0008,1150)	O	O	O	R
>>>Referenced SOP Instance UID	(0008,1155)	O	O	O	R
Resulting General Purpose Performed Procedure Step Sequence	(0040,4015)				
>Referenced SOP Class UID	(0008,1150)	O	O	O	R
>Referenced SOP Instance UID	(0008,1155)	O	O	O	R
Actual Human Performers Sequence	(0040,4035)				
>Human Performer Code Sequence	(0040,4009)	O	O	O	R
>>Code Value	(0008,0100)	O	O	O	R
>>Coding Scheme Designator	(0008,0102)	O	O	O	R
>>Code Meaning	(0008,0104)	-	-	O	R
>Human Performer's Name	(0040,4037)	O	O	O	R+
>Human Performer's Organization	(0040,4036)	O	O	O	R+
Study Instance UID	(0020,000D)	O	O	R+*	R
Multiple Copies Flag	(0040,4006)	O	O	O	R
All other Attributes from the General Purpose Scheduled Procedure Step Information Module		O	O	O	O
General Purpose Scheduled Procedure Step Relationship					
Referenced Request Sequence	(0040,A370)				
>Study Instance UID	(0020,000D)	O	O	R+*	R
>Referenced Study Sequence	(0008,1110)				
>>Referenced SOP Class UID	(0008,1150)	O	O	R+*	R
>>Referenced SOP Instance UID	(0008,1155)	O	O	R+*	R
>Requested Procedure ID	(0040,1001)	R+	R+	R+	R
>Requested Procedure Description	(0032,1060)	O	O	O	R
>Requested Procedure Code Sequence	(0032,1064)				
>>Code Value	(0008,0100)	O	O	O	R
>>Coding Scheme Designator	(0008,0102)	O	O	O	R
>>Code Meaning	(0008,0104)	-	-	O	R

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Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
>Accession Number	(0008,0050)	R+	R	R+	R
>Requesting Physician	(0032,1032)	O	O	O	R
>All other Attributes relating to the Requested Procedure and the Imaging Service Request in the General Purpose Scheduled Procedure Step Relationship Module		O	O	O	O
Patient Relationship					
All Attributes from the Patient Relationship Module		O	O	O	O
Patient Identification					
Patient's Name	(0010,0010)	R+	R	R+	R
Patient ID	(0010,0020)	R+	R	R+	R
All other Attributes from the Patient Identification Module		O	O	O	O
Patient Demographic					
Patient's Birth Date	(0010,0030)	O	O	R+	R
Patient's Sex	(0010,0040)	O	O	R+	R
All other Attributes from the Patient Demographic Module		O	O	O	O
Patient Medical					
All Attributes from the Patient Medical Module		O	O	O	O

4.37.4.1.3 Expected Actions

The Post-Processing Manager performs the query and sends the matching General Purpose Worklist items to the Evidence Creator.

4.37.4.2 Receive General Purpose Worklist Message

This is the message the Post-Processing Manager sends containing post-processing General Purpose Worklist information as a response to the Evidence Creator query.

4.37.4.2.1 Trigger Events

The Post-Processing Manager receives a query for a Post-Processing Worklist.

4.37.4.2.2 Message Semantics

C-FIND Response from the DICOM General Purpose Worklist SOP Class will be used for this message. Some of the attributes queried through the worklist originate from other sources during previous steps in the workflow, and are made available to the Post-Processing Manager (grouped

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with Department System Scheduler or Image Manager) through other transactions such as MPPS. It is up to the Post-Processing Manager to determine the Input Information, e.g., study, series, etc. appropriate to be used in a workitem Scheduled Procedure Step, i.e., it is independent of the acquisition process and resulting MPPS.

The Post-Processing Manager shall specify the type of task to be performed in the content of the Scheduled Workitem Code Sequence (0040,4018) using one of the following values from DCMR CID 9231:

Table 4.37-5: Post-Processing Workitem Definition

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	110001	Image Processing
DCM	110002	Quality Control
DCM	110003	Computer Aided Diagnosis
DCM	110004	Computer Aided Detection
DCM	110008	Print
DCM	110009	No subsequent Workitems

4.37.4.2.3 Expected Actions

An automated Evidence Creator uses the worklist to start post-processing or the user is provided with the worklist to start work.

4.38 Workitem Claimed [RAD-38]

4.38.1 Scope

Upon selecting a post-processing workitem, the Evidence Creator takes ownership of the item by telling the Post Processing Manager to change the status of the SPS to IN PROGRESS. This allows the Post-Processing Manager to update its worklist and permits other worklist users to detect that this SPS has been claimed and is possibly already being worked on.

Similarly, during the reporting workflow, upon selecting a Reporting workitem, the Report Creator takes ownership of the item by telling the Reporting Manager to change the status of the SPS to IN PROGRESS. This allows the Report Manager to update its worklist and permits other worklist users to detect that this SPS has been claimed and is possibly already being worked on.

In both workflow cases, the SCU can also set the status to SUSPEND.

4.38.2 Actor Roles

Actor: Evidence Creator

Role: Updates the Post-Processing Manager of the new status of the post-processing SPS when the Evidence Creator claims the post-processing SPS.

Actor: Post-Processing Manager

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Role: Accepts post-processing GP-SPS update information from the Evidence Creator.

Actor: Report Creator

Role: Updates Report Manager with status of the Reporting SPS when the Report Creator claims the reporting SPS.

Actor: Report Manager

Role: Accepts GP-SPS update information from the Report Creator.

4.38.3 Referenced Standards

DICOM PS3.4: General Purpose Scheduled Procedure Step SOP Class.

4.38.4 Messages

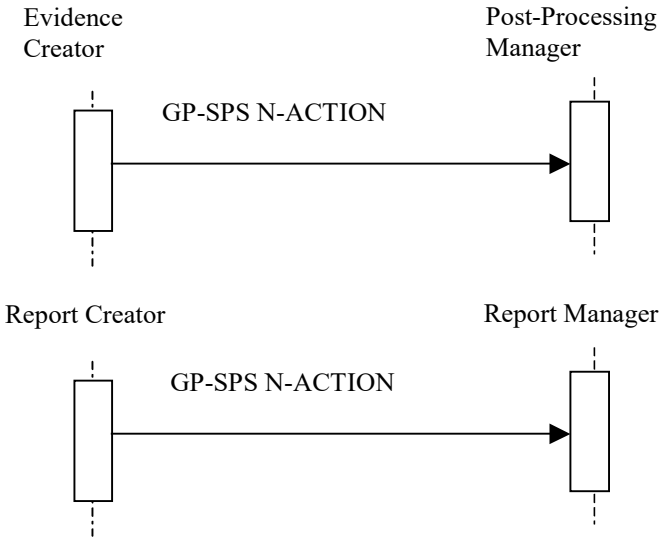

Figure 4.38.4-1: Interaction Diagram

4.38.4.1 General Purpose Scheduled Procedure Step In Progress/Suspend Message

4.38.4.1.1 Trigger Events

For a post-processing workitem, a user or an automated function on the Evidence Creator begins to act on a post-processing scheduled procedure step, or stops acting on it without completing it.

For the reporting workitem, the user begins to act on the scheduled procedure step at the Report Creator, or stops acting on it without completing it.

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4.38.4.1.2 Message Semantics

The Evidence Creator uses the N-ACTION request of the DICOM General Purpose Scheduled Procedure Step SOP Class to inform the Post-Processing Manager that a specific SPS has been started, and its status is IN PROGRESS. The Evidence Creator performs the SCU role, and the Post-Processing Manager performs the SCP role. An SPS may also be suspended or resumed, and the associated status of SUSPENDED or SCHEDULED will be set (see the DICOM PS3.4 Section F.1.6 for additional information).

The Report Creator and Report Manager utilize the same mechanism, where the Report Creator performs the SCU role, and the Report Manager performs the SCP role.

If a human is performing the Post-Processing scheduled procedure step, then the N-ACTION request may include the Actual Human Performers Sequence.

In a case of the reporting scheduled procedure step, the Report Creator shall send the Actual Human Performer Sequence to the Reporting Manager, who shall then check if the person is allowed to perform the workitem. The Report Creator application shall ensure that the correct user information is filled in the sequence.

4.38.4.1.3 Expected Actions

The Post-Processing Manager updates the status of the SPS to IN PROGRESS, which is an indication that the SPS is already being working on, and other Evidence Creators shall not perform any action on it. Attempts by any Evidence Creator without the current Transaction UID to update the SPS will be rejected.

When Post-Processing Manager updates the status of the SPS to SUSPENDED or SCHEDULED, the SPS has now been released from the control of the Evidence Creator.

In the same way, the Report Manager updates the status of the SPS to IN PROGRESS, which is an indication that the SPS is already being working on, and other Report Creators shall not perform any action on it. Attempts by any other Report Creator to update the SPS will be rejected by the Report Manager.

When the Report Manager updates the status of the SPS to SUSPENDED or SCHEDULED, the SPS has now been released from the control of the Report Creator.

4.39 Workitem Performed Procedure Step In Progress [RAD-39]

4.39.1 Scope

Upon starting to work on the claimed post-processing scheduled procedure step, Evidence Creator sends a message to the Post-Processing Manager to create a Performed Procedure Step (PPS).

Upon starting to work on the claimed reporting scheduled procedure step, Report Creator sends a message to the Report Manager to create a Performed Procedure Step (PPS).

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4.39.2 Actor Roles

Actor: Evidence Creator

Role: Update the Post-Processing Manager with creation of a post-processing PPS when the **Evidence** Creator starts the work.

Actor: Report Manager

Role: Accept PPS information from Report Creator.

Actor: Report Creator

Role: Updates the Report Manager with the creation of a Reporting Workitem PPS, when the Report Creator starts the work.

Actor: Post-Processing Manager

Role: Accept post-processing PPS information from the Evidence Creator.

4.39.3 Referenced Standards

DICOM PS3.4: General Purpose Performed Procedure Step SOP Class

4.39.4 Messages

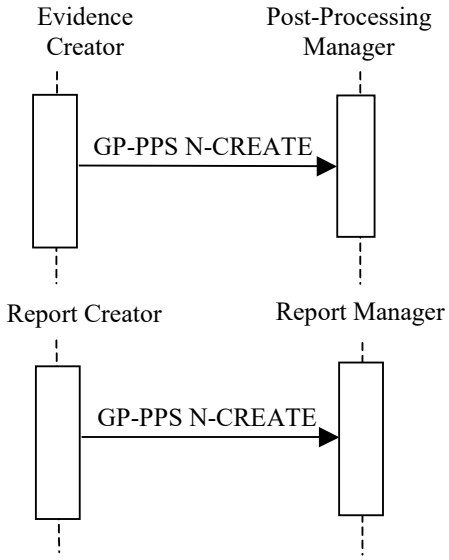

Figure 4.39.4-1: Interaction Diagrams

4.39.4.1 General Purpose Performed Procedure Step In Progress Message

4.39.4.1.1 Trigger Events

For a post-processing workitem, a user or an automated function on the Evidence Creator begins a post-processing performed procedure step.

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For a reporting workitem, a user begins to perform the scheduled procedure step at the Report Creator.

4.39.4.1.2 Message Semantics

The Evidence Creator as SCU uses the N-CREATE request of the DICOM General Purpose Performed Procedure Step SOP to inform the Post-Processing Manager as SCP that a specific PPS has been started and its status is IN PROGRESS.

4.39.4.1.3 Expected Actions

The Post-Processing Manager or the Report Manager creates the PPS with status IN PROGRESS.

If a Referenced General Purpose Scheduled Procedure Step Sequence (0040,4016) item is present in the N-CREATE request, the Post-Processing Manager or the Report Manager shall update the Attribute Resulting General Purpose Performed Procedure Steps Sequence (0040,4015) in the identified General Purpose Scheduled Procedure Step SOP Instance.

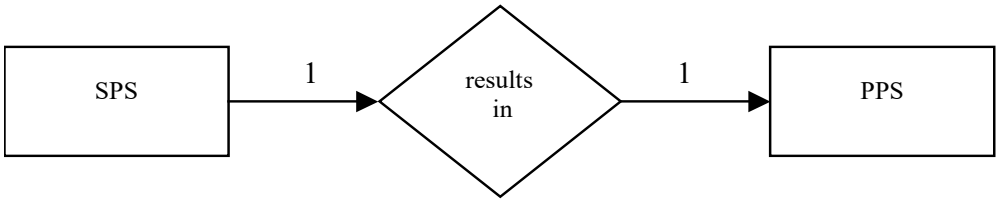
The Post-Processing Manager may use the Performed Work Status Update transaction to notify the interested recipients about the received GP-PPS.

The Report Manager may use the Performed Work Status Update transaction to notify the interested recipients about the received GP-PPS using for this purpose.

4.39.4.1.3.1 Relationship between Scheduled and Performed Procedure Steps

The relationship between Scheduled and Performed Procedure Step information is shown in the following cases. Refer to RAD TF-2x: Appendix C for details of forming attributes in each of these cases.

4.39.4.1.3.1.1 Simple Case



This case indicates a 1-to-1 relationship between SPS and PPS. Information about the Scheduled Procedure Step and Requested Procedure shall be copied from the Scheduled Procedure Step object to the Performed Procedure Step Relationship Module.

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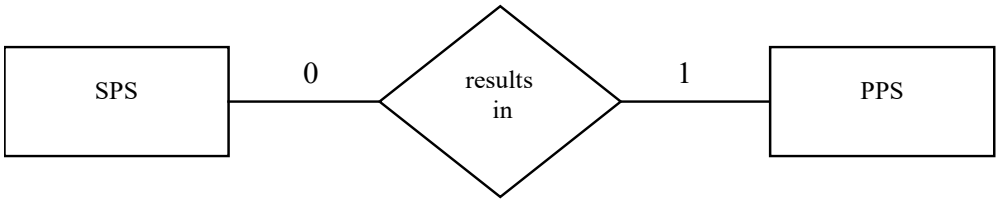
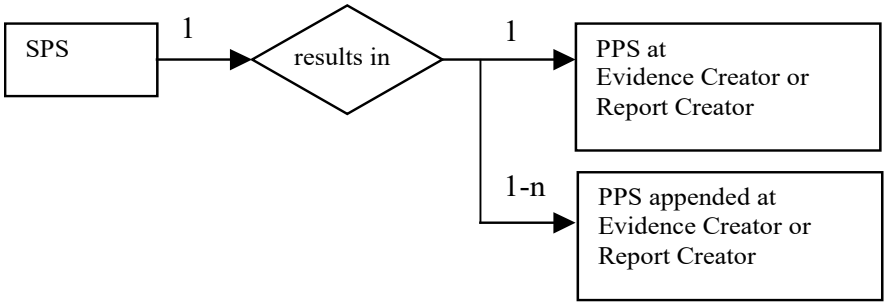
4.39.4.1.3.1.2 Unscheduled Case



This case indicates a 0-to-1 relationship between SPS and PPS. Information about the Scheduled Procedure Step and, possibly, Requested Procedure is not available to the Evence Creator or Report Creator due to different reasons, e.g., General Purpose Worklist SCP not available, unplanned post-processing during reporting.

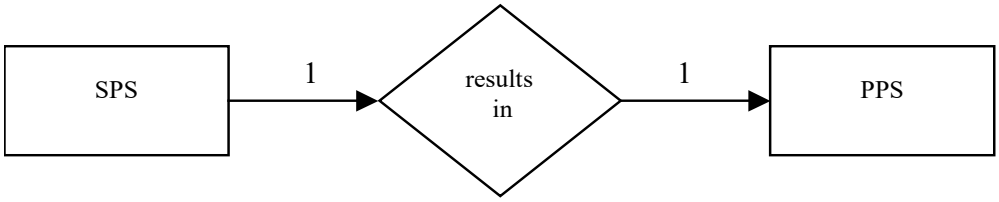
4.39.4.1.3.1.3 Append Case



This case indicates a 1-to-N relationship between SPS and PPS where first the PPS is generated in response to an SPS. Other Performed Procedure Steps are added sequentially at a later time. All Performed Procedure Steps shall refer back to the same Requested Procedure and to the original SPS. All Requested Procedure and Scheduled Procedure Step attributes shall be copied from the Scheduled Procedure Step Object to the Performed Procedure Step Relationship Module and to the Request Attribute Sequence of the resulting composite instance.

No PPS can be appended if the SPS status is COMPLETED or DISCONTINUED.

4.39.4.1.3.1.4 Abandoned Case



This case indicates a 1-to-1 relationship between SPS and PPS, even though the PPS may or may not have associated Evidence Documents Images or other data objects. A procedure step may have to be abandoned for clinical reasons before it is complete. If SOP instances are sent by the Evidence Creator to the Image Archive or from the Report Creator to Report Manager, then they shall be identified in the PPS N-SET. This is a means to explicitly communicate this information to the Post-Processing Manager. All Requested Procedure and Scheduled Procedure Step

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attributes shall be copied from the Scheduled Procedure Step Object to the Performed Procedure Step Relationship Module.

4.40 Workitem Performed Procedure Step Completed [RAD-40]

4.40.1 Scope

After completing or discontinuing a post-processing performed procedure step, the Evidence Creator sends a message to the Post-Processing Manager to update the PPS status to COMPLETED or DISCONTINUED and references any results that have been created and sent to the Image Manager/Archive.

Report Creator behaves similarly to update the Report Manager with the PPS status and the references to the result that was created and sent to the Report Manager, e.g., an SR object, or an external ID of an object outside of IHE scope.

4.40.2 Actor Roles

Actor: Evidence Creator

Role: Update the Post-Processing Manager with status of the post-processing PPS when the Evidence Creator finishes or discontinues work.

Actor: Post-Processing Manager

Role: Accept post-processing PPS information from the Evidence Creator.

Actor: Report Creator

Role: Updates Report Manager with status of the Reporting Workitem PPS, when it finishes or discontinues work.

Actor: Report Manager

Role: Accepts PPS information from Report Creator.

4.40.3 Referenced Standards

DICOM PS3.4: General Purpose Performed Procedure Step SOP Class

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4.40.4 Messages

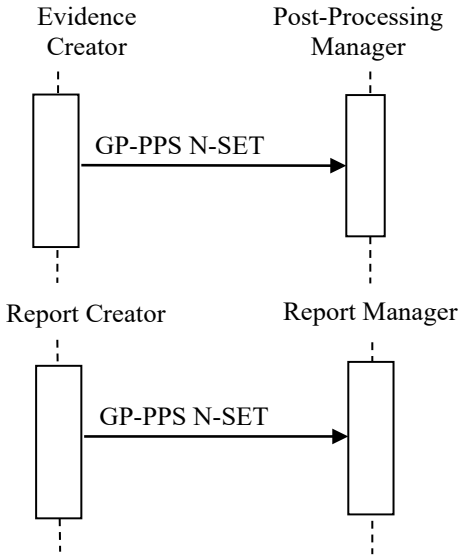

Figure 4.40.4-1: Interaction Diagrams

4.40.4.1 General Purpose Performed Procedure Step Completed Message

4.40.4.1.1 Trigger Events

For a post-processing workitem, automated Evidence Creator, or a user finishes the post-processing scheduled procedure step.

For a reporting Workitem, a user finishes the work on the scheduled procedure step.

4.40.4.1.2 Message Semantics

The Evidence Creator as SCU uses the N-SET request of the DICOM General Purpose Performed Procedure Step SOP Class to inform the Post-Processing Manager as SCP that a specific performed procedure step has been done and its status is COMPLETED. The Evidence Creator may use N-SET to send intermediate updates of the PPS information. The final N-SET has either the status of COMPLETED or DISCONTINUED. The Report Manager acts in the same way as SCU with the Report Manger as SCP. The Report Manager notifies the DSS about the PPS status through either the Performed Work Status Update or by grouping with it.

When the status is set to COMPLETED or DISCONTINUED, the Evidence Creator shall send to the Post-Processing Manager a list of all Composite SOP Instances, if any, created in the Output Information Sequence (0040,4033). Similarly, the Report Creator shall send the list of all SOP Instances in the Output Information Sequence (0040,4033) or identify non-DICOM output in the Non-DICOM Output Code Sequence (0040,4032).

4.40.4.1.3 Reporting Message Semantics

After the workitem has been completed, the Report Creator shall provide the Report Manager with the details of the reporting task that has been performed. This information shall be included

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into the Performed Work Item Code Sequence in the General Purpose Performed Procedure Step N-SET message. The Report Creator shall also reference any results created during the reporting task performed. The output information is part of the General Purpose Performed Procedure Step Results Module. The output data must be stored to an appropriate data repository. Which data repository is used will depend on the type of the output data that might be a report, an audio file, an Evidence Document or other objects.

The Report Creator may also suggest subsequent work items to the Report Manager. The requested subsequent work items are included in the General Purpose Performed Procedure Step Results Module.

4.40.4.1.4 Expected Actions

The Post-Processing Manager or Report Manager updates the status of the PPS to COMPLETED or DISCONTINUED.

4.41 Workitem Completed [RAD-41]

4.41.1 Scope

After completing or discontinuing a post-processing scheduled procedure step, the Evidence Creator sends a message to the Post-Processing Manager to update the SPS status to COMPLETED or DISCONTINUED. This allows the Post-Processing Manager to update its worklist.

After completing or discontinuing a reporting scheduled procedure step, the Report Creator sends a message to the Report Manager to update the SPS status to COMPLETED or DISCONTINUED. This allows the Report Manager to update its worklist.

4.41.2 Actor Roles

Actor: Evidence Creator

Role: Update the Post-Processing Manager with status of the post-processing SPS when the Evidence Creator finishes work.

Actor: Post-Processing Manager

Role: Accept post-processing GP-SPS information from Evidence Creator.

Actor: Report Creator

Role: Updates Report Manager with status of the Reporting Workitem SPS, when it finishes the work.

Actor: Report Manager

Role: Accepts reporting GP-SPS information from Report Creator.

4.41.3 Referenced Standards

DICOM PS3.4: General Purpose Scheduled Procedure Step SOP Class

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4.41.4 Messages

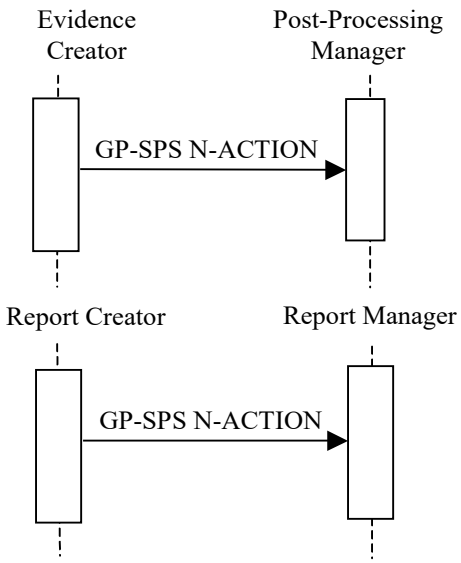

Figure 4.41.4-1: Interaction Diagrams

4.41.4.1 General Purpose SPS Completed Message

4.41.4.1.1 Trigger Events

For a post-processing workitem, a user or automated function on the Evidence Creator finishes the post-processing scheduled procedure step.

For the reporting workitem, a user finishes the work on the scheduled procedure step at the Report Creator.

4.41.4.1.2 Message Semantics

The Evidence Creator as SCU uses the N-ACTION request of the DICOM General Purpose Scheduled Procedure Step SOP Class to inform the Post-Processing Manager as SCP that a specific scheduled procedure step has been finished and its status is COMPLETED. This message informs the Post-Processing Manager that the SPS is complete and that further PPS will not be created for this SPS. The Evidence Creator may also discontinue a SPS with a status of DISCONTINUED.

In the same way, the Report Creator uses the N-ACTION request of the DICOM General Purpose Scheduled Procedure Step SOP Class to inform the Report Manager as SCP that a specific scheduled procedure step has been finished and its status is COMPLETED. This message informs the Report Manager that the workitem SPS is complete and that further PPS will not be created for this SPS. The Report Creator may also discontinue a SPS with a status of DISCONTINUED.

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4.41.4.1.3 Expected Actions

The Post-Processing Manager or the Report Manager updates the status of the SPS to COMPLETED or DISCONTINUED.

In addition, the Post-Processing Manager or Report Manager informs the DSS and Image Manager using the Performed Work Status Update transaction.

4.42 Performed Work Status Update [RAD-42]

4.42.1 Scope

This transaction is used by the Department System Scheduler, Report Manager or the Image Manager to inform the others of the status of performed work being managed. This transaction allows the system not managing the performed work to stay in sync with the status.

How or whether the non-managing system uses this information is at the discretion of implementers and customers. Some examples are given below:

- The Department System Scheduler is grouped with the Post-Processing Manager and manages all post-processing tasks. This transaction enables the Department System Scheduler to notify the Image Manager about the Post-Processing work that has been performed, e.g., CAD has been performed on a set of images and an evidence document has been stored.
- The Image Manager is grouped with the Post-Processing Manager and manages some post-processing tasks. This transaction enables the Image Manager to notify the Department System Scheduler about the post-processing work that has been performed.
- The Report Manager is implemented as a standalone system and manages reporting tasks. This transaction enables Report Manager to notify Department System Scheduler and Image Manager that report has been completed.

4.42.2 Actor Roles

Actor: Department System Scheduler

Role: When managing tasks (i.e., is grouped with a Post-processing Manager), it must send task status notifications to the Image Manager and Report Manager. When monitoring the status of tasks managed by the Image Manager or Report Manager it must be ready to receive task status notifications.

Actor: Image Manager

Role: When managing tasks (i.e., is grouped with a Post-processing Manager), it must send task status notifications to the Department System Scheduler and Report Manager. When monitoring the status of tasks managed by the Department System Scheduler or Report Manager it must be ready to receive task status notifications.

Actor: Report Manager

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Role: When managing tasks (i.e., implementing Reporting Worklist, Workitem Claimed, Workitem Completed, Workitem Performed Procedure Step In Progress, Workitem Performed Procedure Step Completed), it must send task status notifications to the Department System Scheduler and Image Manager. When monitoring the status of tasks managed by the Department System Scheduler or Image Manager it must be ready to receive task status notifications.

4.42.3 Referenced Standards

DICOM PS3.4: General Purpose Performed Procedure Step SOP Class

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4.42.4 Messages

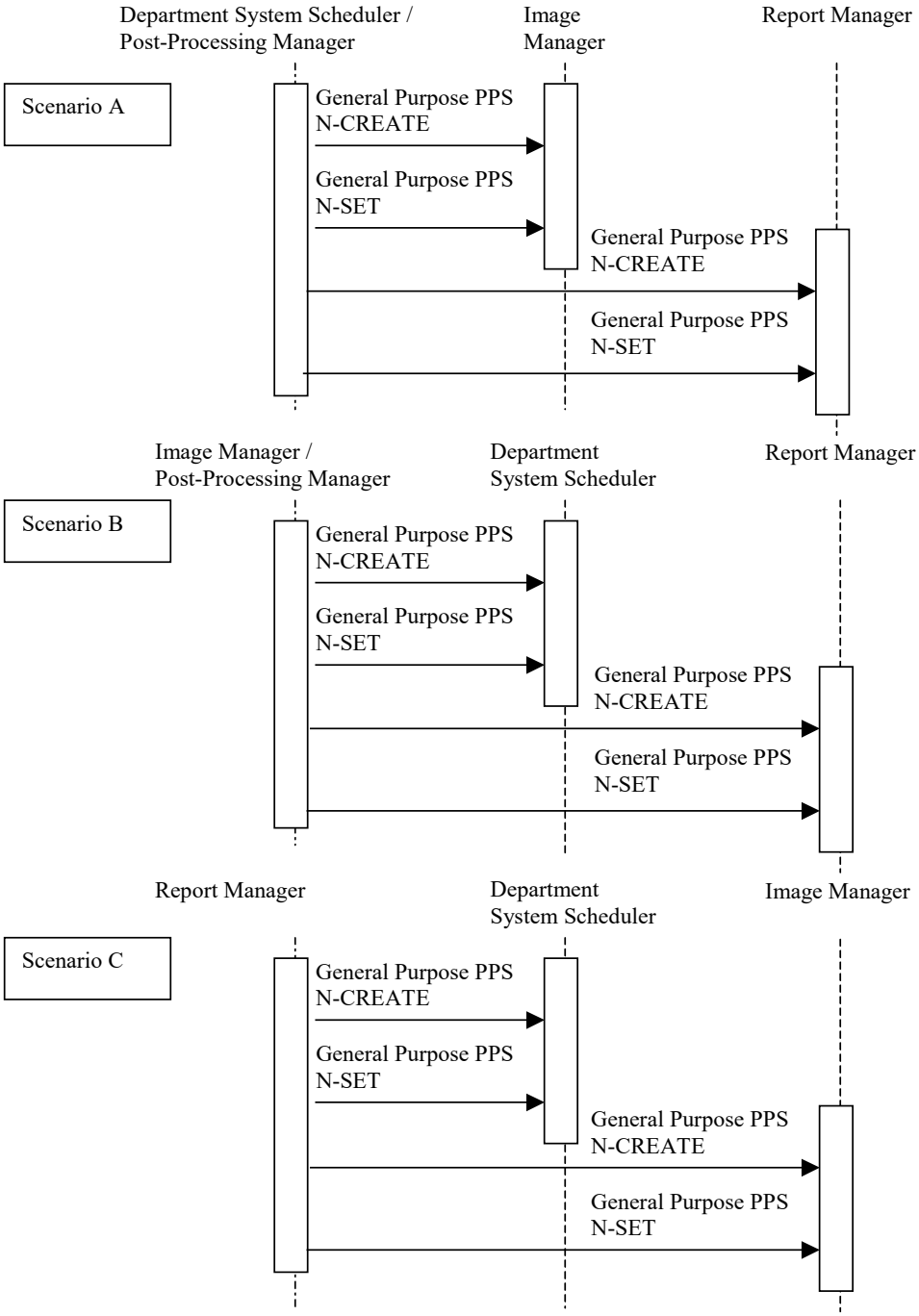

Figure 4.42.4-1: Interaction Diagrams

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4.42.4.1 Post-Processing Performed Procedure Step Created/Updated Message

4.42.4.1.1 Trigger Events

In scenario A, the Department System Scheduler is grouped with a Post-Processing Manager and receives status creation or update on tasks it manages. In scenario B, the Image Manager, due to being grouped with a Post-Processing Manager, receives status creation or updates on tasks it manages, e.g., from an Evidence Creator. In Scenario C, Report Manager receives status creation or updates on tasks it manages from Report Creator. In either scenario, for example, a GP-PPS Completed message received by the Post-Processing Manager or Report Manager shall trigger the Work Status Update message to be sent.

4.42.4.1.2 Message Semantics

In scenario A, the Department System Scheduler uses the N-CREATE and N-SET requests of the DICOM General Purpose Performed Procedure Step SOP to inform the Image Manager and Report Manager when work has been started and when it is complete. The Department System Scheduler performs the SCU role, and the Image Manager and Report Manager perform the SCP role.

In scenario B, the Image Manager uses the N-CREATE and N-SET requests of the DICOM General Purpose Performed Procedure Step SOP to inform the Department System Scheduler and Report Manager when work has been started and when it is complete. The Image Manager performs the SCU role, and the Department System Scheduler and Report Manager perform the SCP role.

In scenario C, the Report Manager uses the N-CREATE and N-SET requests of the DICOM General Purpose Performed Procedure Step SOP to inform the Department System Scheduler and Image Manager when work has been started and when it is complete. The Report Manager performs the SCU role, and the Department System Scheduler and Image Manager performs the SCP role.

"Performed work" may consist of one or more related sub-workitems managed by the SCU, who is acting as the workflow manager for these workitems. As the SCU receives status information about each sub-workitem, it will in turn update the SCP. The SCU sends N-CREATE with GP-PPS status of "IN PROGRESS" after the sub-workitem has been claimed, but no later than the first workitem performed procedure step in progress transaction for that sub-workitem has been performed. In the N-CREATE, the SCU uses the Performed Workitem Code Sequence (0040,4019) to communicate the sub-workitem. The SCU may use N-SET to send intermediate updates. The final N-SET with GP-PPS status of "COMPLETED" is sent after the sub-workitem GP-SPS is completed. If there are further sub-workitems managed by the SCU, N-SET will contain the Requested Subsequent WorkItem Code Sequence, indicating the next workitem it will be updating. When the SCU finishes updating all sub-workitems it manages, this attribute will be sent with the workitem of "No Subsequent Workitems," signifying the end of this set of performed work. This means that another workflow manager may take over managing subsequent set of work.

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Post-Processing Manager and Report Manager shall generate unscheduled GP-PPS to use in the Performed Work Status transaction; they cannot simply re-transmit the GP-PPS received from the Evidence Creator or Report Creator. To populate Performed WorkItem Code Sequence, they shall use appropriate codes from DCMR Context Group 9231 (see Table 4.42-1).

Table 4.42-1: Context ID 9231 – General Purpose Workitem Definition

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	110001	Image Processing
DCM	110002	Quality Control
DCM	110003	Computer Aided Diagnosis
DCM	110004	Computer Aided Detection
DCM	110005	Interpretation
DCM	110006	Transcription
DCM	110007	Report Verification
DCM	110008	Print
DCM	110009	No subsequent Workitems

4.42.4.1.3 Expected Actions

The Department System Scheduler or Image Manager records and uses the information as appropriate to its responsibilities.

4.43 Evidence Document Stored [RAD-43]

4.43.1 Scope

In the Evidence Documents Stored transaction, the Acquisition Modality or the Evidence Creator transmits an Evidence Document, which is stored in the Image Archive.

Evidence Documents are DICOM composite objects that are produced as a result of performing procedure steps such as image acquisition, image processing or computer-aided detection.

These objects are intended to serve as evidence for diagnostic interpretation; however, they are not images but rather DICOM Structured Reporting documents. Evidence Documents represent the uninterpreted information which is primarily managed and used inside imaging department, although distribution outside Radiology is not precluded. Such objects are not expected to be managed by the Report Manager. Objects encoded as SOP Instances of such SOP classes as Mammography CAD are examples of Evidence documents.

4.43.2 Actor Roles

Actor: Acquisition Modality

Role: Records non-imaging evidence information in the Evidence Documents and stores them to the Image Archive.

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Actor: Evidence Creator

Role: Records non-imaging evidence information in the Evidence Documents and stores them to the Image Archive.

Actor: Image Archive

Role: Accepts and Stores Evidence Document Instances received from the Acquisition Modality or Evidence Creator.

4.43.3 Referenced Standards

DICOM PS3.4 Annex B: Storage Service Class

DICOM PS3.3: Information Object Definitions -

Basic Text SR SOP Class; Enhanced SR SOP Class; Comprehensive SR SOP Class; Chest CAD SR SOP Class; Mammography CAD SR SOP Class; OB-GYN Ultrasound Procedure Reports; Catheterization Lab SR; Vascular Ultrasound SR.

Note: This list is intended to provide a base list of examples. It is expected that DICOM will continue to publish additional SR SOP Classes and Templates appropriate for Evidence Documents.

4.43.4 Messages

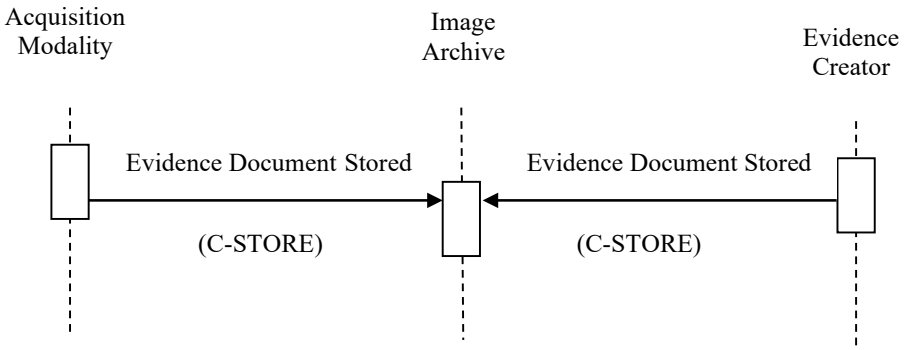

Figure 4.43.4-1: Interaction Diagram

4.43.4.1 Evidence Document Stored

This transaction relates to the “DICOM C-STORE” event between the Acquisition modality or the Evidence Creator and the Image Archive in the above interaction diagram.

4.43.4.1.1 Trigger Events

The Acquisition Modality or the Evidence Creator generates Evidence Documents that need to be archived.

4.43.4.1.2 Message Semantics

The Acquisition Modality or the Evidence Creator uses the DICOM C-STORE message to transfer the Evidence Documents (as SR objects) to the Image Archive for storage. The

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Acquisition Modality or the Evidence Creator is the DICOM Storage SCU and the Image Archive is the DICOM Storage SCP.

It is a requirement that certain information be recorded in the Evidence Document header. The details of mapping such information to DICOM SOP instances are specified in RAD TF-2x: Appendix A.2, Table A.2-1.

4.43.4.1.3 Expected Actions

The DICOM Standard defines a number of non-image storage SOP classes that may be used for creation of Evidence Documents. It is expected that the Image Archive will support multiple storage SOP classes as defined in Table 4.43-1 below.

Table 4.43-1: Suggested Evidence Document SOP Classes

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.88.50	Mammography CAD SR
1.2.840.10008.5.1.4.1.1.88.11	Basic Text SR
1.2.840.10008.5.1.4.1.1.88.22	Enhanced SR
1.2.840.10008.5.1.4.1.1.88.33	Comprehensive SR
1.2.840.10008.5.1.4.1.1.88.65	Chest CAD SR

It is also expected that the Image Archive will support one or more Templates that are defined to be used with the Evidence Documents, as specified in the Table 4.43-2.

Table 4.43-2: Suggested Evidence Document Templates

Template ID	Template Name
TID 4000	Mammography CAD Document Root Template
TID 5000	OB-GYN Ultrasound Procedure Report
TID 3500	Hemodynamics Report
TID 4100	Chest CAD SR Document Root Template
TID 5100	Vascular Ultrasound Procedure Report Template

The Image Archive must support storage level 2: i.e., all type 3 attributes must be supported.

4.43.4.1.3.1 Mammography Image Profile

Evidence Creator and Image Manager/Image Archive Actors supporting the Mammography Image Profile shall support the Mammography CAD SR SOP Class.

In particular, CAD systems (acting as Evidence Creators) performing analysis on Mammography images shall be able to return their results in Mammography CAD SR SOP Class instances. This does not preclude them from additionally creating Presentation States and/or Secondary Capture or Mammography images.

Also, Image Manager/Image Archive Actors shall not only be able to receive Mammography CAD SR SOP Class objects from the Evidence Creator, but also be able to return them in

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response to queries (i.e., they must actually be stored intact for later retrieval, not merely processed or burned in to images dynamically). See Retrieve Evidence Documents [RAD-45] transaction, Section 4.45.4.2.3.1.

4.44 Query Evidence Documents [RAD-44]

4.44.1 Scope

This section describes the sequence of transactions required for the Image Display to query the Image Archive for instances of Evidence Documents.

4.44.2 Actor Roles

Actor: Image Display

Role: Query for Evidence Documents objects (generally in order to retrieve them).

Actor: Image Archive

Role: Respond to queries from the Image Display for Evidence Documents objects.

4.44.3 Referenced Standards

DICOM PS3.4 Annex C: Query/Retrieve Service Class

4.44.4 Messages

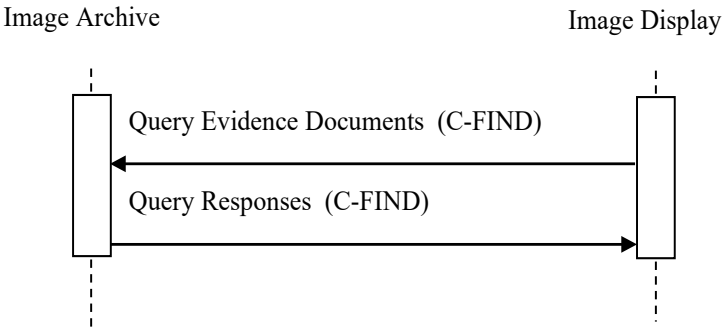

Figure 4.44.4-1: Interaction Diagram

4.44.4.1 Query Evidence Documents

The Query (Study Root – FIND and optionally Patient Root – FIND) SOP Classes shall be supported. Refer to DICOM PS3.4 Annex C Query/Retrieve Service Class for detailed descriptive semantics.

4.44.4.1.1 Trigger Events

Image Display needs to obtain information about Evidence Documents.

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4.44.4.1.2 Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes.

A C-FIND Request from the DICOM Study Root Query/Retrieve Information Model – FIND SOP Class or the DICOM Patient Root Query/Retrieve Information Model – FIND SOP Class shall be sent from the Image Display to the Image Archive.

The Image Display uses one or more matching keys as filter criteria to obtain the list of matching entries in the Image Archive at the selected level (Patient & Study/Series/Instance).

In addition to the required and unique keys defined by the DICOM Standard, the IHE Radiology Technical Framework has defined matching and return keys to be supported by query SCUs and SCPs. The keys are defined in Section 4.14.4.1.2 and Table 4.14-1. The conventions for key usage are defined in Section 2.2. For the Image Display (SCU) and the Image Archive (SCP) the additional Evidence Document Instances specific keys are defined in Table 4.44-1.

Table 4.44-1: Evidence Document Instance Specific Query Matching and Return Keys

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
Evidence Document Instance Specific Level					
Content Date	(0008,0023)	O	O	O	R+
Content Time	(0008,0033)	O	O	O	R+
Referenced Request Sequence	(0040,A370)				
>Study Instance UID	(0020,000D)	O	O	R+*	R+
>Accession Number	(0008,0050)	O	O	R+	R+
>Requested Procedure ID	(0040,1001)	O	O	R+	R+
>Requested Procedure Code Sequence	(0032,1064)				
>>Code Value	(0008,0100)	O	O	O	R+
>>Coding Scheme Designator	(0008,0102)	O	O	O	R+
>>Coding Scheme Version	(0008,0103)	O	O	O	R+
>>Code Meaning	(0008,0104)	O	O	O	R+
Content Template Sequence	(0040,A504)				
>Template Identifier	(0040,DB00)	O	O	R+	R+
Concept Name Code Sequence	(0040,A043)				
>Code Value	(0008,0100)	O	O	R+*	R+
>Coding Scheme Designator	(0008,0102)	O	O	R+*	R+
>Coding Scheme Version	(0008,0103)	O	O	O	R+
>Code Meaning	(0008,0104)	O	O	R+	R+

4.44.4.1.3 Expected Actions

The Image Archive receives the C-FIND request, performs the matching on the provided keys and sends the list of matching records back to the Image Display via C-FIND responses.

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The Image Display is expected to use the Template ID to select Evidence Documents for retrieval that it supports.

4.44.4.1.3.1 Mammography Image Profile

Image Display and Image Manager/Image Archive Actors supporting the Mammography Image Profile shall support the Mammography CAD SR SOP Class.

4.45 Retrieve Evidence Documents [RAD-45]

4.45.1 Scope

In the Retrieve Evidence Documents Transaction, the requested DICOM Evidence Documents are transferred from the Image Archive to the Image Display or from the Imaging Document Source to the Imaging Document Consumer.

4.45.2 Actor Roles

Actor: Image Archive:

Role: Sends requested Evidence Documents to the Image Display.

Actor: Imaging Document Source

Role: Sends requested Evidence Documents to the Imaging Document Consumer.

Actor: Image Display

Role: Receives requested Evidence Documents from the Image Archive.

Actor: Imaging Document Consumer

Role: Receives requested Evidence Documents from the Imaging Document Source

4.45.3 Referenced Standards

DICOM PS3.4 Annex C: Query/Retrieve Service Class

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4.45.4 Messages

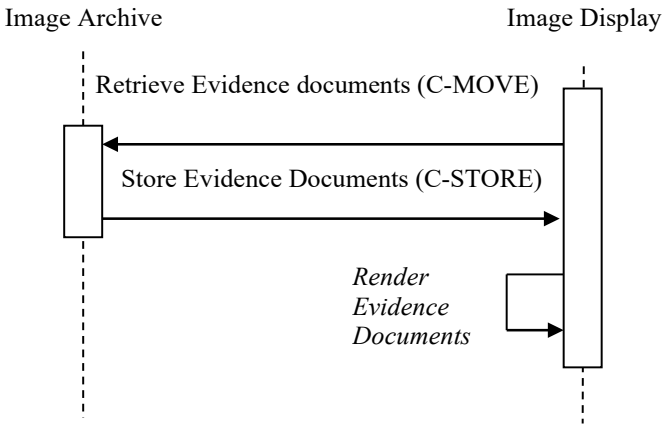

Figure 4.45.4-1: Interaction Diagram

4.45.4.1 Retrieve Evidence Documents

The Retrieve (Study Root – MOVE and optionally Patient Root – MOVE) SOP Classes shall be supported. The Image Archive as an SCU shall support DICOM Storage SOP Classes that may be used as Evidence Documents. The Imaging Document Source as an SCU shall support DICOM Storage SOP Classes that may be used as Evidence Documents it published for sharing. Refer to DICOM PS3.4 Annex C for detailed descriptive semantics (see Table 4.38-1).

In the case of retrieving Evidence Documents in a Cross-Enterprise, imaging document sharing (XDS-I.b) network environment, a configuration of mapping the AE Titles to DICOM AE Network Addresses (IP Address and Port number) needs to be exchanged between the Imaging Document Source and the Imaging Document Consumer. RAD TF-2x: Appendix G describes in detail the AE Title mapping to the DICOM AE Network Addresses.

4.45.4.1.1 Trigger Events

The Image Display or the Imaging Document Consumer selects specific Evidence Document objects to retrieve from the Image Archive or the Imaging Document Source.

4.45.4.1.2 Message Semantics

The message semantics are defined in DICOM PS3.4 Annex C Query/Retrieve Service Class. It is the responsibility of the Image Manager or Imaging Document Source to assure that the patient and procedure information is current in the Evidence Document objects when they are retrieved from the Image Archive or Imaging Document Source.

4.45.4.1.3 Expected Actions

The Image Archive or the Imaging Document Source receives the C-MOVE request, establishes a DICOM association with the Image Display or the Imaging Document Consumer, and uses the DICOM C-STORE command to transfer the requested Evidence Document objects.

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Since the Image Display or the Imaging Document Consumer can select compatible documents based on the Template IDs returned in the query, the Image Display or the Imaging Document Consumer is required not to return an error to the Image Archive or the Imaging Document Source due to the retrieved document content. The retrieved results may simply be discarded instead.

4.45.4.2 Render Evidence Documents

This transaction relates to the "Render Evidence Documents" event of the above interaction diagram.

4.45.4.2.1 Trigger Events

The Image Display or the Imaging Document Consumer receives Evidence Document instances from the Image Archive or the Imaging Document Source.

4.45.4.2.2 Invocation Semantics

This is a local invocation of functions resident within the Image Display or the Imaging Document Consumer. Evidence Documents shall be displayed to the user of the Image Display or the Imaging Document Consumer. The method used by the Image Display or the Imaging Document Consumer to present Evidence Documents for viewing by the user is outside the scope of the IHE Radiology Technical Framework. For example, in the case when an Image Display or an Imaging Document Source is grouped with an Evidence Creator, the Evidence Document may be rendered as input for further processing by the Evidence Creator.

4.45.4.2.3 Expected Actions

The Image Display or the Imaging Document Consumer renders the Evidence Documents retrieved. If the Image Display or the Imaging Document Consumer is unable to handle parts of the document, it may inform the user and offer the choice of doing a "low-grade" rendering or ignoring the data.

Evidence Documents may contain references to other types of evidence objects. The Image Display or the Imaging Document Consumer shall always be able to render (or "low-grade" render) referenced Evidence Documents or to invoke other rendering display functionality.

If the Image Display also supports the Consistent Presentation of Images Profile, it is also required to apply any presentation states referenced in the Evidence Document for application to the relevant images.

If the Image Display also supports the Key Image Notes Profile, it is also required to render any Key Image Notes referenced in the Evidence Document.

Note: It is recommended to use the just retrieved instance of the Evidence Document to ensure that the most recent patient data be displayed to reflect possible patient merge and patient update in the Image Manager/Image Archive. This patient data may be inconsistent with patient data contained in a previously retrieved copy of the same Evidence Document instance.

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4.45.4.2.3.1 Mammography Image Profile

Image Display and Image Manager/Image Archive Actors supporting the Mammography Image Profile shall support the Mammography CAD SR SOP Class.

Image Display Actors shall be able to apply Mammography CAD SR information to displayed images; see Section 4.16.4.2.2.1.1.8 Display of CAD Marks. It is not permitted to ignore data that has a rendering intent of presentation required; there is no such thing as a "low-grade" rendering for Mammography CAD SR.

4.46 Query Reporting Worklist [RAD-46]

4.46.1 Scope

This transaction is used during Reporting work done by the Report Creator to find out what tasks have been scheduled or assigned to it by the Report Manager. This transaction allows the Report Manager to provide the Report Creator with a worklist that shall contain Reporting-related workitem codes for conducting Interpretation of Images, Dictation, Transcription and Verification of the report.

The Report Manager is the provider of the worklist. It obtains the necessary information about the patient and type of a procedure through the Procedure Scheduled transaction from the Department System Scheduler. It is being notified about the existence of images and other evidence objects through the Modality Procedure Step completed transaction from Performed Procedure Step Manager, and may confirm their availability through the Images Available Query.

The Report Creator retrieves the worklist and includes received information such as patient demographics, Study Instance UID, etc., in the resulting instances (see RAD TF-2x: Appendix D), which are stored through instance stored transactions such as Evidence Document Stored, Image Stored, etc.

4.46.2 Actor Roles

Actor: Report Creator

Role: Queries the Report Manager for Reporting Scheduled Procedure Steps.

Actor: Report Manager

Role: Schedules Reporting procedure steps for the workitems of Interpretation, Dictation, Transcription and Verification as applicable; accepts query requests for Worklist items and returns responses.

4.46.3 Referenced Standards

DICOM PS3.4: General Purpose Worklist SOP Class

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4.46.4 Messages

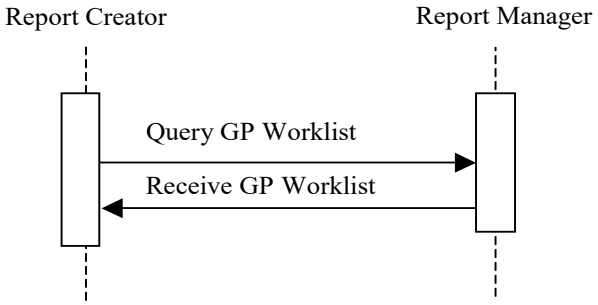

Figure 4.46.4-1: Interaction Diagram

4.46.4.1 Query General Purpose Worklist Message

This is the worklist query sent to the Report Manager.

4.46.4.1.1 Trigger Events

A user or an automated function on the Report Creator queries for scheduled Reporting worklist items.

4.46.4.1.2 Message Semantics

C-FIND request of the DICOM General Purpose Worklist SOP Class is used to query for the general purpose worklist. Report Creator performs the SCU role, and the Report Manager performs the SCP role.

4.46.4.1.2.1 Matching Keys and Return Keys

The Report Creator is required to query for specific attributes (return keys) that will be inserted into the instances created as a result of creation of a diagnostic report. See Appendix D for more details.

The Report Creator shall support individually each one of the required query keys listed in Table 4.46-3 – Return and Matching Keys For Reporting Worklist. In addition, at least one of the following two combinations shall be implemented by the Report Creator:

3. **Patient Oriented Query:** Query for a worklist for a specific patient/procedure. The SCU shall support all combinations (31) of the matching key attributes listed in Table 4.46-1 by including 1 or more keys. The sequence attributes denoted in the italics are not matching keys on their own but have to be included in a query to convey the value of the attributes contained within them. Thus, the SCU shall support any combination of Patient's Name, Patient ID, Accession Number, Requested Procedure ID, and Scheduled Workitem Code.

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Table 4.46-1: GPWL Keys for Patient Oriented Query

Matching Key Attributes	Tag
Patient's Name	(0010,0010)
Patient ID	(0010,0020)
Referenced Request Sequence	*(0040,A370)*
>Accession Number	(0008,0050)
>Requested Procedure ID	(0040,1001)
Scheduled Workitem Code Sequence	*(0040,4018)*
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)

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4. **User-oriented Query:** Query for a broad worklist for particular user being logged in on a particular station. The SCU shall support all (63) combinations of the matching key attributes listed in Table 4.46-2 by including 1 or more keys. The sequence attributes denoted in the italics are not matching keys on their own but have to be included in a
8795 query to convey the value of the attributes contained within them. Code Value of the Scheduled Station Name Code Sequence, if valued, shall be set to the AE Title of the workstation's General Purpose Worklist SCU.

Table 4.46-2: GPWL Keys for User-Oriented Queries

Matching Key Attributes	Tag
General Purpose Scheduled Procedure Step Status	(0040,4001)
Scheduled Station Name Code Sequence	*(0040,4025)*
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)
Scheduled Procedure Step Start Date and Time	(0040,4005)
Scheduled Workitem Code Sequence	*(0040,4018)*
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)
Scheduled Human Performers Sequence	*(0040,4034)*
>Human Performer Code Sequence	*(0040,4009)*
>>Code Value	(0008,0100)
>>Coding Scheme Designator	(0008,0102)
>Human Performer's Name	(0040,4037)

4.46.4.1.2.2 Examples for the Use of Matching Key Attributes

8800 • Using the Scheduled Procedure Step Start Date and Time key: query for all the Reporting tasks scheduled for today.

• Using the Scheduled Workitem Code key: query for all Transcription tasks.

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- Using Scheduled Human Performer Name key: query for all the Reporting tasks that are scheduled for this radiologist.
- Using the Scheduled Procedure Step Start Date and Time, Scheduled Workitem Code and Scheduled Human Performer Name keys: query for all the report verification tasks that are scheduled for today on for this radiologist.

Note: Applications are recommended to append a wildcard "*" at the end of each component of the structured Patient Name to facilitate matching with both structured and unstructured Patient Names.

4.46.4.1.2.3 Matching Keys and Return Keys

The Report Creator is required to query for specific attributes (return keys), many of which will be required in the objects it creates. The requirements for the attributes in the stored objects are defined in RAD TF-2x: Appendix D. There are additional attributes that may be queried but might not be used elsewhere.

Table 4.46-3 summarizes the matching key requirements and lists the optional and required attributes that may be requested and shall be returned in order to make these available to the user at the Report Creator. See Section 2.2 for more information on the requirements expressed in this table.

Table 4.46-3: Matching and Return Keys for Report Worklist Queries

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
SOP Common					
Specific Character Set	(0008,0005)	O	O	O	R
SOP Class UID	(0008,0016)	O	O	R+*	R
SOP Instance UID	(0008,0018)	O	R	R+*	R
General Purpose Scheduled Procedure Step Information					
General Purpose Scheduled Procedure Step Status	(0040,4001)	R+	R	R+	R
Input Availability Flag	(0040,4020)	O	R	R+	R
General Purpose Scheduled Procedure Step Priority	(0040,4003)	O	R	R+	R
Scheduled Procedure Step ID	(0040,0009)	O	O	O	R
Scheduled Workitem Code Sequence	(0040,4018)				
>Code Value	(0008,0100)	R+	R	R+*	R
>Coding Scheme Designator	(0008,0102)	R+	R	R+*	R
>Code Meaning	(0008,0104)	-	-	R+	R
Scheduled Processing Applications Code Sequence	(0040,4004)				
>Code Value	(0008,0100)	O	R	O	R
>Coding Scheme Designator	(0008,0102)	O	R	O	R
>Code Meaning	(0008,0104)	-	-	O	R

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Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
Scheduled Station Name Code Sequence	(0040,4025)				
>Code Value	(0008,0100)	R+	R	R+*	R
>Coding Scheme Designator	(0008,0102)	R+	R	R+*	R
>Code Meaning	(0008,0104)	-	-	R+	R
Scheduled Station Class Code Sequence	(0040,4026)				
>Code Value	(0008,0100)	O	R	O	R
>Coding Scheme Designator	(0008,0102)	O	R	O	R
>Code Meaning	(0008,0104)	-	-	O	R
Scheduled Station Geographic Location Code Sequence	(0040,4027)				
>Code Value	(0008,0100)	O	R	O	R
>Coding Scheme Designator	(0008,0102)	O	R	O	R
>Code Meaning	(0008,0104)	-	-	O	R
Scheduled Procedure Step Start Date and Time	(0040,4005)	R+	R	R+	R
Expected Completion Date and Time	(0040,4011)	O	R	O	R
Scheduled Human Performers Sequence	(0040,4034)				
>Human Performer Code Sequence	(0040,4009)				
>>Code Value	(0008,0100)	R+	R	R+*	R
>>Coding Scheme Designator	(0008,0102)	R+	R	R+*	R
>>Code Meaning	(0008,0104)	-	-	R+	R
>Human Performer's Name	(0040,4037)	R+	R+	R+	R+
>Human Performer's Organization	(0040,4036)	O	O	O	R+
Referenced Study Component Sequence	(0008,1111)				
>Referenced SOP Class UID	(0008,1150)	O	O	O	R
>Referenced SOP Instance UID	(0008,1155)	O	O	O	R
Input Information Sequence	(0040,4021)				
>Study Instance UID	(0020,000D)	O	O	R+*	R
>Referenced Series Sequence	(0008,1115)				
>>Series Instance UID	(0020,000E)	O	O	R+*	R
>>Retrieve AE Title	(0008,0054)	O	O	O	R
>>Storage Media File-Set ID	(0088,0130)	O	O	O	O
>>Storage Media File-Set UID	(0088,0140)	O	O	O	O
>>Referenced SOP Sequence	(0008,1199)				
>>>Referenced SOP Class UID	(0008,1150)	O	O	R+*	R
>>>Referenced SOP Instance UID	(0008,1155)	O	O	R+*	R
Relevant Information Sequence	(0040,4022)				
>Study Instance UID	(0020,000D)	O	O	O	R

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Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
>Referenced Series Sequence	(0008,1115)				
>>Series Instance UID	(0020,000E)	O	O	O	R
>>Retrieve AE Title	(0008,0054)	O	O	O	O
>>Storage Media File-Set ID	(0088,0130)	O	O	O	O
>>Storage Media File-Set UID	(0088,0140)	O	O	O	R
>>Referenced SOP Sequence	(0008,1199)				
>>>Referenced SOP Class UID	(0008,1150)	O	O	O	R
>>>Referenced SOP Instance UID	(0008,1155)	O	O	O	R
Resulting General Purpose Performed Procedure Step Sequence	(0040,4015)				
>Referenced SOP Class UID	(0008,1150)	O	O	O	R
>Referenced SOP Instance UID	(0008,1155)	O	O	O	R
Actual Human Performers Sequence	(0040,4035)				
>Human Performer Code Sequence	(0040,4009)				
>>Code Value	(0008,0100)	O	O	O	R
>>Coding Scheme Designator	(0008,0102)	O	O	O	R
>>Code Meaning	(0008,0104)	-	-	O	R
>Human Performer's Name	(0040,4037)	O	O	O	R+
>Human Performer's Organization	(0040,4036)	O	O	O	R+
Study Instance UID	(0020,000D)	O	O	R+*	R
Multiple Copies Flag	(0040,4006)	O	O	O	R
All other Attributes from the General Purpose Scheduled Procedure Step Information Module		O	O	O	O
General Purpose Scheduled Procedure Step Relationship					
Referenced Request Sequence	(0040,A370)				
>Study Instance UID	(0020,000D)	O	O	R+*	R
>Referenced Study Sequence	(0008,1110)				
>>Referenced SOP Class UID	(0008,1150)	O	O	R+*	R
>>Referenced SOP Instance UID	(0008,1155)	O	O	R+*	R
>Requested Procedure ID	(0040,1001)	R+	R+	R+	R
>Requested Procedure Description	(0032,1060)	O	O	O	R
>Requested Procedure Code Sequence	(0032,1064)				
>>Code Value	(0008,0100)	O	O	O	R
>>Coding Scheme Designator	(0008,0102)	O	O	O	R
>>Code Meaning	(0008,0104)	-	-	O	R
>Accession Number	(0008,0050)	R+	R	R+	R
>Requesting Physician	(0032,1032)	O	O	O	R

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Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
>All other Attributes relating to the Requested Procedure and the Imaging Service Request in the General Purpose Scheduled Procedure Step Relationship Module		O	O	O	O
Patient Relationship					
All Attributes from the Patient Relationship Module		O	O	O	O
Patient Identification					
Patient's Name	(0010,0010)	R+	R	R+	R
Patient ID	(0010,0020)	R+	R	R+	R
All other Attributes from the Patient Identification Module		O	O	O	O
Patient Demographic					
Patient's Birth Date	(0010,0030)	O	O	R+	R
Patient's Sex	(0010,0040)	O	O	R+	R
All other Attributes from the Patient Demographic Module		O	O	O	O
Patient Medical					
All Attributes from the Patient Medical Module		O	O	O	O

4.46.4.1.3 Expected Actions

The Report Manager performs the query and sends the matching General Purpose Worklist items to the Report Creator.

4.46.4.2 Receive General Purpose Worklist Message

This is the message the Report Manager sends containing General Purpose Worklist information as a response to the Report Creator query.

4.46.4.2.1 Trigger Events

The Report Manager receives a query for a Worklist.

4.46.4.2.2 Message Semantics

C-FIND Response from the DICOM General Purpose Worklist SOP Class will be used for this message. Some of the attributes queried through the worklist originate from other sources during previous steps in the workflow, and are made available to the Report Manager through other transactions such as MPPS. It is up to the Report Manager to determine the Input Information, e.g., study, series, etc. appropriate to be used in a workitem Scheduled Procedure Step, i.e., it is independent of the acquisition process and resulting MPPS.

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The Post-Processing Manager shall specify the type of task to be performed in the content of the Scheduled Workitem Code Sequence (0040,4018) using one of the following values from DCMR CID 9231:

Table 4.46-4: Reporting Workitem Definition

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	110005	Interpretation
DCM	110006	Transcription
DCM	110007	Report Verification
DCM	110009	No subsequent Workitems

4.46.4.2.3 Expected Actions

A Report Creator displays the worklist to the user who might then select the item to work on. When the user selects the workitem and performs the report creation work, the Report Creator will notify the Report Creator of the work progress as defined in the Workitem Claimed and Workitem Completed transactions.

4.47 Distribute Imaging Information on Media [RAD-47]

4.47.1 Scope

In the Distribute Imaging Information on Media transaction the Portable Media Creator sends information to media reading actors by means of Interchange Media where it stores the information.

4.47.2 Actor Roles

Actor: Portable Media Creator

Role: Assemble the media content and store it on the media to be distributed.

Actor: Portable Media Importer

Role: Read the DICOM content of distributed media in order to access information stored in the DICOMDIR file and its referenced instances (DICOM FSR) and perform import of media data.

Actor: Image Display

Role: Read the DICOM content of distributed media in order to access information stored in the DICOMDIR file (DICOM FSR) and display its referenced evidence objects.

Actor: Report Reader

Role: Read the DICOM content of distributed media in order to access information stored in the DICOMDIR file (DICOM FSR) and read its referenced diagnostic reports.

Actor: Print Composer

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Role: Read the DICOM content of distributed media in order to access information stored in the DICOMDIR file (DICOM FSR) and send print data (images) to the Print Server.

Actor: Display (from ITI TF)

Role: Read the web-viewable content of distributed media in order to access information stored in the INDEX.HTM file and display its referenced data (XHTML files and JPEG images).

4.47.3 Referenced Standard

DICOM PS3.10: Media Storage and File Format for Data Interchange

DICOM PS3.11: Media Storage Application Profiles

DICOM PS3.12: Media Formats and Physical Media for Data Interchange

XHTML™ 1.0 The Extensible HyperText Markup Language (Second Edition). A Reformulation of HTML 4 in XML 1.0. W3C Recommendation 26 January 2000, revised 1 August 2002. http://www.w3.org/TR/xhtml1.

XHTML™ Basic. W3C Recommendation 19 December 2000. http://www.w3.org/TR/xhtm-basic.

4.47.4 Messages

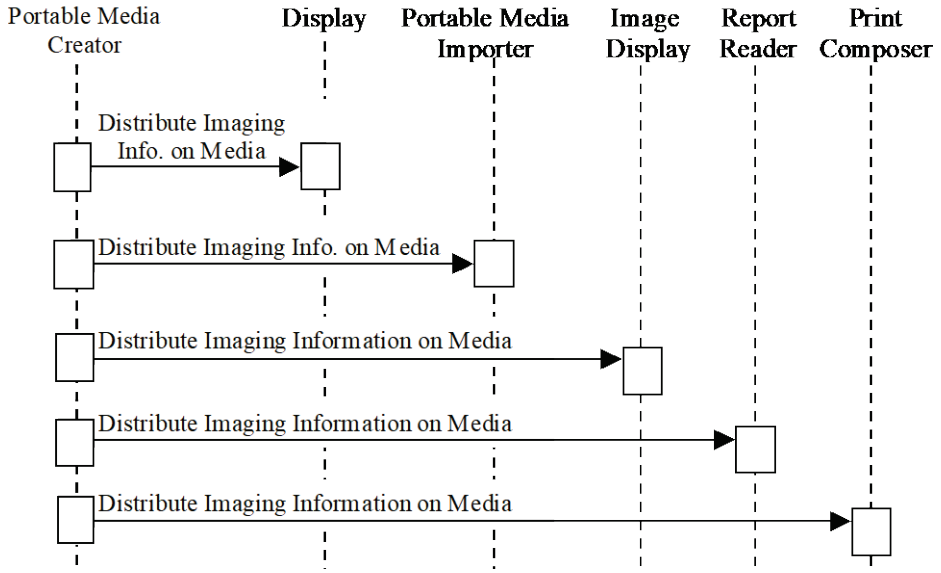

Figure 4.47.4-1: Interaction Diagram

4.47.4.1 Distribute Imaging Information on Media

This transaction consists of the interchange of information on media by way of the physical transport of the created media from the Portable Media Creator to a media-reading actor.

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4.47.4.1.1 Trigger Events

The user at the Portable Media Creator wishes to transport information by the creation and transport of interchange media. The Portable Media Creator assembles the Interchange Media content and stores it on the media.

4.47.4.1.2 Message Semantics

The message semantics of this transaction are described in terms of content specifications for the media.

The Portable Media Creator shall be able to include all DICOM objects supported by the IHE actors with which it is grouped. If not grouped with any IHE actors, it shall be able to include all DICOM Storage objects listed in its DICOM Conformance Statement.

4.47.4.1.2.1 Media Filesystem and File Naming Restrictions

Since the DICOM content on the media is required to conform to the DICOM standard, some of the requirements specified in DICOM PS3.10, 3.11 and 3.12 are reiterated here for emphasis:

- Strict ISO 9660 Level 1 compliance with respect to file naming
- No packet writing
- File and folder names referenced by the DICOMDIR file restricted to 8 characters, uppercase letters, digits and underscore only, with no extension

Specifically, it is not permitted to name DICOM files based on their SOP Instance UID, since that would exceed the 8 character limit and use the illegal period character, and it is not permitted to add a ".dcm" extension or similar. Filenames should not be in lower case, nor have lower case equivalent file names encoded as Joliet or Rockridge extensions to the ISO 9660 filesystem.

Refer to Appendix E for a reference to common implementation misinterpretations and/or errors that are detrimental to interoperability.

Non-DICOM data is restricted to ISO 9660 Level 1 compliance for media encoded with ISO 9660 rather than UDF or FAT filesystems, but without the restrictions on file extensions and characters imposed by DICOM; i.e., a 3 character extension is permitted.

4.47.4.1.2.2 Content Organization Overview

The following diagram illustrates the content organization principles (see RAD TF-2x: Appendix F for examples):

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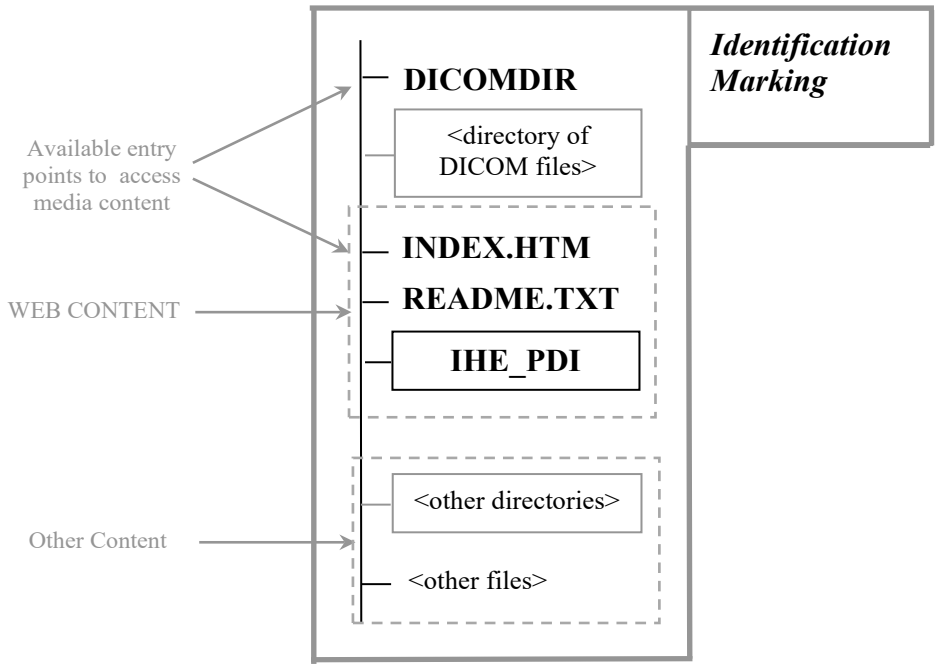

Figure 4.47.4.1.2.2-1: Media Content Organization

Description of the content to be contained in the media file system:

4.47.4.1.2.2.1 DICOM Content

The ***DICOMDIR*** file shall be located in the root directory and shall reference all DICOM instances contained in the media.

The DICOM instance files shall not be in the root directory or in the IHE_PDI sub-directory, instead they shall reside in a sub-directory whose name is not otherwise constrained. No other DICOM instance files shall be placed on the media.

It is recommended, though not required, to include the README.TXT file described below, even if the Web Content Option is not supported.

4.47.4.1.2.2.2 Web Content Option

Portable Media Creators implementing the Web Content Option shall meet the following requirements:

- ***INDEX.HTM*** file located in the root directory, which shall portray the exact content of the interchange media. The file shall present:
  - An informative header containing:
    - Identification of the institution that created the interchange media
    - Optionally, a link to an Internet-accessible site where, with the appropriate authentication and access control, a user may view the most recent version(s) of

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the report(s) about the media content, since any report content on the media may have been amended

- a link to an entry point for accessing the web content of the *IHE_PDI* directory
- a link to the *README.TXT* file
- a link to additional non-constrained data (if it exists) – See Section 4.47.4.1.2.2.3
- a manifest which lists the data that can be imported by a Portable Media Importer. (i.e., all DICOM content on the media)
- a manifest which lists any patient-related data contained on the CD that cannot be imported (i.e., additional non-constrained content that doesn't have an importable DICOM equivalent on the media).
- a link to a launch point for a DICOM viewer, if present on the interchange media

Note: The file INDEX.HTM is required to present the content defined above to the user. This does not imply that the information must necessarily be contained in INDEX.HTM. Instead, INDEX.HTM might also open a frame set consisting of additional XHTML files that in total contains the information specified above.

- **README.TXT** file located in the root directory, that shall contain:
  - Contact information regarding the Institution that created the media.
  - Information regarding the Application that created the media.
    - Name of the product application and software version
    - Contact information of the vendor of the application that created the media
  - General information about the overall organization of the interchange media. This is not intended to be specific to the content stored on this instance of interchange media, which, if necessary, should be placed in the *INDEX.HTM* file.
  - Information regarding the Media Viewer application (if a Media Viewer is contained)
    - Operating system(s) supported
    - Name of the product application and software version
    - Contact information of vendor that provided the application
    - List of minimum requirements
    - Additional information regarding the usage of the application

Note that generally the README.TXT file is independent of the clinical content of the media, i.e., the same README.TXT may be included on all media created by that application at that institution.

It is recommended that information is included in the README.TXT file about web browsers (including version number) that are known to be capable of displaying the web content as intended.

- ***IHE_PDI*** directory located in the root directory of the interchange media which shall contain:

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- Web-viewable objects in XHTML, JPEG, PNG and/or GIF derived from the DICOM encoded objects or used for web page navigation (see Section 4.47.4.1.2.3.2).
- The web content shall faithfully represent the patient's clinical condition.
- It is not allowed to place any other data in the *IHE_PDI* directory.
- It is allowed to have sub-directories within the *IHE_PDI* directory

Note that these are IHE requirements (not DICOM requirements) that are intended to facilitate the overall organization of the media and make easier the access to the INDEX.HTM file, especially for non-expert users like patients and referring physicians.

Note: There is a recognized need for cine/video data, however a standardized method (format) has not yet been identified for endorsement by IHE and inclusion in this transaction.

4.47.4.1.2.2.3 Optional Content

It is permitted to place other data on the media outside the *IHE_PDI* directory. Any additional content shall take into account all constraints listed above especially:

- No DICOM instance files are allowed.
- This data shall be described or referenced as defined in Section 4.47.4.1.2.2.2.

Furthermore, any additional directory in the root directory not specified by other IHE profiles (such as XDM) cannot begin with "IHE", and those folders shall not be used by PDI.

Additional files (files other than mandatory files) in the root directory are not expressly prohibited however their inclusion is discouraged. Any viewing application on the media shall have a minimum number of files and launch file in the root directory. Any supporting files shall be contained in a minimum number of sub-directories in the root directory.

Note that it cannot be assumed that any automatically launching application will run on the receiving device.

4.47.4.1.2.2.3.1 DICOM Media Viewer

If a DICOM media viewer is present on the media, it is recommended that:

- the media viewer be capable of correctly rendering all DICOM objects stored on the medium
- a user manual in PDF format be included on the medium, in the root directory
- a short manual in hardcopy be provided within the CD jewel case

4.47.4.1.2.2.4 Media Identification

The Portable Media Creator shall support a user in adding human-readable identification information on the outside of the physical medium. The method of media marking is outside the scope of this integration profile.

It is recommended that the following be marked on the medium:

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- Patient Name
- Patient ID
- birthdate
- media creation date
- the study dates for the studies on the medium and
- the name of the originating institution

If the Media Creator prints a label on, or to be applied to, the physical media, then the label shall include information about the type of content and which options are used by the Portable Media Creator:

- The type of content ("DICOM" or "DICOM WEB")
- If the DVD Option is used by the Portable Media Creator
  - if the physical media is not a CD, then the label shall include an indication that a DVD drive is required to read the media.
  - if compression is used, then the label shall include an indication of which compressed Transfer Syntax (e.g., JPEG or JPEG 2000) was used.
- For example, a typical label might include:
  - St. Elsewhere's Radiology
  - John Smith #54672354 1973/04/02
  - CT Brain 2009/05/13
  - Recorded 2009/05/14 710
  - IHE PDI DICOM WEB DVD J2K BIR
- For media that is physically small (e.g., a USB memory stick that is not packaged in a larger form, such as credit card size), it may be difficult to fit the required and recommended information, in which case only the required information should be used.
- The labelling requirements and recommendations apply to the physical media itself and any directly applied label; it is not sufficient merely to label the package in which the media is transported, since the media may become separated from the package.

4.47.4.1.2.3 Content Organization Detail

4.47.4.1.2.3.1 DICOM Content

The DICOM portion of the media content is defined by the current DICOM standard. It is required that created file-sets be correctly formatted in order to grant maximum interoperability.

All DICOM data shall be referenced by the *DICOMDIR* file.

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The Portable Media Creator, Portable Media Importer, Image Display, Report Reader and Print Composer shall use the STD-GEN-CD Media Storage Application Profile to interchange DICOM information on interchange media, unless the DVD or USB Options are specified (see Section 4.47.4.1.4).

The Portable Media Creator is not required to be able to create media containing data from multiple patients. However, all media reading actors shall be able to import media containing multiple patients' data.

While the Portable Media Creator is not required to correct DICOM SOP instances from a source that incorrectly encodes the DICOM data, it is expected that the DICOM Media Creator will store the DICOM files in Explicit VR Little Endian, unless the DVD or USB Options are specified (see Section 4.47.4.1.4). The DICOMDIR, whose content is entirely the responsibility of the Portable Media Creator, shall be correctly encoded regardless of the correctness of any referenced SOP Instances.

The Portable Media Creator may be requested to include DICOM SOP Instances that do not contain sufficient information to encode mandatory DICOMDIR information. For example, Patient ID and Study ID are Type 2 and may be zero length in image SOP Instances, but are Type 1 in the Patient and Study Directory Records. The complete list of attributes which fall into this category for the STD-GEN-CD Media Storage Application Profile is in Table 4.47.4-1.

Table 4.47.4-1: Optional or Empty DICOM SOP Instance Attributes required in DICOMDIR

Directory Record Type	Attribute Name	Tag
PATIENT	Patient ID	(0010,0020)
STUDY	Study ID	(0020,0010)
	Study Date	(0008,0020)
	Study Time	(0008,0030)
SERIES	Modality	(0008,0060)
	Series Number	(0020,0011)
IMAGE	Instance Number	(0020,0013)

The DVD and USB Options contain additional such Attributes that are optional in the SOP Instance but are required in the DICOMDIR (see Section 4.47.4.1.4).

The Portable Media Creator is required to synthesize appropriate values for all such mandatory attributes. No specific guidance is given as to from whence appropriate values should be obtained or what default values are appropriate, except that different patients, studies, and series must remain distinct (e.g., two different Studies with differing Study Instance UIDs shall not be assigned the same synthesized Study ID). There is no firm requirement that a synthesized Patient ID must be globally unique as it is not a UID. However, it is the only Type 1 attribute for Patient Directory Records and is a key index value for searching. Any synthesized Patient ID values shall be unique, at least in the context of the DICOMDIR on the media being created, so that each corresponding Patient Directory Record will be guaranteed to be unique. Implementers

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must also be careful to ensure that multiple Patient Directory Records do not link to Study Directory Records with the same Study Instance UID. The requirements for synthesizing new Study ID values are less rigid as Study Directory Records are still guaranteed to have unique Study UID values. The Portable Media Creator is not required to add these synthesized values to the instances to be stored on media.

4.47.4.1.2.3.1.1 DICOM Instances Content

There are no additional requirements specified here on the Attributes contained within DICOM Instances on the media.

If the Portable Media Creator is grouped with an Acquisition Modality (or other) within the Scheduled Workflow Integration Profile, then the attributes may effectively be constrained beyond the normative requirements of the DICOM standard. For example, certain attribute values in the Modality Worklist query shall be included.

However, since such grouping is not required under this profile, actors receiving created media such as the Portable Media Importer, Image Display, Report Reader and Print Composer may not assume that the DICOM Instance Attributes are constrained beyond the definitions of the IODs in the DICOM Standard.

The instances on the Interchange Media generated by a Portable Media Creator shall all be DICOM Composite IODs. Therefore, the Interchange Media shall not contain instances from the following SOP Classes:

- Detached Patient Management SOP Class
- Detached Study Management SOP Class
- Detached Visit Management SOP Class
- Study Component Management SOP Class
- Modality Performed Procedure Step SOP Class
- Detached Result Management SOP Class
- Detached Interpretation Management SOP Class
- Stored Print Storage SOP Class

The Media Creator shall not change the values of the stored pixels, though it may change the encoding. It is required that images on the PDI media be of diagnostic quality (RAD TF-1:15.4), hence for Options that support the use of lossy (irreversible) image compression, the Portable Media Creator shall not:

- apply lossy compression to images just for the purpose of exchange (e.g., to fit on the media or to accelerate load time); images can be encoded in lossy compressed form if and only if this is the form in which they had been made available to the Portable Media Creator (see also Media Exchange Certification Project of the German Radiological

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Society rule 3.1.3.8 http://www.dicom-cd.de/docs/DRG-RequirementsSpecification-2006.pdf).

- alter the bit depth or rescaling or color space of an image in such a manner that information is lost in order to allow compression (lossless or lossy) to be applied (e.g., to change an image containing 16 bits of data to 12 bits to allow JPEG compression to be applied).

4.47.4.1.2.3.1.2 DICOMDIR Directory Content

There are no additional DICOMDIR keys required beyond those required by the DICOM STD-GEN-CD specification, or the appropriate profile used with the DVD or USB Options (see Section 4.47.4.1.4).

No private elements shall be included in the standard directory records and no private directory records shall be present.

The following types of Directory shall not be used in the Basic Directory object (DICOMDIR File):

- VISIT
- RESULTS
- INTERPRETATION
- STUDY COMPONENT
- STORED PRINT
- TOPIC
- PRIVATE

The PATIENT, STUDY, SERIES Directory Records shall follow the following rules:

- Only one Directory Record per Patient ID shall be present in the DICOMDIR.
- Only one STUDY Directory Record per Study Instance UID shall be present in the DICOMDIR; this implies that a study belongs to a single patient.
- Only one SERIES Directory Record per Series Instance UID shall be present in the DICOMDIR; this implies that a series belongs to a single study.
- Only one composite instance level Directory Record shall be present per SOP Instance UID; this implies that an instance belongs to only a single series.
- Only one HL7 STRUC DOC Directory Record shall be present per SOP Instance UID; this implies that an instance belongs to only a single Patient.
- Only one HANGING PROTOCOL Directory Record shall be present per SOP Instance UID

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Users should review the supported Media Storage SOP Classes in the Conformance Statements of media creators and readers to ensure interoperability in the interchange of media objects.

There is no requirement to include Icon Image Sequences in DICOMDIR Directory Records. However, their presence at the SERIES level, or the IMAGE level for multi-frame images, may be helpful to improve performance in a viewer that provides visual information for the user to navigate. Accordingly, it is strongly recommended that such Icon Image Sequences be present, without causing excessive increase in size of the DICOMDIR file.

Note: The Transfer Syntax for the DICOMDIR is always Explicit VR Little Endian, and this precludes the use of any form of compression for Icon Image Sequences in the DICOMDIR, since the Transfer Syntax that defines the encoding of the nested Pixel Data is the same for the top-level data.

4.47.4.1.2.3.1.3 DICOM Report Content

It is possible to place diagnostic reports on the media.

Note: The report on or accompanying the media may be obsolete if a report is amended or corrected subsequently. Other means that recording on media are widely used to distribute up to date reports (e.g., fax and email), and it is potentially unsafe to rely on the report on media for clinical decision making.

The Portable Media Creator, if grouped with a Report Creator, shall support the ability to create a diagnostic imaging report. A Basic Text DICOM SR, according to a proper subset of the Simple Image Report Pattern as defined by the SINR Integration Profile, can be created and this kind of diagnostic report can be imported by a Portable Media Importer.

Additional optional diagnostic reports in non-DICOM formats (such as HL7 CDA) are not defined by this transaction and may be placed on the media without the need to create DICOM SRs or DICOM Encapsulated PDF or DICOM Encapsulated CDA, but they will be non-importable data. See also the Cross-Enterprise Document Sharing Media Interchange (XDM) Profile in the IHE ITI Technical Framework.

Note: This requirement may be met with other DICOM SR SOP Classes that are used for diagnostic or therapeutic reports. For the most basic radiology report, a simple pattern with one or more sections including a paragraph of text meets this requirement. Image references do not have to be included, but may be if so desired.

4.47.4.1.2.3.2 Web Content Option

Portable Media Creators claiming the Web Content Option shall meet the following requirements:

End-users should be able to access information at a minimum using a web browser to view content on media. In order to grant maximum interoperability using the stored XHTML files, they shall be formatted according to the XHTML Basic and W3C HTML Compatibility Guidelines provided in Appendix C of the W3C XHTML 1.0 Recommendation.

The web-viewable data that is generated by Portable Media Creators claiming the Web Content Option shall:

- contain the web representation of a subset that faithfully preserves the clinical intent of the media's DICOM information, using only XHTML files, JPEG referenced images, and PNG and/or GIF files used for navigation,

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- contain hyperlinks within XHTML files which contain only lowercase letters to promote interoperability across O/S Platforms,
- reside in the *IHE_PDI,* while the corresponding DICOM data from which it is derived is located in a different sub-directory (see Section 4.47.4.1.2.2.1), and
- be completely referenced in the *INDEX.HTM* file

The web-viewable data included shall be a set or subset that was considered at the time of creation to faithfully represent the patient's clinical condition. While it may be a subset, merely listing the contents is insufficient to satisfy this requirement, and if DICOM images are present on the media, for example, there shall be images in the Web Content. Though not required to be of diagnostic quality, Web Content images shall be a faithful representation and not excessively compressed nor excessively small (e.g., a 32x32 image of a 512x512 original would not be a faithful representation). For multi-frame original images, a sufficient number of frames shall be rendered to be a faithful representation.

If the Portable Media Creator supports Presentation States, it shall have the capability to apply them to the relevant images when including web-viewable content. The user of the application may choose not to make use of this capability.

The constraints placed by DICOM on the ISO 9660 file system are not required for web-viewable content, i.e., a 3-character extension is permitted.

To ensure interoperability, JPEG means a file with a JFIF header and encoded using the sequential Huffman DCT 8bit per component process (baseline), and the progressive variant thereof.

To ensure interoperability the use of XHTML shall be limited to static and restricted forms of dynamic web content. At this time Dynamic Web Content such as DHTML and most Scripting Languages are explicitly prohibited as no single established Standard exists to ensure interoperability between web browsers. The use of JavaScript is explicitly permitted, recognizing that there may be issues with different browsers. Portable Media Creators should make every effort to use portable constructs or use JavaScript that works with or adapts to all known portable browsers; further, the failure of JavaScripts should not make the resulting web pages unusable, by which it is meant that the static content shall be understandable as a faithful representation of the clinical condition without JavaScript.

Because XHTML rather than legacy HTML is required, it is necessary to provide information about appearance using either embedded styles or an external stylesheet, since legacy attributes controlling appearance are not permitted in XHTML Strict. The use of Cascading Stylesheets (CSS) is explicitly permitted, recognizing that there may be issues with different browsers. Portable Media Creators should make every effort to use portable constructs or use CSS that works with or adapts to all known portable browsers; further, the failure of CSS should not make the resulting web pages unusable, by which it is meant that the static content shall be understandable as a faithful representation of the clinical condition without CSS.

Additional optional web-viewable content not derived from DICOM objects may be stored on the media, but not in the *IHE_PDI* directory.

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4.47.4.1.2.3.3 Content when Grouping with XDM (IHE ITI Technical Framework)

A PDI Portable Media Creator that is grouped with a Portable Media Creator in the ITI Cross-Enterprise Document Sharing on Media (XDM) Profile is able to create media with combined DICOM and XDM content. The grouped actor will be referred to as the Portable Media Creator.

The Portable Media Creator shall assemble the necessary PDI content according to the specification in ITI TF-2: 3.32.4.1 with the following additional requirements:

- The content of the INDEX.HTM and README.TXT files of PDI and XDM shall be merged to one INDEX.HTM and one README.TXT file. The resulting files shall meet all requirements of both profiles (PDI and XDM).
- All DICOM instances shall be referenced by a Key Object Selection (KOS) instance with a document title of (113030, DCM, "Manifest"). This helps the Portable Media Importer to recognize such a KOS instance (see Section 4.47.4.1.3.4) during the import process and distinguish it from any other KOS instances, e.g., Key Image Notes (KIN). If a manifest KOS instance is not available, it shall be created by the Portable Media Creator. The XDM Manifest METADATA.XML then references the KOS instance which in turn references multiple DICOM instances. In cases where multiple patients/ studies are stored on the media, there may be multiple Manifest KOS instances in order to distinguish the patients/ studies during import.
- Each Manifest KOS instance shall be referenced in the METADATA.XML file as defined in the XDM Profile.
- The Manifest KOS instance(s) shall be stored in the DICOM sub-directory of the PDI media structure and referenced in the DICOMDIR file as specified in Section 4.47.4.1.2.2.1.

Note: Although it is not prohibited to reference in the METADATA.XML all of the DICOM instances, this is not recommended since it is redundant with the content of the KOS instance, it increases the bulk of the METADATA.XML, and it raises the risk of inconsistency between the two lists.

Figure 4.47.4.1.2.3.3-1 illustrates the processing chain for the Portable Media Creator.

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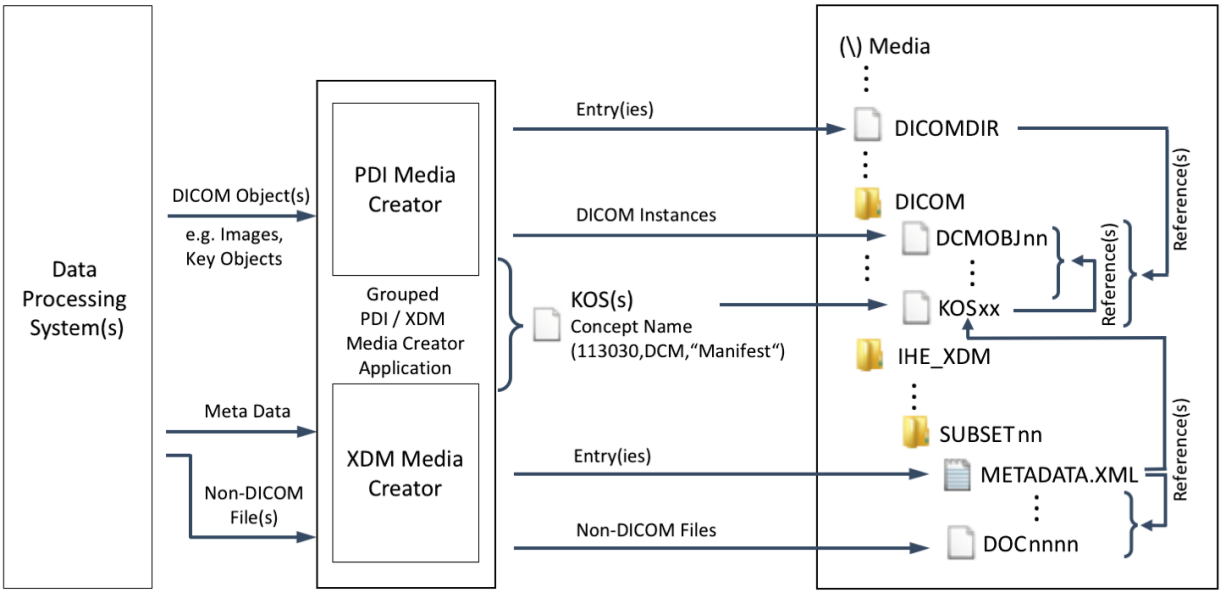

Figure 4.47.4.1.2.3.3-1: Processing Chain – Portable Media Creator

4.47.4.1.3 Expected Actions

The receiving/reading actors (Portable Media Importer, Image Display, Report Reader, Print Composer and Display) read the patient's data from the media and act upon it as specified below. The receiving actor shall document which DICOM objects it supports in its Conformance Statement. If a SOP Class on the media is not supported, the actor shall present the user with a summary of the data that could not be acted upon, containing the Patient Name(s) and ID(s), Study ID(s), Study Date(s), Study and Series Description(s) and Modality as obtained (if present) from the *DICOMDIR* file.

The automatic launching of applications is not expressly prohibited on media interchanged within this profile; its use is discouraged, however.

To facilitate avoidance of malicious software, receiving actors are not required to launch automatically running applications present on media.

4.47.4.1.3.1 Expected Actions Common to All Actors

All receiving actors that support the DVD Media Option or the USB Media Option shall be able to read all types of media and Transfer Syntaxes specified in the corresponding DICOM Media Application Profiles defined for the option, which includes the ability to decompress all specified compression schemes.

4.47.4.1.3.2 Image Display

The Image Display reads the DICOM image data from the media and provides the user with the ability to view all studies (that it supports) contained on the media. GSPS objects and Key Image Notes are read from the media and applied if the Consistent Presentation of Images (CPI) or the

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Key Image Notes (KIN) Profiles are supported. The Image Display may optionally be grouped with other actors that view other evidence objects.

4.47.4.1.3.3 Report Reader

The Report Reader reads the DICOM SR Reports from the media and may process them (based on the SR object classes it supports). At a minimum, it provides the user with the ability to view all reports per the DICOM SR SCP requirements.

4.47.4.1.3.4 Portable Media Importer

The Portable Media Importer reads DICOM data from the media. Together with the actor with which it is grouped (see RAD TF-1: 2.5), it shall be able to perform key attribute reconciliation on attributes in Table 4.47.4-2. The Portable Media Creator might not be required to perform reconciliation in all deployments (e.g., within the same importing institution/enterprise, the values in the imported object may already match what is expected by the importing institution/enterprise).

The Import Reconciliation Workflow Profile provides mechanisms to obtain the necessary values to reconcile the key attributes below. (See the Import Reconciliation Workflow (IRWF.b) Trial Implementation Supplement.)

The grouped actors provide the capability of storing the supported DICOM objects to an Image Manager/ Image Archive (for image objects like Images, Presentation States, Key Image Notes, Evidence Documents), or to a Report Repository (for Diagnostic Reports).

Table 4.47.4-2: Media instances – Key attributes to be reconciled

Attribute from Media	Updating action
Patient Name	Replace with value from ADT (See Note 1)
Patient ID	Replace with value from ADT (See Note 1)
Patient's Birth Date	Replace with value from ADT (See Note 1)
Patient's Sex	Replace with value from ADT (See Note 1)
Study Instance UID	Remains unchanged
Series Instance UID	Remains unchanged
SOP Instance UID	Remains unchanged
Workflow-related Identifying Attributes (e.g., Order, Requested Procedure, Scheduled and Performed IDs and UIDs).	Values from such identifying attributes of media information • remain unchanged, • are replaced with a value from the local environment, or • are removed (zero length value). (See Note 3) The exact method of reconciliation depends on the importing institution's procedures, and goes beyond the IHE scope.

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Attribute from Media	Updating action
Descriptive performed procedure information (this is information that pertains to the manner in which the information was created (e.g., acquisition context) or it may be payload of the instance (e.g., image structure, document content))	Remains unchanged (see Note 2).

Note 1: The manner in which the Portable Media Importer receives the ADT value is beyond the scope of this transaction.

Note 2: Handling of Coded information is beyond the scope of this transaction.

Note 3: The Referenced Study Sequence and Requested Attributes Sequence (which contain Workflow Identifying Attributes) are omitted in the unscheduled case of Scheduled Workflow, so removing them during import would be consistent with that behavior.

4.47.4.1.3.4.1 Grouping with XDM (IHE ITI Technical Framework)

A PDI Portable Media Importer that is grouped with a Portable Media Importer in the ITI Cross-Enterprise Document Sharing on Media (XDM) Profile is able to import media with combined DICOM and XDM content. The grouped actor will be referred to as the Portable Media Importer.

The Portable Media Importer shall process the PDI content according to the specification in ITI TF-2: 3.32.4.1.4 with the following additional requirements:

- The Manifest KOS instances (as described in Section 4.47.4.1.2.3.3) shall not be imported as they are only meant to provide an overview of the DICOM instances present on the media to the Portable Media Importer.

Figure 4.47.4.1.3.4.1-1 illustrates the processing chain for the Portable Media Importer.

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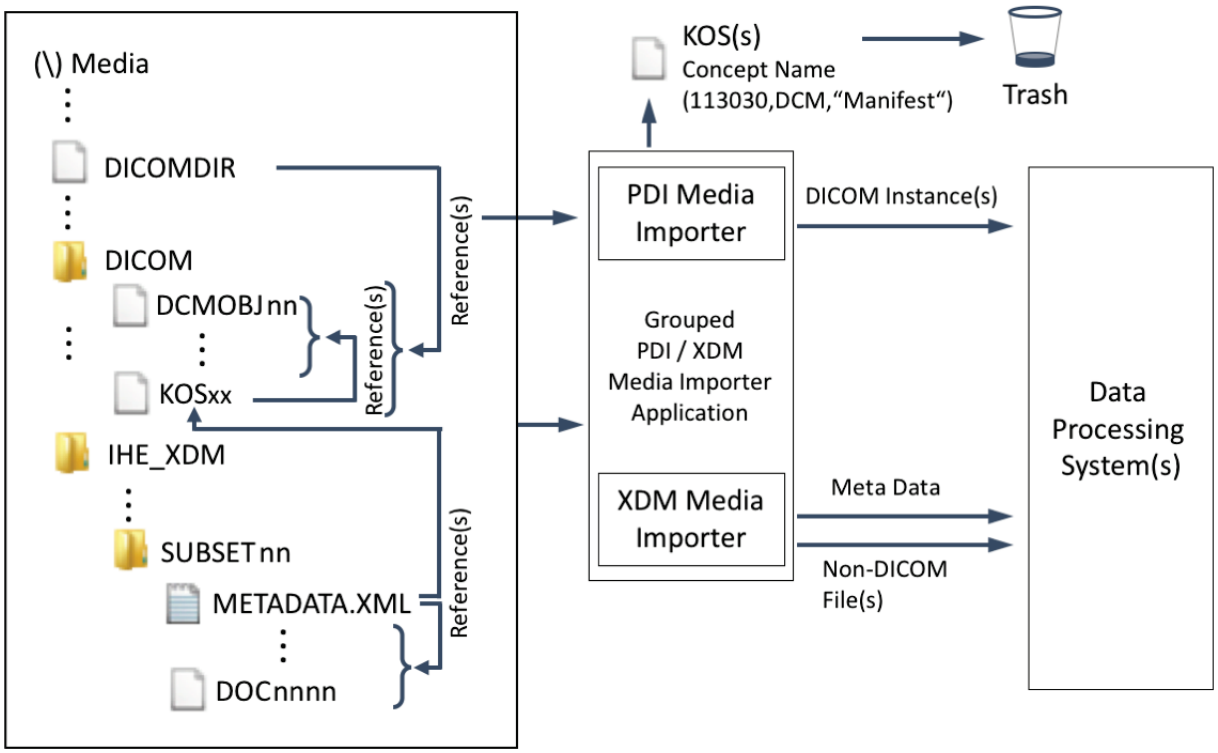

Figure 4.47.4.1.3.4.1-1: Processing Chain – Portable Media Importer

4.47.4.1.3.5 Print Composer

The Print Composer reads the DICOM image data from the media and provides a means to print it.

4.47.4.1.3.6 Display

The Display reads the web-viewable information from the media and displays it. Note that the web-viewable content will only be present if the Portable Media Creator involved supports the Web Content Option.

4.47.4.1.4 Media Options

The baseline media type is CD using the DICOM STD-GEN-CD Media Storage Application Profile.

Options are provided for DVD Media and USB Media.

4.47.4.1.4.1 DVD Media Option

A Portable Media Creator that supports the DVD Media Option shall create media that complies with either the DICOM STD-GEN-DVD-JPEG or STD-GEN-DVD-J2K Media Application Profiles, as defined in DICOM PS3.11 Annex H.

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A Portable Media Importer that supports the DVD Media Option shall be capable of reading any media written with the DICOM STD-GEN-DVD-JPEG and any media written with the STD-GEN-DVD-J2K Media Application Profiles.

In summary, these DICOM Media Application Profiles specify:

- the use of any of the conventional (non-HD) 120 mm DVD-compatible media except DVD-RAM, specifically CD, DVD-R authoring and general, DVD-RW, DVD+R and DVD+RW (see DICOM PS3.12 Annex P), which means that the Portable Media Creator can create any of these choices, and the receiving actors shall be capable of reading all of them
- the use of UDF or ISO 9660 (or both) as a filesystem, which means the Portable Media Creator can create either (or both), but the receiving actors shall be capable of reading either
- the use of uncompressed images, or compressed images using JPEG lossy (8 or 12 bits) or lossless (up to 16 bit), or JPEG 2000 reversible or irreversible (up to 16 bit) schemes, which means the Portable Media Creator can make a choice, but receiving actors shall be capable of decompressing all of them
- additional DICOMDIR keys that shall be included by the Portable Media Creator (which are listed in DICOM PS3.11 Section H.3.3.1)

Several other DICOM Media Application Profiles are effectively subsumed by the DICOM STD-GEN-DVD-JPEG profile. In particular, a Portable Media Creator that creates media using such a DICOM Media Application Profile will create media that is readable by a receiving actor that supports the DVD Media Option and hence the DICOM STD-GEN-DVD-JPEG profile. This is true as long as the received supports the encoded SOP Classes, which is true of any PDI media, and any additional required DICOMDIR keys are present. This includes profiles that create CD media that is readable in a DVD drive. Those DICOM Media Application Profiles, with any exceptions related to specific Transfer Syntaxes noted, are:

- STD-CTMR-CD
- STD-US-ID-SF-CDR, STD-US-ID-MF-CDR, STD-US-SC-SF-CDR, STD-US-SC-MF-CDR, STD-US-CC-SF-CDR, and STD-US-CC-MF-CDR, except that RLE Lossless Image Compression is unsupported
- STD-XABC-CD
- STD-XA1K-CD

4.47.4.1.4.2 USB Media Option

A Portable Media Creator that supports the USB Media Option shall create media that complies with either the DICOM STD-GEN-USB-JPEG or STD-GEN-USB-J2K Media Application Profiles, as defined in DICOM PS3.11 Annex J.

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A Portable Media Importer that supports the USB Media Option shall be capable of reading any media written with the DICOM STD-GEN-USB-JPEG and any media written with the STD-GEN-USB-J2K Media Application Profiles.

The USB media shall have a Type A physical connector (DICOM has no such restriction).

In summary, these DICOM Media Application Profiles specify:

- the use of any USB-Connected Removable Storage Devices (see DICOM PS3.12 Annex R), which includes the typical "memory stick" or "thumb drive"
- the use of a FAT16 or FAT32 filesystem
- the use of uncompressed images, or compressed images using JPEG lossy (8 or 12 bits) or lossless (up to 16 bit), or JPEG 2000 reversible or irreversible (up to 16 bit) schemes, which means the Portable Media Creator can make a choice, but the receiving actors shall be capable of decompressing all of them
- additional DICOMDIR keys that shall be included by the Portable Media Creator (which are specified in DICOM PS3.11 Section J.3.3.1, and are the same as those for DVD specified in DICOM PS3.11 Section H.3.3.1).

4.48 Appointment Notification [RAD-48]

4.48.1 Scope

In the Appointment Notification Transaction, a Department System Scheduler/Order Filler sends to an Order Placer new appointment bookings and appointment rescheduling which contains the date(s) and time(s) of the Scheduled Procedures Steps. It may also notify an Order Placer of the cancellation of appointment bookings.

4.48.2 Actor Roles

Actor: Department System Scheduler/Order Filler

Role: Generates Appointment Notification messages and sends them to the corresponding Order Placer.

Actor: Order Placer

Role: Receives Appointment Notification messages and internally processes them.

4.48.3 Referenced Standard

HL7 V2.4, chapter 10.

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4.48.4 Messages

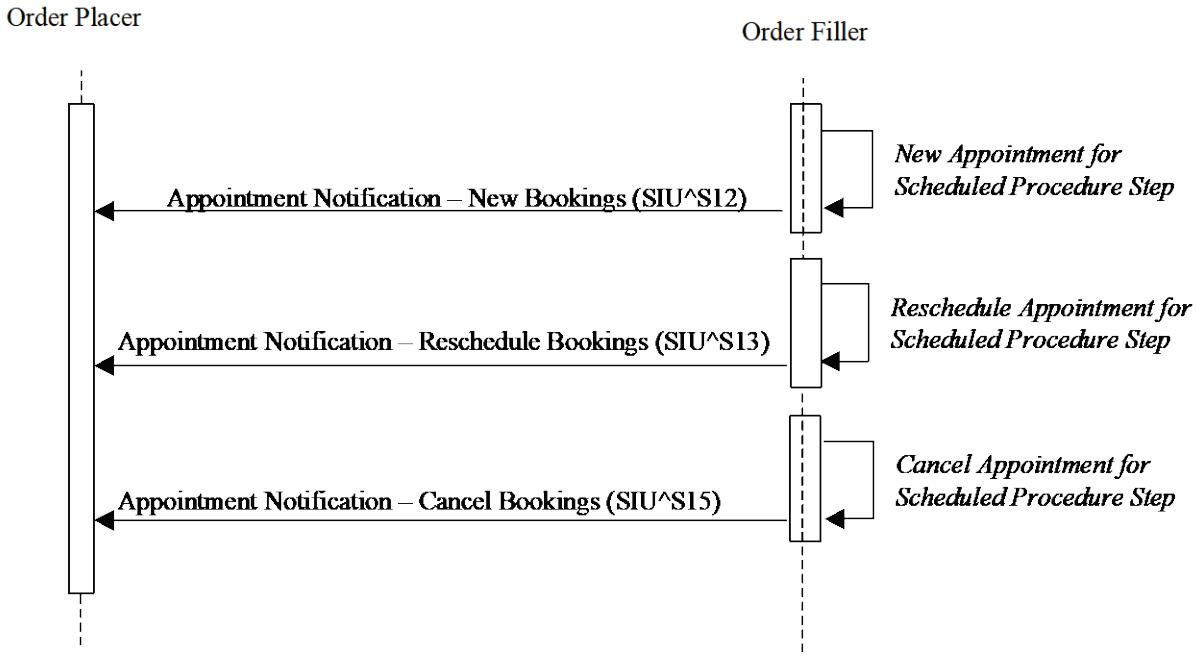

Figure 4.48.4-1: Interaction Diagram

4.48.4.1 Appointment Notification -New Bookings

4.48.4.1.1 Trigger Events

SIU^S12 – Notification of New Appointment Booking

The DSS/Order Filler receives an order from an Order Placer. The DSS/Order Filler determines what procedure steps need to be scheduled. After scheduling the corresponding appointment(s), the DSS/Order Filler may send the Order Placer an Appointment Notification – New Appointment Booking message. Each appointment may satisfy zero or more Scheduled Procedure Steps. Information in the AIS segment describes the date(s) and time(s) of the appointment(s) that has been booked.

4.48.4.1.2 Message Semantics

The message semantics follow the SIU^S12 message as specified in HL7 V2.4 Chapter 10. Refer to HL7 Standard for general message semantics. The cardinality of each segment is given within square brackets (minimum and maximum number of repetitions authorized).

SIU^S12	Schedule Information Unsolicited	Chapter in HL7 V2.4
MSH	Message Header	2
SCH	Schedule Activity Information	10
{ RGS	Resource Group Segment	10

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SIU^S12	Schedule Information Unsolicited	Chapter in HL7 V2.4
{ AIS	Appointment Information – Service	10
[{ NTE }]	Notes and Comments	2
}		

There is one group (RGS, AIS) per appointment booking. It is repeated when several appointment bookings have been made for the same Order. There must be at least one AIS segment (and therefore one RGS segment) since it contains timing information of the appointment.

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of the SIU message to its sender. See Section 2.4.3 “Acknowledgement Modes” for definition and discussion of the HL7 ACK message.

4.48.4.1.2.1 MSH Segment

The MSH segment shall be constructed as defined in Section 2.4.2.2 “Message Control”.

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of SIU; the second component shall have a value of S12. The third component is optional; however, if present, it shall have a value of SIU_S12.

4.48.4.1.2.2 SCH Segment

The following table identifies required and optional fields of the SCH segment.

SEQ	LEN	DT	OPT	RP/ #	TBL #	ITEM#	ELEMENT NAME
1	75	EI	O			00860	Placer Appointment ID
2	75	EI	R			00861	Filler Appointment ID
4	22	EI	C			00218	Placer Group Number
6	250	CE	R			00883	Event Reason
11	200	TQ	R	Y		00884	Appointment Timing Quantity
16	250	XCN	R	Y		00885	Filler Contact Person
20	250	XCN	O	Y		00878	Entered by Person
26	22	EI	R	Y		00216	Placer Order Number
27	22	EI	R	Y		00217	Filler Order Number

Adapted from the HL7 Standard, version 2.4

Field *SCH-1 Placer Appointment ID* contains the placer application’s permanent identifier for the appointment request. This field is not used.

Field *SCH-2 Filler Appointment ID* contains the filler application’s permanent identifier for the appointment request. This field is required to be sent.

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Field *SCH-4 Placer Group Number* shall be valued only if the Order Placer and the Order Filler utilize concept of Order Groups. Shall not be present otherwise.

Field *SCH-6 Event Reason* is mandatory in HL7 V2.4 but not used by the Order Placer in this IHE transaction. In order to keep the compatibility with HL7 V2.4, it shall be sent by the Order Filler with the value `^APT`.

Field *SCH-11 Appointment Quantity Timing* is mandatory in HL7 V2.4 but not used by the Order Placer in this IHE transaction. Dates and Times are set in the AIS segment. In order to keep the compatibility with HL7 V2.4, it shall be sent with a value set to `1`.

Field *SCH-16 Filler Contact Person* identifies the person responsible for the scheduling of the requested appointment. Most often, this person will be the same person responsible for maintaining the schedule or for reviewing appointment requests. This is the person to call if the appointment needs to be rescheduled or cancelled.

Field *SCH-20 Entered by Person* identifies the person responsible for entering the request for the scheduling of an appointment. It is included to trace the persons responsible for the request.

Field *SCH-26 Placer Order Number* is the order number assigned by the placer application for the order associated with this scheduling filler response. In the context of IHE Radiology Scheduled Workflow, this field is required to be sent.

Field *SCH-27 Filler Order Number* is the order number assigned by the filler application for the order associated with this scheduling filler response. In the context of IHE Radiology Scheduled Workflow, this field is required to be sent.

4.48.4.1.2.3 RGS Segment

The RGS segment is used to identify relationships between resources (date and time, location, medical staff) identified for a scheduled event. Related resources are defined in a group of resources. Each group starts with an RGS segment, followed by an AIS segment (for the date and time). The use of other segments (AIG, AIL, AIP) is beyond the scope of this integration profile. There must be one group per set of Scheduled Procedure Steps that are scheduled to take place during the same appointment.

RGS segment shall be constructed as defined in Section 10.6.3 “RGS – Resource Group Segment” of HL7 V2.4 chapter 10 “Scheduling”. The following table identifies required and optional fields of the RGS segment.

SEQ	LEN	DT	OPT	RP/ #	TBL #	ITEM#	ELEMENT NAME
1	4	SI	R			01203	Set ID – RGS
2	3	ID	C		0206	00763	Segment Action Code
3	250	CE	O			01204	Resource Group ID

Adapted from the HL7 Standard, version 2.4

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4.48.4.1.2.4 AIS Segment

The AIS segment contains the date and time of a Scheduled Procedure. There is only one AIS segment per group of resources.

AIS segment shall be constructed as defined in Section 10.6.4 "AIS – Appointment Information – Service Segment" of HL7 V2.4 chapter 10 "Scheduling". The following table identifies required and optional fields of the AIS segment.

SEQ	LEN	DT	OPT	RP/ #	TBL #	ITEM#	ELEMENT NAME
1	4	SI	R			00890	Set ID – AIS
2	3	ID	R		0206	00763	Segment Action Code
3	250	CE	R			00238	Universal Service Identifier
4	26	TS	R			01202	Start Date/Time
5	20	NM	O			00891	Start Date/Time Offset
6	250	CE	O			00892	Start Date/Time Offset Units
7	20	NM	O			00893	Duration
8	250	CE	O			00894	Duration Units
9	10	IS	C		0279	00895	Allow Substitution Code
10	250	CE	C		0278	00889	Filler Status Code
11	250	CE	O	Y	0411	01474	Placer Supplemental Service Information
12	250	CE	O	Y	0411	01475	Filler Supplemental Service Information

Adapted from the HL7 Standard, version 2.4

Field *AIS-2 Segment Action Code* contains the action to be taken when adding, updating or modifying information in this segment. All AIS segments in the same RGS group shall contain the same action code. This field is required and is valued with: `A` (Add/Insert).

Field *AIS-3 Universal Service Identifier* contains an identifier for the Scheduled Procedure Steps to be scheduled and the associated Requested Procedure Components. The 3 first components ("identifier", "text", "name of coding system") contain the Requested Procedure Code (Code Value, Meaning and Coding Scheme). The fifth component ("alternate text") shall contain a concatenated text description of the Scheduled Procedure Step(s) which can be understood at the Order Placer level. The fourth ("identifier") and sixth ("name of coding system") components are not used.

Field *AIS-4 Start Date/Time* contains the date and time of the appointment. Both date and time are required. A time zone offset (from UTC) may be included. If the offset is not included the time zone is understood to be the local time zone of the sender. For example, 09:00 AM US Central Time on October 22, 2004 could be represented as: 200410220900-0600 or 200410220900 for a sender within the US Central time zone.

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4.48.4.1.2.5 NTE Segment

Any information relative to the examination can be sent in NTE segments like Patient instructions (empty stomach, full or empty bladder), pre-medication (preliminary injection, biological examination), etc.

SEQ	LEN	DT	OPT	RP/ #	TBL #	ITEM#	ELEMENT NAME
1	4	SI	R			00096	Set ID – NTE
2	8	ID	R			00097	Source of Comment
3	65536	FT	R			00098	Comment
4	250	CE	R			01318	Comment Type

Adapted from the HL7 Standard, version 2.4

Field *NTE-2 Source of Comment* identifies the source of the comment. This field is required but may be empty. Valid values are:

Value	Description
L	Order Filler is the source of the comment
O	Other system is the source of comment

Field *NTE-3 Comment* contains the text of the comment. To delete a previously sent comment, the field shall contain empty quotation mark “”.

Field NTE-4 Comment Type contains a value to identify the type of comment. Valid values are:

Value	Description
PI	Patient Instruction
AI	Ancillary Instruction
GI	General Instruction
RE	Remark

4.48.4.1.3 Expected Actions

The Order Placer shall accept the appointment bookings as scheduled and shall return an HL7 ACK message.

4.48.4.2 Appointment Notification – Reschedule Bookings

4.48.4.2.1 Trigger Events

SIU^S13 – Appointment Notification – Reschedule Bookings

In some cases, appointments may be rescheduled in the Radiology Department. This message is sent by the DSS/Order Filler to notify the Order Placer that an existing appointment has been

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rescheduled. The information in the AIS segment describes the new date(s) and time(s) to which the previously booked appointment has been moved. Additionally, it describes the unchanged information in the previously booked appointments.

4.48.4.2.2 Message Semantics

The message semantics follow the SIU^S13 message as specified in HL7 V2.4 Chapter 10. Refer to HL7 Standard for general message semantics.

SIU^S13	Schedule Information Unsolicited	Chapter in HL7 V2.4
MSH	Message Header	2
SCH	Schedule Activity Information	10
{ RGS	Resource Group Segment	10
{ AIS	Appointment Information – Service	10
[{ NTE }]	Notes and Comments	2
}		

There is one group (RGS, AIS) per appointment booking. It is repeated when several appointment bookings have been made for the same Order. There must be at least one AIS segment (and therefore one RGS segment) since it contains timing information of the appointment.

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of the SIU message to its sender. See Section 2.4.3 “Acknowledgement Modes” for definition and discussion of the HL7 ACK message.

4.48.4.2.2.1 MSH Segment

MSH segment shall be constructed as defined in Section 2.4.2.2 “Message Control”.

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of SIU; the second component shall have a value of S13. The third component is optional; however, if present, it shall have a value of SIU_S13.

4.48.4.2.2.2 SCH, RGS, NTE Segments

SCH, RGS and NTE segments shall be constructed as defined in Section 4.48.4.1.2 “Message Semantics” of the current proposition.

4.48.4.2.2.3 AIS Segment

The segment shall be constructed as defined in Section 4.48.4.1.2.4 except for Field *AIS-2 Segment Action Code* which is valued with: U (Update).

4.48.4.2.3 Expected Actions

The Order Placer shall accept the appointment information for rescheduling and shall return an HL7 ACK message.

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4.48.4.3 Appointment Notification – Cancel Bookings

4.48.4.3.1 Trigger Events

SIU^S15 – Appointment Notification – Cancel Booking

This event is triggered when existing appointment bookings have been cancelled by an Order Filler.

4.48.4.3.2 Message Semantics

The message semantics follow the SIU^S15 message as specified in HL7 V2.4 Chapter 10. Refer to HL7 Standard for general message semantics.

SIU^S15	Schedule Information Unsolicited	Chapter in HL7 V2.4
MSH	Message Header	2
SCH	Schedule Activity Information	10
{ RGS	Resource Group Segment	10
{ AIS	Appointment Information – Service	10
[{ NTE }]	Notes and Comments	2
}		

There is one group (RGS, AIS) per appointment booking. It is repeated when several appointment bookings have been made for the same Order. There must be at least one AIS segment (and therefore one RGS segment).

Each message shall be acknowledged by the HL7 ACK message sent by the receiver of the SIU message to its sender. See Section 2.4.3 “Acknowledgement Modes” for definition and discussion of the HL7 ACK message.

4.48.4.3.2.1 MSH Segment

MSH segment shall be constructed as defined in Section 2.4.2.2 “Message Control”.

Field *MSH-9 Message Type* shall have at least two components. The first component shall have a value of SIU; the second component shall have a value of S15. The third component is optional; however, if present, it shall have a value of SIU_S15.

4.48.4.3.2.2 SCH, RGS, NTE Segments

SCH, RGS and NTE segments shall be constructed as defined in Section 4.48.4.1.2 “Message Semantics”.

4.48.4.3.2.3 AIS Segment

The segment shall be constructed as defined in Section 4.48.4.1.2.4 except for:

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- Field *AIS-2 Segment Action Code* is valued with: **D** (Delete).

4.48.4.3.3 Expected Actions

The Order Placer shall accept the appointment information for cancellation and shall return an HL7 ACK message. This message shall not be sent when the Order Filler or the Order Placer cancel an order. It is assumed that appointments are automatically cancelled by the Order Filler and that the Order Placer will take the same action.

4.49 Instance Availability Notification [RAD-49]

4.49.1 Scope

In the Instance Availability Notification Transaction, an Image Manager/Image Archive sends a message to relevant actors to inform them of the availability status of newly stored DICOM objects. Actors being notified are known to need these objects for fulfilling scheduled workflow processes and can retrieve and use the objects referenced in this message. This allows for supporting a variety of workflow conditions in imaging departments.

4.49.2 Actor Roles

Actor: Image Manager/Image Archive

Role: Generate an Instance Availability Notification message and send it to the DSS/Order Filler and optionally to other workflow managing actors (Post-Processing Manager, Report Manager).

Actor: DSS/Order Filler

Role: Receive an Instance Availability Notification message and internally process it.

Actor: Post-Processing Manager

Role: Receive an Instance Availability Notification message and internally process it.

Actor: Report Manager

Role: Receive an Instance Availability Notification message and internally process it.

4.49.3 Referenced Standard

DICOM PS3.4 Annex R: Instance Availability Notification Service Class

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4.49.4 Messages

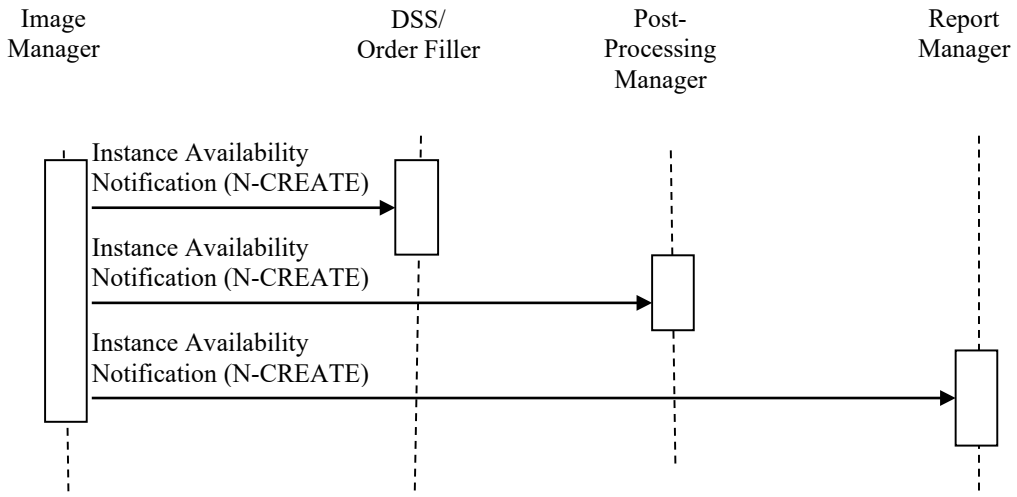

Figure 4.49.4-1: Interaction Diagram

4.49.4.1 Instance Availability Notification

This message uses the DICOM Instance Availability Notification Service from an Image Manager/Image Archive to inform other workflow managing actors about the availability of DICOM instances they may be waiting for in order to be able to schedule or start procedure steps.

4.49.4.1.1 Trigger Events

During image acquisition, an MPPS-capable Acquisition Modality creates a set of instances and stores them to an Image Manager/Image Archive. Alternatively, as a part of importing Evidence Objects, an MPPS capable Importer imports instances and stores them to an Image Manager/Image Archive. The Image Manager/Image Archive, after having received the last instance of the instance set referenced in the MPPS Completed/Discontinued message or after a configurable timeout, shall send an Instance Availability Notification referencing the received instances to the DSS/Order Filler that has also received the related MPPS. It may also decide to send the Instance Availability Notification to other instance managing actors in the workflow to inform them that all instances referenced in the related MPPS are available.

One Instance Availability Notification shall be sent for each MPPS that contains references to instances. MPPS without references to instances shall not trigger the sending of an Instance Availability Notification. This applies to all the MPPS cases described in transaction [RAD-6] (Section 4.6 Simple Case, Unscheduled Case, Group Case, Append Case (Normal and Group Case, Abandoned Case) and in transaction [RAD-7] (Section 4.7 MPPS DISCONTINUED, except the case of incorrect worklist entry selected (Section 4.7.4.1.3.1). It also applies to the Import PPS cases described in Section 4.59.4.1.2. (Unscheduled Import and Unscheduled Import Cases) and Section 4.60.4.1.2.2 (Import PPS Discontinued).

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4.49.4.1.2 Message Semantics

The end of the image acquisition is indicated to the Department System Scheduler/Order Filler and Image Manager/ Image Archive by an MPPS Completed/Discontinued message from the Acquisition Modality referencing the DICOM instances that were created and are to be stored in the Image Manager/Image Archive. The end of the DICOM object import is indicated to the Department System Scheduler/Order Filler and Image Manager/ Image Archive by an Import MPPS Completed/Discontinued message from the Importer referencing the DICOM instances that were created and are to be stored in the Image Manager/Image Archive.

Note that the MPPS and Instance Availability Notification inform about different events. Thus, depending on the total volume of the images stored and characteristics of the local system environment, the MPPS Completed/Discontinued may arrive considerably earlier at the DSS/OF than the Instance Availability Notification. The dependency of the IAN transaction on the MPPS Completed/Discontinued transaction may result in delayed notification to the DSS/OF of available instances, if the MPPS is not sent from the Acquisition Modality or Importer to the Image Manager/Image Archive in a timely fashion. This delay may be adjustable if there is a configurable timeout on the Image Manager/Image Archive regarding when to send the Instance Availability Notification.

The Image Manager/Image Archive shall act as an Instance Notification SOP Class SCU and create an Instance Availability Notification SOP Class. It shall populate the Reference SOP Instance UID in the Referenced Performed Procedure Step Sequence. It shall include references to all received instances that are referenced in the corresponding MPPS. The Instance Availability (0008,0056) attribute of each instance shall be set to one of ONLINE, NEARLINE or OFFLINE if they are available for retrieve, or set to UNAVAILABLE if they are not available for retrieve (e.g., if the Image Manager deletes the referenced instances upon receiving a MPPS Discontinued message). The other attributes of the SOP Class are used as specified in DICOM.

The Image Manager/Image Archive shall be able to send the Instance Availability Notification to multiple actors. The Image Manager/Image Archive shall send the Instance Availability Notification to the DSS/Order Filler and may be configured to also send it to other actors described in this transaction.

The DSS/Order Filler, Post-Processing Manager or the Report Manager shall understand that the receipt of this notification message implies that the referenced instances are available at the Image Manager/Image Archive that is identified by the Retrieve AE Title attribute.

Due to transient error conditions (e.g., corrupted storage media, Query/Retrieve SCP not running) that may occur within the Image Manager/Image Archive, an actor may not be able to retrieve instances for which it has received availability notifications. If an actor is uncertain about the availability status of instances referenced by the Instance Availability Notification, it can use the Image Availability Query [RAD-11] transaction to confirm the status as a supplementary method. Additionally, the Image Manager/Image Archive is assumed to be able to handle exceptions in instance storage or provision internally, based on local policy.

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4.49.4.1.2.1 Availability status of rejected images in Mammography Acquisition Workflow

This section is currently in the Mammography Acquisition Workflow (MAWF) Trial Implementation Supplement.

4.49.4.1.3 Expected Actions

The Department System Scheduler/Order Filler, Post-Processing Manager and Report Manager shall act as an Instance Notification SOP Class SCP. As a result of receiving the notification, the Department System Scheduler/Order Filler (or other actors) shall take appropriate action knowing that the referenced instances are available for further use in the workflow. Examples of such actions can be:

- The Department System Scheduler/Order Filler updates the procedure status internally, indicating that images for the procedure have been stored.
- The Post-Processing Manager adds items to a corresponding worklist.
- The Report Manager adds items to a corresponding worklist.

The Report Manager adds items to a list of relevant priors for use within Reporting.

4.50 Store Instances [RAD-50]

4.50.1 Scope

In the Store Instances transaction, the Export Selector sends the selected composite instances to the Export Manager.

4.50.2 Actor Roles

Actor: Export Selector

Role: Transmit instances to Export Manager.

Actor: Export Manager

Role: Accept instances from Export Selector and queue them for de-identification, pseudonymization and export

4.50.3 Referenced Standard

DICOM PS3.4 Annex B: Storage Service Class.

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4.50.4 Messages

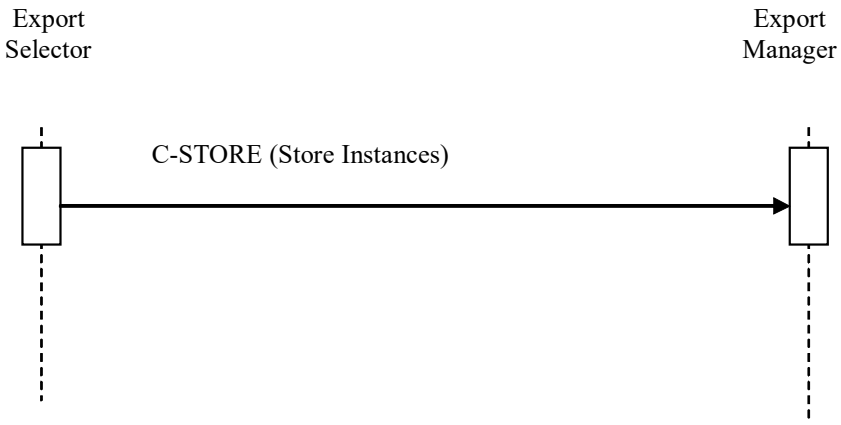

Figure 4.50.4-1: Interaction Diagram

4.50.4.1 Store Instances

4.50.4.1.1 Trigger Events

The Export Selector can transfer instances to the Export Manager sequentially within one or more DICOM associations.

4.50.4.1.2 Message Semantics

The Export Selector uses the DICOM C-STORE message to transfer the instances. The Export Selector is the DICOM Storage SCU and the Export Manager is the DICOM Storage SCP.

4.50.4.1.3 Expected Actions

The Export Manager will queue the received DICOM objects, until ready to process them.

The DICOM Standard defines a number of composite storage SOP classes. The Export Manager shall support at least one composite storage SOP class, such as Images (see Table 4.8-1 for suggestions), Evidence Documents, Structured Reports, Presentation States and Radiotherapy objects.

4.51 Store Export Selection [RAD-51]

4.51.1 Scope

In the Store Export Selection transaction, the Export Selector sends a Key Object Selection document acting as a manifest of a collection of selected composite instances to the Export Manager.

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4.51.2 Actor Roles

Actor: Export Selector

Role: Transmit manifest to Export Manager.

Actor: Export Manager

Role: Accept manifest from Export Selector and queue the manifest and the referenced composite instances for processing (de-identification, pseudonymization and export)

4.51.3 Referenced Standard

DICOM PS3.4 Annex B: Storage Service Class.

DICOM PS3.15 Section E.2: Basic Application Level Confidentiality Profile.

DICOM PS3.3: Information Object Definitions

DICOM PS3.16: Content Mapping Resource

4.51.4 Messages

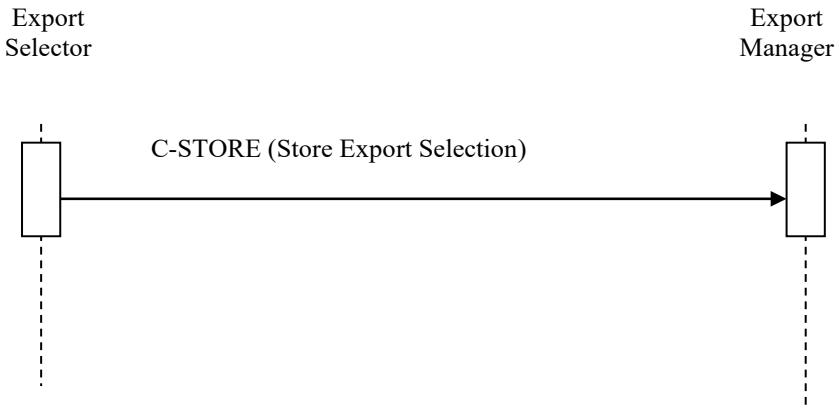

Figure 4.51.4-1: Interaction Diagram

4.51.4.1 Store Export Selection

4.51.4.1.1 Trigger Events

The Export Selector can transfer a manifest to the Export Manager with a DICOM association.

The timing of the transfer is not coupled to the timing of any Store Instances transaction, in that they may occur over the same or different associations, and the manifest may be received before, during or after the instances referred to by the manifest.

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4.51.4.1.2 Message Semantics

The Export Selector uses the DICOM C-STORE message to transfer the manifest. The Export Selector is the DICOM Storage SCU and the Export Manager is the DICOM Storage SCP.

The manifest (Export Selection) is an instance of the Key Object Selection SOP Class constructed according to the template defined in Table 4.51.4-1, which is a specialization of DICOM PS3.16 TID 2010, and is itself non-extensible.

Table 4.51.4-1: Export Selection ("Manifest") Template – Specializes DICOM TID 2010

	NL	Rel with parent	Value Type	Concept Name	VM	Req Type	Cond	Value Set Constraint
1			CONTAINER	EV (TCE001, IHERADTF, "For Teaching File Export") or (TCE002, IHERADTF, "For Clinical Trial Export") or (TCE007, IHERADTF, "For Research Collection Export") or (TCE008, IHERADTF, "For Publication Export")	1	M		Root node
2	>	HAS CONCEPT MOD	CODE	EV (113011, DCM, "Document Title Modifier")	1	U		See Table 4.51.4-2 Delay Reason Values
3	>	HAS CONCEPT MOD	INCLUDE	DTID(1204) Language of Content Item and Descendants	1	U		
4	>	HAS OBS CONTEXT	INCLUDE	DTID (1002) Observer Context	1-n	U		
5	>	CONTAINS	TEXT	EV(113012, DCM, "Key Object Description")	1	U		Disposition
6	>	CONTAINS	IMAGE	Purpose of Reference shall not be present	1-n	MC	At least one of Rows 6 or 7 shall be present.	
7	>	CONTAINS	COMPOSITE	Purpose of Reference shall not be present	1-n	MC	At least one of Rows 6 or7 shall be present.	

The Document Title shall be either (TCE001, IHERADTF, "For Teaching File Export") or (TCE002, IHERADTF, "For Clinical Trial Export") or (TCE007, IHERADTF, "For Research Collection Export") or (TCE008, IHERADTF, "For Publication Export").

The Key Object Description TEXT content item, if present, shall describe the disposition of the selection. The use of this value requires coordination between the Export Selector and the Export Manager that is beyond the scope of this transaction to define.

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- In the case of teaching files, this value could contain the identifier of a user to whom the case is to be routed for authoring, or it could be more generic and reference a role, a department, or a category of teaching file.
- In the case of clinical trials, this value could contain the identifier of clinical trial protocol, and may affect behavior of the Remap Identifiers Option.
- In the case of research collections, this value could contain the identifier of a research collection.

A single Document Title Modifier content item may be present and specify a value that may be one of those listed in Table 4.51.4-2.

Table 4.51.4-2: Delay Reason Values

Coding Scheme Designator	Code Value	Code Meaning
IHERADTF	TCE011	Delay export until final report is available
IHERADTF	TCE012	Delay export until clinical information is available
IHERADTF	TCE013	Delay export until confirmation of diagnosis is available
IHERADTF	TCE014	Delay export until histopathology is available
IHERADTF	TCE015	Delay export until other laboratory results is available
IHERADTF	TCE016	Delay export until patient is discharged
IHERADTF	TCE017	Delay export until patient dies
IHERADTF	TCE018	Delay export until expert review is available

No additional information describing the collection of referenced instances is contained in the manifest. Any such additional content, such as pre-formatted information to be conveyed to the teaching file authoring system, may be conveyed in separate SR documents referenced by the manifest; see Section 4.52 Store Additional Teaching File Information.

The manifest shall not contain references to Additional Teaching File Information alone; hence any SR documents containing Additional Teaching File Information shall be referenced by the original export selection, and may not be added or sent in a separate manifest.

Note that if the manifest does not include the DICOM TID 1003 Person Observer Identifying Attributes within the DICOM TID 1002 Observer Context, then it will not be possible to identify which individual assembled the collection. Accordingly, it may not be possible for the Export Manager and subsequent actors to route the collection to that individual, other than as specified by the disposition encoded in the Key Object Description TEXT content item.

Only instances of a single patient may be referenced by the manifest, but there may be instances of multiple studies.

A common use-case involving multiple studies occurs when the selection references current and prior images. When the selection references more than one study, DICOM requires that multiple

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instances of the Key Object Selection Document be created, one for each Study Instance UID and cross-referenced by the Identical Documents Sequence (see DICOM PS3.3 Section. C.17.6.2.1). IHE therefore requires that there be multiple copies of the same manifest sent in this transaction, one for each study.

4.51.4.1.3 Expected Actions

The Export Manager will queue the manifest until it has received all DICOM instances referenced therein, and is ready to process them.

The instances shall not be processed until the manifest has been received, since it dictates the form of processing required. The Delay for Reason Option may require the processing to be further delayed; see Section 4.51.4.1.5.

Note that in the case of multiple manifests to handle the multiple study case, since the lists of referenced instances therein are identical, the Export Manager need not wait until all copies of the manifest have been received before commencing processing. In the multiple study case, receipt of only a single manifest shall not be considered as an error condition and normal processing shall occur. The Export Manager shall examine the Identical Documents Sequence in each manifest to detect the multiple study case and to prevent the same export from being repeated.

No export shall be performed if instances are received but no referencing manifest is received within a configurable time.

If all the instances in the manifest are not received within a configurable time, the Export Manager shall proceed with an incomplete set and create an updated manifest. If the missing instances are received later, either they shall not be exported or a separate export and manifest shall be exported containing only those instances.

Instances referenced by the manifest may be of a SOP Class not supported by the Export Manager as a Storage SCP and hence will never be received. The SOP Class UIDs are encoded in the manifest. The Export Manager shall proceed with an incomplete set and create an updated manifest.

If the Export Manager is grouped with an Image Manager/Archive and already has all referenced DICOM instances, it may begin processing upon receipt of the manifest.

The Export Manager shall de-identify and pseudonymize all the DICOM instances referenced by the manifest, as defined in Section 4.51.4.1.4, before forwarding them all by initiating Export Instances [RAD-53] transactions.

4.51.4.1.4 De-identification and Pseudonymization

4.51.4.1.4.1 Baseline De-identification and Pseudonymization Requirements

There is considerable variation in what attributes need to be removed to achieve sufficient de-identification and pseudonymization for any particular purpose. See the discussion in RAD TF-2x: Appendix I.1.

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Accordingly, this transaction does not require the removal of all text attribute values, nor the removal of all private attribute values.

Rather, it requires that the implementation provide a mechanism to allow the user to configure those attributes that will be removed or replaced. The transaction requires that at minimum, the implementation support the ability to configure the use of the Basic Application Level Confidentiality Profile in DICOM PS3.15 Section E.2. Further, it shall be configurable to perform no de-identification at all.

When de-identification has been performed, the Export Manager shall add to the DICOM dataset of each instance the Patient Identity Removed (0012,0062) attribute with a value of YES.

In some scenarios, it will be desirable to configure the Export Manager to perform no de-identification at all, such as when all de-identification will be performed in the Teaching File Receiver, or not at all. In such cases, if the Patient Identity Removed (0012,0062) attribute is present in the dataset it shall not be changed; if it is absent it shall not be added.

In some de-identification scenarios, the UIDs need to be replaced. This transaction does not require that UIDs be replaced, but does require that if UIDs are replaced, internal consistency within the exported set of instances be maintained; the implementation shall be configurable to support both. This entails adherence to the following rules:

- The same replacement UID is used for all composite instances of the same entity within the set, e.g., the same Study Instance UID for all instances within the same original study.
- References by UID to other instances or entities within the set are updated, e.g., references to the SOP Instance UIDs of predecessor documents, reference images and source images.
- References by UID to other instances or entities not included within the set are removed or replaced with consistent, well-formed, dummy references.

If the same instances are exported multiple times on different occasions, the identifying attributes and UIDs therein may or may not be replaced with the same values on each occasion. That is, this transaction does not require deterministic behavior for replacement of identifying attributes and UIDs, except as specified for the Remap Identifiers Option. See also the discussion in RAD TF-2x: Appendix I.2.

The actions of the de-identification and pseudonymization must not create invalid IODs. Specifically:

- Mandatory and conditional attributes may not be removed, but rather must be replaced.
- Type 1 attributes must be given a value.
- Type 2 attributes may be encoded zero length, but it is often advisable to encode a value, especially for attributes likely to be used in browsers such as Patient Name, Patient ID, Study ID and Accession Number.

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4.51.4.1.4.2 Manifest Coercion

The manifests received from the Export Selector will be Key Object Selection Documents that references instances of a single patient, but possibly from multiple studies. If multiple studies are referenced there will be multiple copies of the Key Object Selection Document.

The manifest(s) will contain the original identifying information, and hence need to undergo de-identification and pseudonymization prior to export, in accordance with the same requirements as the instances to which it refers.

The Export Manager shall update the UIDs in the references in the manifest(s) to the studies, series and instances, if the UIDs in the referenced instances have been changed.

If the Export Manager has not received all the instances in the set referenced by the manifest(s), and will not transmit them to the Receiver, then they shall be removed from the forwarded manifest(s).

Any Document Title Modifier specifying a Delay for Reason shall be removed.

A manifest shall always be included in the export from the Export Manager to the Receiver.

In the multiple study case, the correct number of manifests shall be exported to the Receiver, regardless of what was received from the Export Selector.

4.51.4.1.4.3 Remap Identifiers Option

The purpose of this option and its requirements are described in RAD TF-1: 17.2.2. The DICOM Clinical Trials attributes are further discussed in RAD TF-2x: Appendix I.3.

Table 4.51.4-3 below lists the attributes that shall be used as keys to select which values to use for remapping of identifiers, and which attributes shall be replaced.

If the same instances are exported multiple times, the attributes in Table 4.51.4-3 shall be remapped to the same values. Other attributes, including UIDs, may or may not be replaced with the same values on each occasion. That is, this option only requires deterministic behavior for the attributes in Table 4.51.4-3.

Table 4.51.4-3 uses the following conventions:

- M – Match means that the attribute is used as the key value to match at the specified level, and hence to select new values for mapping other attributes at that level
- C – Change means that any value shall be replaced by a non-zero value, or the attribute shall be inserted with a value if not present
- D – Deletion means either removal of the attribute if it is Type 3, or replacement with zero length if it is Type 2, or replacement with a dummy value if it is Type 1
- L – Leave means do not change the existing value of the attribute

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Table 4.51.4-3: Remap Identifiers Option Attributes

Attributes Name	Tag	Match	Delete, Change or Leave	Notes
Clinical Trial Protocol Level				
Clinical Trial Protocol ID	(0012,0020)		C	Note 1
Clinical Trial Site Level				
Institution Name	(0012,0020)	M	C	Note 2
Clinical Trial Site ID	(0012,0030)		C	
Clinical Trial Subject Level				
Patient ID	(0010,0020)	M	C	Note 2
Patient Name	(0010,0010)		C	Note 2
Other Patient IDs	(0010,1000)		D	
Patient's Birth Date	(0010,0030)		L or C or D	Note 4
Patient's Age	(0010,1010)		L or C or D	Note 4
Patient's Sex	(0010,0040)		L or C or D	Note 4
Clinical Trial Subject ID	(0012,0040)		C	
Clinical Trial Study Level				
Study Date	(0008,0020)	M	L or C	Notes 3, 4
Study Time	(0008,0030)		L or C	Notes 3, 4
Study Description	(0008,1030)		L or C	Note 4
Clinical Trial Timepoint ID	(0012,0050)		C	
Accession Number	(0008,0050)		D	
Clinical Trial Series Level				
Series Description	(0008,103E)	M	L or C	Note 4
Series Number	(0020,0011)		L or C	Note 4

Note 1: No matching of the Clinical Trial Protocol level based on attributes in the instances is specified, since the clinical trial protocol that is the target of the export will be conveyed in the disposition specified in the manifest.

Note 2: The delete option is not provided for these attributes; replacement is required. This is because these attributes are important for the correct operation of conventional databases and browsers, hence null or dummy values are not acceptable. Typically, for example, the same value inserted in Clinical Trial Subject ID will also be duplicated in Patient ID and Patient Name. Likewise, the same value inserted in Clinical Trial Site ID will also be duplicated in Institution Name.

Note 3: Whether or not the Study Date and Time need to be left or replaced depends on the requirements of the clinical trial; the implementation shall support both.

Note 4: The presence of more than one option means that the application shall be configurable to allow for any of the options.

4.51.4.1.4.4 De-identify Pixel Data Option

The removal of identifying information that is burned into the pixel data of single or multi-frame images is a non-trivial task. With image sources from multiple modalities and multiple vendors it is difficult to predict *a priori* within which pixels such identification is contained. Hence this task

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is difficult to automate and in the majority of instances requires intervention by a human operator acting through a user interface with what is essentially a pixel data editor.

An Export Manager claiming this option shall provide a method of de-identification of the pixel data. The manner in which this is performed is not specified. De-identification is generally considered successful if patient-identifying information can no longer be read or recovered from the pixel data.

Whether or not de-identification of the pixel data of a particular image is required may be difficult to determine, and may require human intervention. This option requires that the Export Manager provide a mechanism for categorizing those images that are at risk, and requiring confirmation by a human operator that the identification has been removed.

If an instance already contains the Burned In Annotation (0028,0301) attribute with a value of NO, then pixel data de-identification is not required. When de-identification of pixel data has been performed, the Export Manager shall add to the DICOM dataset of each instance the Burned In Annotation (0028,0301) attribute with a value of NO.

This option neither requires nor prohibits changing the SOP Instance UIDs; the implementation shall be configurable to support both.

4.51.4.1.4.5 De-identification of Non-Image Instances

There are no specific requirements or named options for the removal of identification information that may be contained within the payload of non-image instances. For example, an SR object that contains a plain text report or an evidence document, or an encapsulated PDF document, could contain identifying information within the payload that is difficult to detect and remove in an automated manner, and operator intervention may be required. It is beyond the scope of this profile to define the mechanisms for the removal of such information. It suffices to say that the subset of DICOM composite storage SOP instances supported by the Export Manager as an SCP should take this factor into consideration.

4.51.4.1.5 Delay for Reason

When the Exporter supports the Delay for Reason Option, and the Document Title Modifier of a manifest specifies a coded reason for delay, and the Exporter supports that coded reason, then processing shall not begin until the reason for the delay has been satisfied, or the delay condition is not satisfied within a configurable time.

4.52 Store Additional Teaching File Information [RAD-52]

4.52.1 Scope

In the Store Additional Teaching File Information transaction, the Export Selector sends an SR document containing additional teaching file information to the Export Manager.

4.52.2 Actor Roles

Actor: Export Selector

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Role: Transmit information to Export Manager.

Actor: Export Manager

Role: Accept information from Export Selector and queue it for de-identification, pseudonymization and export

4.52.3 Referenced Standard

DICOM PS3.4 Annex B: Storage Service Class.

4.52.4 Messages

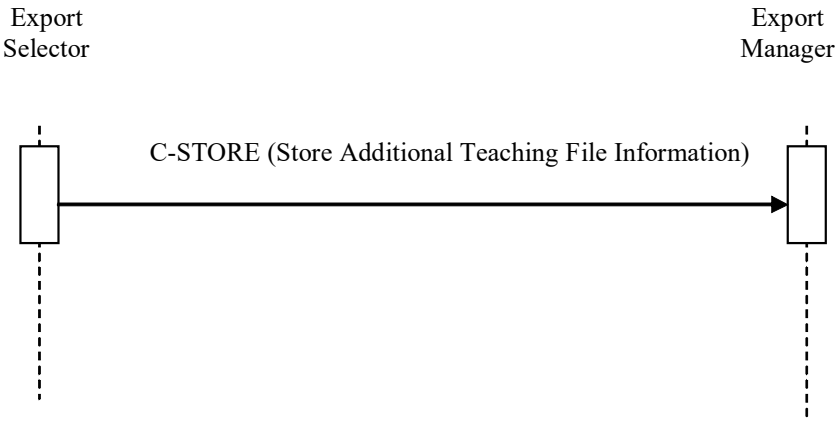

Figure 4.52.4-1: Interaction Diagram

4.52.4.1 Store Additional Teaching File Information

4.52.4.1.1 Trigger Events

The Export Selector can transfer information to the Export Manager sequentially within one or more DICOM associations.

The timing of the transfer is not coupled to the timing of any Store Instances or Store Export Selection transactions, in that they may occur over the same or different associations, and the manifest may be received before, during or after the instances referred to by the manifest.

4.52.4.1.2 Message Semantics

The Export Selector uses the DICOM C-STORE message to transfer the additional information encoded as one or more Enhanced SR SOP Class instances. The Export Selector is the DICOM Storage SCU and the Export Manager is the DICOM Storage SCP.

This information is separate from the manifest summarizing the collection of referenced instances is contained.

More than one instance may be present.

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To be included in the material to be exported, the instances of this transaction must be referenced by the manifest(s) in the Store Export Selection transaction.

The Document Title shall be (TCE006, IHERADTF, “Additional Teaching File Information”).

An example template for an SR describing a typical Radiology Teaching File collection is described in RAD TF-2x: Appendix H.

4.52.4.1.3 Expected Actions

The Export Manager will queue the received DICOM objects, until ready to process them.

4.53 Export Instances [RAD-53]

4.53.1 Scope

In the Export Instances transaction, the Export Manager sends the de-identified and pseudonymized composite instances and a Key Object Selection document acting as a manifest of the collection to a Receiver. The purpose of the manifest is to retain the information that the referenced instances constitute the collection that it is being exported.

4.53.2 Actor Roles

Actor: Export Manager

Role: Transmit de-identified and pseudonymized instances and manifest to Receiver.

Actor: Receiver

Role: Accept instances from the Export Manager

4.53.3 Referenced Standard

DICOM PS3.4 Annex B: Storage Service Class

DICOM PS3.3 Section A.35.4: Key Object Selection Document IOD

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4.53.4 Messages

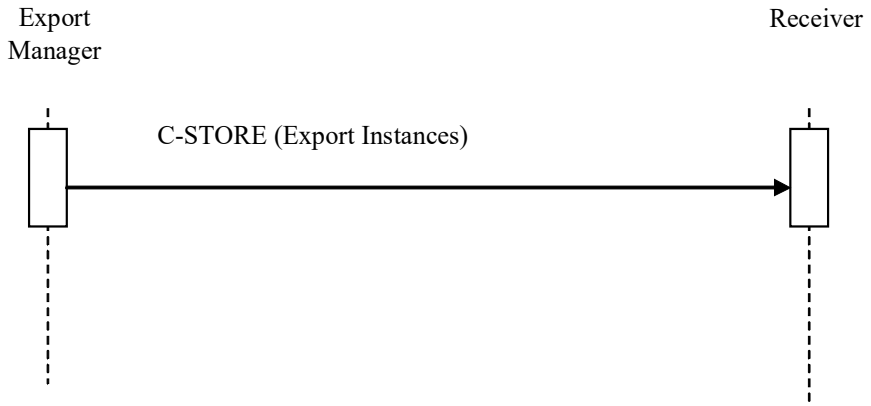

Figure 4.53.4-1: Interaction Diagram

4.53.4.1 Export Instances

4.53.4.1.1 Trigger Events

The Export Manager initiates this transaction when it has de-identified and pseudonymized all the instances referenced within an Export Selection, as well as any instances of Additional Teaching File Information and the manifest.

4.53.4.1.2 Message Semantics

The Export Manager uses the DICOM C-STORE message to transfer the instances and the manifest. The Export Manager is the DICOM Storage SCU and the Receiver is the DICOM Storage SCP.

The Export Manager can transfer the instances and the manifest to the Receiver within one or more DICOM associations.

The timing of the transfer of the manifest and the instances to which it refers is not defined, in that they may occur over the same or different associations, and the manifest may be received before, during or after the instances referred to by the manifest.

The manifest is an instance of the Key Object Selection SOP Class.

4.53.4.1.3 Expected Actions

A receiver shall support the Key Object Selection SOP Class as an SCP.

The Receiver may support any composite storage SOP class, including Images, Evidence Documents, Structured Reports, Presentation States, and Radiotherapy objects.

If the Receiver does not support all the SOP Classes of the instances to be exported, then the transfer will partially or completely fail.

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A Receiver claiming the Additional Teaching File Information Option shall be able to receive Enhanced SR SOP Class instances. No specific semantics are defined for receipt of the Additional Teaching File Information.

Unless grouped with other actors, the further behavior of the Receiver on receiving the instances and manifests is beyond the scope of the transaction to define. Typically:

- In the case of teaching files, such a device might store the received instances whilst awaiting a manifest prior to queuing the instances for authoring by the user.
- In the case of clinical trials, such a device might store the received instances whilst awaiting a manifest prior to queuing for entry into the clinical trial workflow

A Receiver grouped with an Image Manager/Archive shall make the received instances available for use in the normal manner as defined by other Profiles. If the Image Manager/Archive claims the Key Image Note Profile, then the manifests shall be made available as Key Image Notes.

A Receiver grouped with a Portable Media Creator shall store the received instances whilst awaiting a manifest prior to burning the referenced instances and manifests to media, as defined by the requirements in the Portable Data for Imaging Profile.

4.54 Provide and Register Imaging Document Set – DEPRECATED

This transaction has been deprecated and is superseded by the Provide and Register Imaging Document Set – MTOM/XOP [RAD-68] as part of the Cross-Enterprise Document Sharing for Imaging (XDS-I.b) Profile.

4.55 WADO Retrieve [RAD-55]

4.55.1 Scope

The WADO Retrieve transaction enables an Imaging Document Consumer to access DICOM SOP Instances with a web-based service through HTTP/HTTPS protocol.

4.55.2 Actor Roles

Actor: Imaging Document Consumer

Role: Issues an HTTP Get Request to access a DICOM instance.

Actor: Imaging Document Source

Role: Receives an HTTP Get Request for accessing a DICOM instance and generates the HTTP response with the appropriate content.

4.55.3 Referenced Standard

DICOM PS3.18 Section 10.4: Web Services - Retrieve Transaction of the DICOM Studies Service (also known as Web Access to DICOM Persistent Objects (WADO))

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4.55.4 Messages

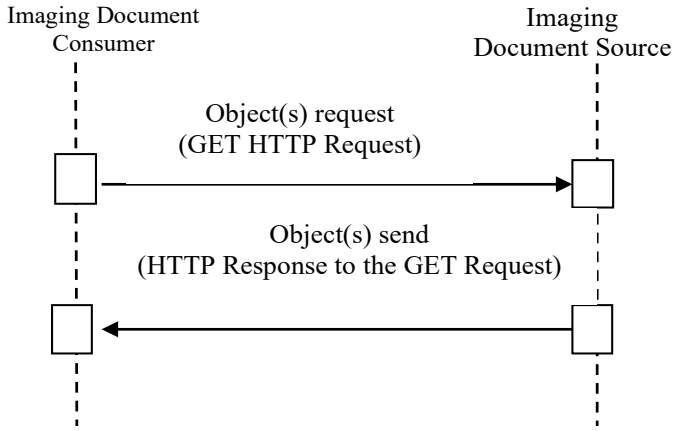

Figure 4.55.4-1: Interaction Diagram

4.55.4.1 WADO Retrieve

The Imaging Document Consumer issues an HTTP Get to request a specific DICOM instance from the Imaging Document Source. The Imaging Document Source receives the request, generates the response with the appropriate content and sends an HTTP Response to the Imaging Document Consumer.

4.55.4.1.1 Trigger Events

The Imaging Document Consumer wishes to retrieve a DICOM instance that is referenced within a DICOM Manifest.

4.55.4.1.2 Message Semantics

The message semantics are defined by in DICOM PS3.18 Section 10.4.

The WADO Retrieve transaction is performed by the Imaging Document Consumer to send a HTTP Request-URI to the web server of the Imaging Document Source. The Imaging Document Consumer generates the HTTP Request-URI to retrieve a DICOM instance. The DICOM instance shall be specified with its Study Instance UID, Series Instance UID, and SOP Instance UID in the HTTP Request-URI. The Imaging Document Consumer must obtain the host information (e.g., web server location, and script language) of the web server to perform this transaction. The Imaging Document Consumer can map the Retrieve AE Title of the SOP Instance to the web server host information based on its local configuration (see RAD TF-2x: Appendix G).

In addition, the Imaging Document Consumer shall support the following fields in the HTTP request:

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Table 4.55-1: WADO HTTP Request Fields

HTTP Field	REQ	Description	Values
Accept	R	This field is used to specify MIME types which are acceptable for the response	At least one of the following values: application/dicom image/jpeg application/text application/html */* Other values may be included as well
Accept-Language	O	This field specifies the language of the object to be retrieved.	Any valid value according to RFC2616

The Imaging Document Source shall list all media types it supports in the Accept field of the HTTP request, and shall use WADO HTTP parameter contentType to request the desired media type of the object to be retrieved in the HTTP response (see Table 4.55-2).

The Imaging Document Source and the Imaging Document Consumer are required to support a number of parameters in the WADO HTTP Request-URI, as described in the following table.

Table 4.55-2: WADO HTTP Request Parameters

Parameter Name	Parameter Description	Requirement		Note
		Imaging Document Source	Imaging Document Consumer	
requestType	Type of the HTTP request performed. It must be "WADO"	R	R	
studyUID	Unique identifier of the study	R	R	
seriesUID	Unique identifier of the series	R	R	
objectUID	Unique identifier of the object	R	R	
contentType	MIME type of the response	R+	R+	IHE-1 IHE-2
charset	Charset of the response	O	O	
anonymize	Anonymize object	O	O	
annotation	Annotation of the object	O	O	IHE-3
rows	Number of pixel rows	O	O	IHE-3
columns	Number of pixel columns	O	O	IHE-3
region	Region of image	O	O	IHE-3
windowCenter	Window center of the image	O	O	IHE-3
windowWidth	Window width of the image	O	O	IHE-3
frameNumber	Frame number of the single frame in a multi-frame image	O	O	IHE-3
imageQuality	Image quality factor	O	O	IHE-3
presentationUID	Unique identifier of the presentation object	O	O	IHE-3

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Parameter Name	Parameter Description	Requirement		Note
		Imaging Document Source	Imaging Document Consumer	
presentationSeriesUID	Unique identifier of the series containing the presentation object	O	O	IHE-3
transferSyntax	Transfer syntax UID used with DICOM image object returned in the response	O	O	IHE-3

IHE-1: The Imaging Document Consumer must use the value "application/dicom" to retrieve a DICOM SOP Instance in the DICOM Part 10 File Format. This allows the Imaging Document Consumer to receive a SOP Instance in the native DICOM format for full data manipulation.

The Imaging Document Consumer can also use the value "application/jpeg" to retrieve an image encoded in JPEG baseline format if it is a single frame DICOM image object or a single frame image encoded in a multi-frame DICOM image object.

The Imaging Document Consumer can also use the values "application/text" or "application/html" to retrieve a DICOM SR object represented in the text or html format.

The Imaging Document Consumer can also use other values for this parameter as specified in DICOM PS3.18, if they are supported by the Imaging Document Source.

This parameter is optional in DICOM PS3.18. Because the default format of the DICOM persistent object returned in the HTTP Get response in the absence of a value in this parameter varies depending on the SOP Class of the retrieved object, this transaction requires that the parameter be supported, to improve interoperability.

IHE-2: This parameter must be compatible to the value(s) that the Imaging Document Consumer placed in the Accept field of the HTTP Request-URI.

IHE-3: The parameter applies only to a DICOM SOP Instance if it is an image object.

4.55.4.1.2.1 Example of WADO Request-URI

The following is an example of HTTP Request-URI for retrieving a persistent DICOM object using WADO:

http://www.hospital/radiology/wado.php?requestType=WADO&studyUID=1.2.250.1.59.40211.12345678.678910&seriesUID=1.2.250.1.59.40211.789001276.14556172.67789&objectUID=1.2.250.1.59.40211.2678810.87991027.899772.2&contentType=application%2Fdicom

This example uses response MIME type application/dicom to request the DICOM SOP Instance returned in the native DICOM Part 10 file format.

4.55.4.1.3 Expected Actions

Upon reception of the WADO HTTP Request, the Imaging Document Source shall parse the request and if there are no errors, shall construct an HTTP Get Response with the requested DICOM instance content and return the response as specified by the DICOM WADO standard, with HTTP response code 200 (OK).

The Imaging Document Source shall return HTTP response code 406 (Not Acceptable), if it cannot serve the requested response MIME type(s) in parameter contentType and/or Accept Field.

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The Imaging Document Source shall return HTTP response code 404 (Not Found) if it cannot locate the requested DICOM SOP Instance or cannot recognize the UID values specified in the received HTTP Request-URI.

The Imaging Document Source shall return HTTP response code 400 (Bad Request) if any required HTTP field or required WADO HTTP parameters are missing in the received HTTP Request-URI, or any other syntactic error is detected in the HTTP Request-URI (e.g., media type in contentType parameter conflicts with media types in Accept field).

The Imaging Document Source in the Imaging Object Change Management Integration Profile shall not return the rejected DICOM SOP Instance(s) referenced by the specific KOS instances with the Document Title valued (113001, DCM, “Rejected for Quality Reasons”), (113037, DCM, “Rejected for Patient Safety Reasons”), (113038, DCM, “Incorrect Modality Worklist Entry) or (113039, DCM, “Data Retention Policy Expired”). The Imaging Document Source shall return HTTP response code 404 (Not Found) if the Imaging Document Consumer requested retrieval of such rejected DICOM SOP Instance(s) referenced in that KOS.

4.55.4.1.4 Audit Trail Trigger Events

IHE specifies a number of events that shall be reportable by means of the Record Audit Event [RAD-20] transaction (ITI TF-2: 3.20) in the ITI Audit Trail and Node Authentication (ATNA) Profile. The Radiology Audit Trial Option further defines a subset of these events, which are particularly applicable to the radiology transactions.

See RAD TF-3: Table 5.1-2 for audit events required for the [RAD-55] transaction.

4.56 Spatial Registrations Stored [RAD-56]

This transaction is currently in the Image Fusion (FUS) Trial Implementation Supplement.

4.57 Blending Presentation States Stored [RAD-57]

This transaction is currently in the Image Fusion (FUS) Trial Implementation Supplement.

4.58 Retrieve Spatial Registrations [RAD-58]

This transaction is currently in the Image Fusion (FUS) Trial Implementation Supplement.

4.59 Import Procedure Step In Progress [RAD-59]

4.59.1 Scope

This transaction includes a message from the Importer to the Performed Procedure Step Manager, which in turn issues the message to the Department System Scheduler/Order Filler, the Image Manager and the Report Manager that the Performed Procedure Step is in progress.

The receiving Performed Procedure Step Manager is grouped with the Image Manager or the Department System Scheduler/Order Filler, and shall support forwarding messages to two other

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destinations besides the actor it is grouped with. It shall start issuing messages to the configured destinations immediately after it accepts the corresponding messages from the Importer.

To allow for proper integration, the following considerations must be taken into account:

The Performed Procedure Step Manager must maintain PPS objects and then store them until corresponding N-CREATE and N-SET messages are transmitted to the actor it is grouped with, and the two other actors. If transmission to a destination fails, the Performed Procedure Step Manager shall try to repeat transmission periodically until it succeeds. The Performed Procedure Step Manager must not use failure of one or more of these transmissions as a reason for rejecting the initial transmission from the Importer.

Because both the Image Manager and the Department System Scheduler/Order Filler incorporate the Performed Procedure Step Manager function, an infinite redistribution of PPS messages is possible. The Image Manager and the Department System Scheduler/Order Filler systems that provide the Performed Procedure Step Manager function shall be configurable to disable this function;

Transfer of the information to the system that the receiving Performed Procedure Step Manager is integrated with is outside the scope of the IHE Radiology Technical Framework (i.e., internal to an implementation).

4.59.2 Actor Roles

Actor: Department System Scheduler/Order Filler.

Role: Receives the PPS information forwarded by the PPS Manager.

Actor: Image Manager.

Role: Receives the PPS information forwarded by the PPS Manager.

Actor: Report Manager.

Role: Receives the PPS information forwarded by the PPS Manager.

Actor: Importer.

Role: Informs the Performed Procedure Step Manager that a particular Performed Procedure Step has started.

Actor: Performed Procedure Step Manager.

Role: Accepts Performed Procedure Step information from an Importer and transmits it to the Department System Scheduler/Order Filler, Image Manager and Report Manager.

4.59.3 Referenced Standards

DICOM PS3.4 Section F.7: Modality Performed Procedure Step SOP Class.

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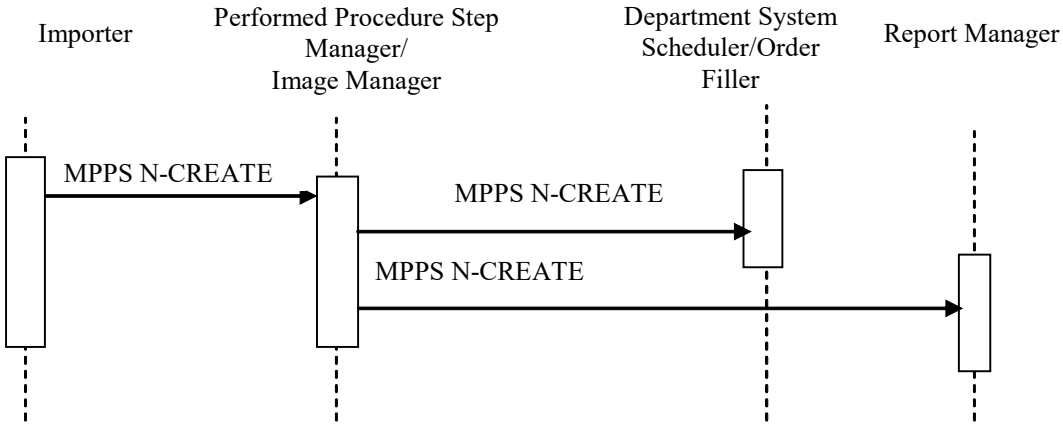
4.59.4 Messages



10135

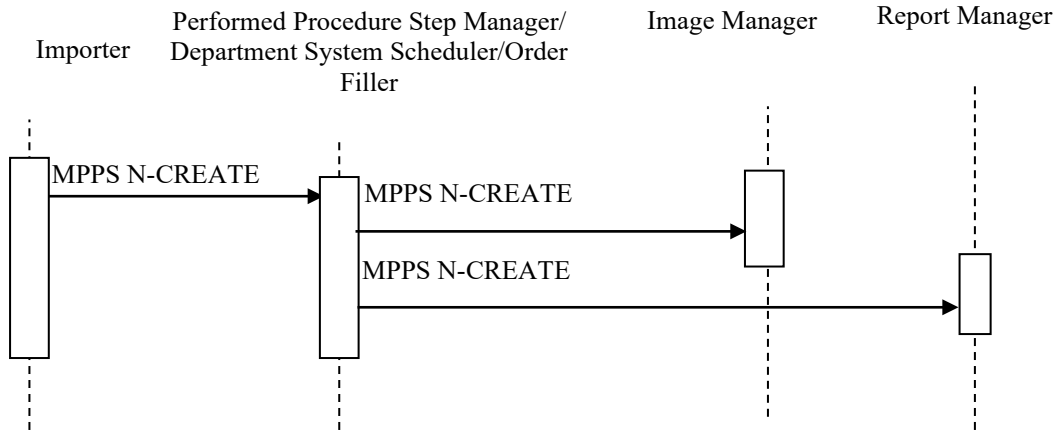


Figure 4.59.4-1: Interaction Diagram

4.59.4.1 Procedure Step In Progress Message

4.59.4.1.1 Trigger Event

10140 The User begins the import procedure step from the Importer.

4.59.4.1.2 Message Semantics

The Importer importing Evidence Objects into the Enterprise uses a Modality Performed Procedure Step SOP Class (N-CREATE Service) to inform the Performed Procedure Step Manager that a specific Procedure Step has been started and is in progress. In turn, the Performed
10145 Procedure Step Manager uses the N-CREATE service to forward the information to the Department System Scheduler/Order Filler, Image Manager and Report Manager. The Performed Procedure Step Manager shall use the same Performed Procedure Step SOP Instance UIDs during this interchange. The following aspects shall be taken into account during implementation of this step:

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4.59.4.1.2.1 Patient/Procedure/Scheduled Procedure Step Information

The Importer shall ensure that the critical Patient information is valid and correct (see RAD TF-2x: Appendix A.5). Additionally, if a Procedure Step has been scheduled for the importation it is also necessary to validate the Procedure information. Due to the fact that the Evidence Objects or Hardcopy to be imported are not native to the Enterprise, the validation process (by the User) of ensuring that the correct Patient is associated with the imported data is critical.

4.59.4.1.2.2 Required Attributes

RAD TF-2x: Appendix A.5 lists a number of attributes that shall be coerced by the Importer to ensure consistency between the information included in the imported SOP instances, the Performed Procedure Step attributes, the Patient Demographic Information and the Scheduled Procedure Step information, if applicable.

4.59.4.1.2.3 Relationship between Scheduled and Performed Procedure Steps and the Imported DICOM Composite Object

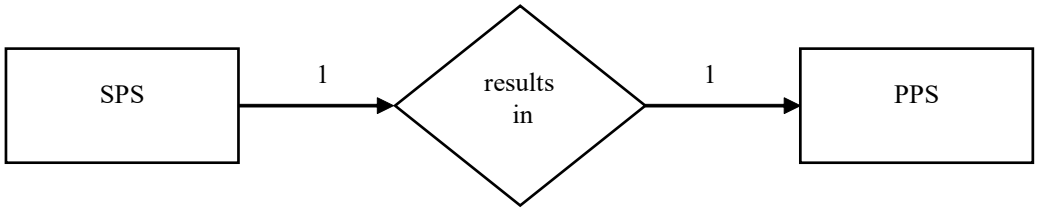
When importing a DICOM Composite Object (e.g., from CD), the DICOM header information must either be preserved to ensure the integrity of the Study or coerced to fit within the local Enterprise. RAD TF-2x: Appendix A.5 defines specific coercion requirement. For example, the Study Instance UID is one of the elements which must be maintained.

The original scheduling and performing of the studies to be imported is outside of the venue of the Enterprise. For this reason, the association of Evidence Objects from a study to be imported may have relationships which are not easily described.

When digitizing Hardcopy and creating a new DICOM Composite Object, some of the original patient and study details may be derived from manual entry, OCR, configuration, etc. or may not be available. RAD TF-2x: Appendix A.5 defines specific requirements.

The relationship between Scheduled and Performed Procedure Step information for an importation is shown in the following 2 cases. Refer to RAD TF-2x: Appendix A.5 for details of filling other attributes (Procedure ID, Accession Number, etc.) in each of these cases. In each case a MPPS N-Create Message is sent to notify the system that the performed procedure import is in progress

4.59.4.1.2.3.1 Scheduled Import Option



In the Scheduled Import Option, the Scheduled Procedure Step information is provided by a Modality Worklist. There exists a 1-to-1 relationship between SPS and PPS. Information about the Scheduled Procedure Step and Requested Procedure shall be copied from the Scheduled

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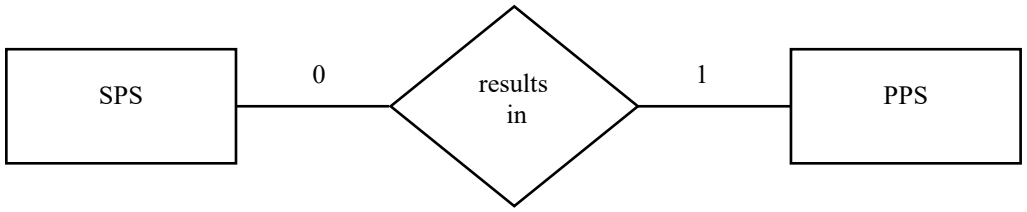
Procedure Step object to the Performed Procedure Step Relationship Module (see RAD TF-2x: Appendix A.5).

Examples: A Procedure Step was performed exactly as scheduled. It could also be that a Procedure Step was not exactly performed as scheduled, but without being rescheduled, e.g., multiple Portable Media exist for a single Patient Study.

4.59.4.1.2.3.2 Unscheduled Import Option



In the Unscheduled Import Option the Importer does not receive Scheduled information. There is a 0-to-1 relationship between SPS and PPS. The Patient information is received through a Patient Demographics Query and no Scheduled Procedure Step or Requested Procedure information is available.

4.59.4.1.2.3.3 Performed Protocol Sequence for Import

The Performed Protocol Code Sequence (0040,0260) shall be present in the Import Modality Performed Procedure Step. It is used to provide information on how the import should be handled (e.g., Interpret the Evidence Objects, Destroy the associated Media).

The Performed Protocol Code Sequence shall always contain one item with the value of (IRWF001, IHETFRAD, “Import”).

In addition, if the Scheduled Protocol Code Sequence (0040,0008) exists, it shall be copied to the Performed Protocol Code Sequence (0040,0260), unless modified by the operator. For both the Scheduled and Unscheduled Import, the Importer may have the ability to add/modify the Import Instructions (see Table 4.5-4).

4.59.4.1.3 Expected Actions

The Department System Scheduler/Order Filler, Report Manager and the Image Manager/Image Archive receive information from the Performed Procedure Step Manager and in the scheduled case, link it with the Requested Procedure and Scheduled Procedure Step.

How the Performed Procedure Step Manager, Department System Scheduler/Order Filler, Report Manager and the Image Manager/Image Archive uses the information contained within the Performed Protocol Sequence is currently undefined.

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4.60 Import Procedure Step Completed/Discontinued [RAD-60]

4.60.1 Scope

This transaction includes a message from the Importer to the Performed Procedure Step Manager, which forwards the messages to the DSS/Order Filler, the Report Manager and the Image Manager that the Performed Procedure Step and importation has been completed. The Image Manager may need the information to co-locate Evidence Objects of the same study. The Modality Procedure Step Completed message does not necessarily mean that the set of Evidence Objects is complete or available for retrieval.

4.60.2 Actor Roles

Actor: Department System Scheduler/Order Filler.

Role: Receives the PPS information forwarded by the PPS Manager.

Actor: Image Manager.

Role: Receives the PPS information forwarded by the PPS Manager.

Actor: Report Manager.

Role: Receives the PPS information forwarded by the PPS Manager.

Actor: Importer.

Role: Informs the Performed Procedure Step Manager that a particular Performed Procedure Step and Importation is completed.

Actor: Performed Procedure Step Manager (PPS Manager)

Role: Accepts Performed Procedure Step information from a Portable Media Importer or Evidence Creator and transmits it to the Department System Scheduler/Order Filler, Image Manager and Report Manager.

4.60.3 Referenced Standards

DICOM PS3.4 Section F.7: Modality Performed Procedure Step SOP Class.

DICOM PS3.16 Section 7: DCMR Context Group Specifications

4.60.4 Messages

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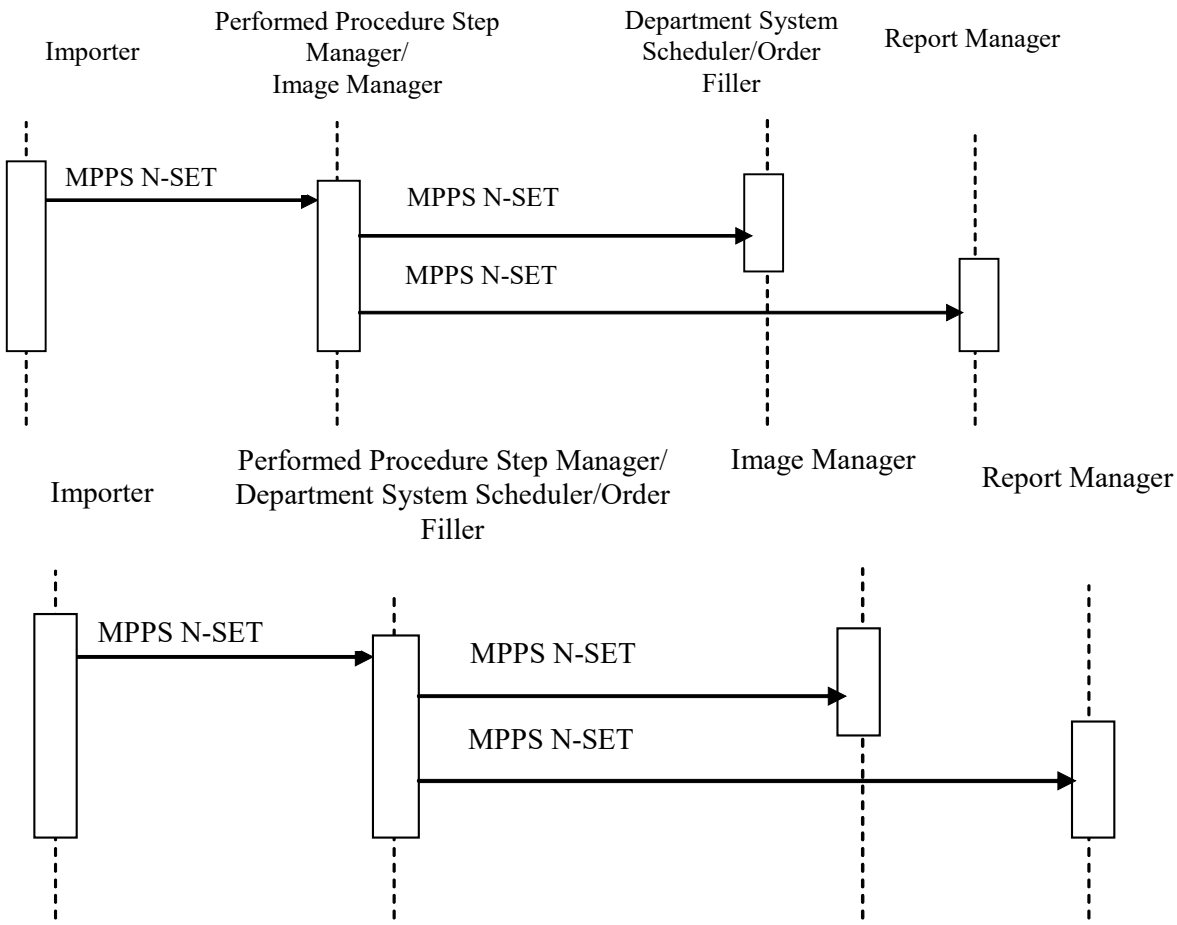

Figure 4.60.4-1: Interaction Diagram

Note: The diagram above shows the sequencing of messages for the Modality Performed Procedure Step SOP Class. Importers will also implement the Storage and Storage Commitment classes. The timing relationship between PPS messages and Storage and Storage Commitment messages is not specified. That is, PPS messages may occur before or after storage requests.

4.60.4.1 Procedure Step Completed/Discontinued

4.60.4.1.1 Trigger Event

User completes procedure step on the Importer.

4.60.4.1.2 Message Semantics

The Importer shall send Modality Performed Procedure Step SOP Class (N-SET service) to inform the Performed Procedure Step Manager that a specific Performed Procedure Step has been completed or discontinued.

The final N-SET has either the MPPS status of "COMPLETED" or "DISCONTINUED". The Performed Procedure Step Manager forwards N-SET messages to the Department System Scheduler/Order Filler, Image Manager and Report Manager.

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When an N-SET is issued with a "DISCONTINUED" status, one or more Series of Instances may be referenced, if Evidence Objects were created and sent.

Note: DICOM specifies that when attributes are allowed to be set by an N-SET, the value provided by the last N-SET overrides any value set by an earlier N-CREATE or N-SET.

4.60.4.1.2.1 Retrieve AE Title

According to the DICOM Standard, the Importer has the ability to include the Retrieve AE Title attribute (0008,0054) in the Performed Series Sequence (0040,0340). This is an AE Title where the referenced SOP instances for the series may be retrieved. This Retrieve AE Title will often be zero length or be of short-term validity, due to the following situations:

- If an Importer supports a Retrieve SOP Class in an SCP Role, the Importer's Retrieve AE Title may be included; however, the Importer does not guarantee long-term availability.
- A Retrieve AE Title of the Image Manager can be configured on the Importer. Otherwise, this field shall be sent zero length. Importer implementers shall not assume that the destination AE Title used for the Storage SCP or Storage Commitment SCP is the same as that for Image Retrieval.
- An Importer may receive the Retrieve AE Title in a Storage Commitment Message (N-EVENT REPORT). However, this information may be received well after the MPPS N-SET (Complete) was performed.

4.60.4.1.2.2 Import PPS Exception Management

When the Modality Procedure Step is sent with the Status DISCONTINUED, the Procedure Step Discontinuation Reason Code Sequence (0040,0281) shall be sent with values defined in DICOM PS3.16 CID 9300 or Table 4.60-1 (additional codes that are in the process of being added by DICOM).

Table 4.60-1: Context ID 9300 – Procedure Discontinuation Reasons Excerpt Most Restrictive Use: Defined

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
...		
DCM	110521	Objects incorrectly formatted
DCM	110522	Object Types not supported
DCM	110523	Object Set incomplete
DCM	110524	Media Failure

The Reason Code when communicated to the DSS/Order Filler and Image Manager/Image Archive may imply canceling an order. It may also facilitate more accurate charge posting.

The Reason Code: "Incorrect Worklist Entry Selected" is used by the Importer to convey that the wrong Patient Demographics and/or Scheduled Procedure Step has been selected (incorrect patient or incorrect Requested procedure/order for the same patient). In this case some or all of

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the incorrectly imported Evidence Objects (for example the ones assigned to the wrong patient) may already have been stored to the Image Manager (see Section 4.60.4.1.3.1).

Importer implementers are left free to decide how to correct the resultant evidence objects. The Importer shall include within the MPPS the list of imported objects that are or will be included in the Import Stored Transaction(s).

Note: When a PPS DISCONTINUED is sent with the reason code "incorrect worklist entry selected", evidence objects referenced in this PPS DISCONTINUED are Evidence Objects that may have been sent to the Image Manager/Archive. The IHE Radiology Technical Framework does not specify whether or not the Importer needs to perform a Storage Commitment for these instances.

The Reason Codes "Equipment Failure", Objects incorrectly formatted", "Object Types not Supported", "Object Set incomplete" and "Media Failure" will be used to indicate that the expected Evidence Objects have been imported.

4.60.4.1.2.3 Billing and Material Management Option

The message semantics are defined in the DICOM Service Class Section of the DICOM Modality Performed Procedure Step SOP Class. It is the responsibility of the Importer to ensure that the patient and procedure information is sent to the Department System Scheduler/Order Filler.

The Attributes defined in Table 4.60-2 provide a means to transmit material management codes from the importer to the DSS/Order Filler that uses them for calculation of charges to be posted to the Charge Processor.

An Importer that supports the Billing and Material Management Option shall be able to provide content within the Billing Procedure Step Sequence and the Billing Supplies and Devices Sequence. If the Billing Procedure Step is used, the Import Billing Code Table shall be configured on the Importer. This table shall be synchronized with the Department System Scheduler/Order Filler. The codes provided by the Importer might not be the same as the code the Department System Scheduler/Order Filler is required to use when posting Charges to the Charge Processor.

The Billing Item Sequence provides the mechanism to track the number of media imported. See Table 4.60.3 for the list of Coded Values that may be specified in the Billing Item sequence when there are charges associated with importing items such as a CD or digitizing a Radiological Film. Multiple codes may be present.

Table 4.60-2: Billing and Material Management Code Module Attributes Excerpt

Attribute name	Tag	Attribute Description
Billing Procedure Step Sequence	(0040,0320)	Contains billing codes for the Procedure Type performed within the Procedure Step. The sequence may have zero or more Items. It may be zero-length if the Billing Supplies and Devices Sequence is populated.
> Code Value	(0008,0100)	
> Coding Scheme Designator	(0008,0102)	

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Attribute name	Tag	Attribute Description
> Code Meaning	(0008,0104)	
…		
Billing Supplies and Devices Sequence	(0040,0324)	Contains billing codes for chemicals, supplies and devices for billing used in the Performed Procedure Step. The sequence may have one or more Items.
>Billing Item Sequence	(0040,0296)	Codes values of chemicals, supplies or devices required for billing. The sequence may have zero or one Items.
>> Code Value	(0008,0100)	
>> Coding Scheme Designator	(0008,0102)	
>> Code Meaning	(0008,0104)	
>Quantity Sequence	(0040,0293)	Sequence containing the quantity of used chemicals or devices. The sequence may have zero or one Items.
>>Quantity	(0040,0294)	Numerical quantity value. Specifies the number of media imported or digitized.
…		

Table 4.60-3: Context ID 7008 – Import Device Media

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	110020	Sheet Film Scanned
DCM	110021	Cine Film Scanned
DCM	110022	Video Tape Scanned
DCM	110023	Page Digitized
DCM	110024	CD Imported
DCM	110025	DVD Imported
DCM	110026	MOD Imported
DCM	110027	Studies Imported
DCM	110028	Instances Imported

4.60.4.1.3 Expected Actions

The Image Manager, Report Manager and Department System Scheduler/Order Filler receive information about the Performed Procedure Step being complete or discontinued. The Image Manager, Report Manager and Department System Scheduler are not required to act on intermediate N-SET messages with the MPPS Status “IN PROGRESS”.

In the case of the Scheduled Import, the Requested Procedure may be considered complete if all Performed Procedure Steps related to all Scheduled Procedure Steps have been completed or properly discontinued.

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4.60.4.1.3.1 Import PPS Exception Management

When an import exception occurs, the DSS/Order Filler or Image Manager/Archive shall use the reason codes in the final N-SET sent with the status of DISCONTINUED.

When the Modality Procedure Step is received with the Status DISCONTINUED, the receiver shall interpret the Performed Procedure Step Discontinuation Reason Code Sequence (0040,0281) values as defined in DICOM (see Section 4.60.4.1.2.2). When received by the Department System Scheduler/Order Filler and the Image Manager/Archive, the Reason Code may indicate the necessity for modification or canceling of an order. With the Reason Code: "Incorrect Worklist Entry Selected", the Importer conveys that the wrong SPS or Patient has been selected (e.g., incorrect patient or incorrect Requested procedure/order for the same patient). In this case, the Image Manager and Department System Scheduler shall take the appropriate action to ensure that already received incorrect instances (i.e., SOP Instances referenced by this Discontinued PPS) are not mistakenly used. If the images, presentation states, or key image notes are not actually deleted, the Image Manager shall:

- not return SOP Instance UIDs for the images in query responses,
- not return such images in Patient, Study, Series, or Instance level retrievals,

On the DSS and Image Manager, the Order/Requested Procedure status shall be corrected to indicate that the discontinued PPS (with wrong worklist entry selected) is not valid. Therefore, the Order Filler/Department System Scheduler shall not query for those instances with an Image Availability Notification [RAD-49] transaction.

When the Modality Procedure Step is received with the Status DISCONTINUED, it shall include a Reason Code from the enumerated list (see Table 4.60-1). The Reason Code indicates that all of the Evidence Objects could not be imported. Typically, this will be because some of the DICOM Composite Objects are not supported by the local Enterprise. How the local Enterprise deals with this situation is up to local policies and is out of scope of the Technical Framework.

4.60.4.1.3.2 Billing and Material Management Information Option

When Billing and Material Management information is provided in the MPPS N-SET, the DSS/Order Filler shall use the billing codes and/or material usage information provided in the final N-SET for calculation of charges that it will eventually post to the Charge Processor. It is recommended that DSS/Order Filler verifies the consistency of provided billing codes with Requested Procedure Code and Performed Procedure Step Protocol codes supplied in the same N-SET.

4.61 Imported Objects Stored [RAD-61]

4.61.1 Scope

In the Imported Objects Stored transaction, the Importer sends the Evidence Objects to the Image Archive. The reconciled information provided from the Modality Worklist [RAD-5] transaction

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or the Patient Demographics Query [ITI-21] transaction (see ITI TF-2: 3.21) shall be included in the headers of the generated images.

4.61.2 Actor Roles

Actor: Image Archive

Role: Accept and store DICOM Composite Objects from the Portable Media Importer.

Actor: Importer

Role: Transmit imported DICOM object data to Image Archive

4.61.3 Referenced Standards

DICOM PS3.4 Section B.4.1: Storage Service Class, Conformance as an SCP

DICOM PS3.3 Section C.12.1: SOP Common Module

4.61.4 Messages

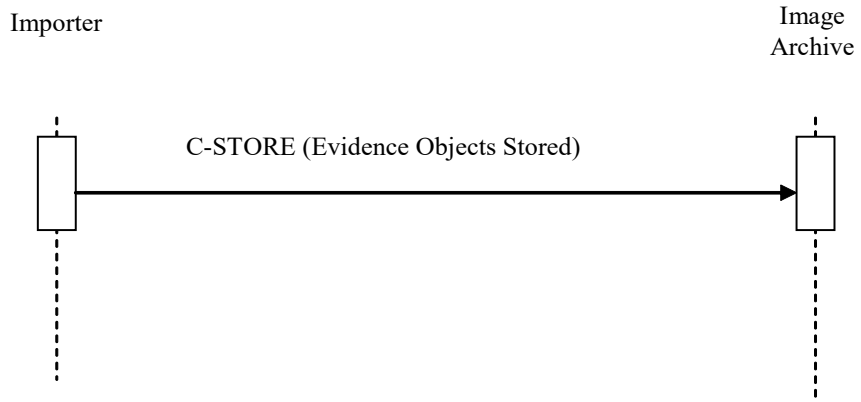

Figure 4.61.4-1: Interaction Diagram

4.61.4.1 Evidence Objects Stored

4.61.4.1.1 Trigger Events

The Importer can transfer Evidence objects to the Image Archive sequentially within one or more DICOM associations, as the Evidence objects become available or collectively.

4.61.4.1.1.1 UIDs

Valid DICOM UIDs are universally unique, so there should be no risk of collision with local UIDs. When a valid set of DICOM UIDs is present, the importer shall use this set and not change them. If the importer detects incorrect UIDs or an inconsistent set of UIDs, then it may correct or re-generate UIDs. The UIDs are used as references between objects, and if they are altered, the Importer shall maintain referential integrity. Additional details about when it is appropriate for

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an Importer to trigger the creation of a new Study/Series/Image Instance are described in Section 4.8.4.1.1.1 “Study UIDs and Series UIDs”.

4.61.4.1.2 Message Semantics

The Importer uses the DICOM C-STORE message to transfer the DICOM Composite Objects. The Importer is the DICOM Storage SCU and the Image Archive is the DICOM Storage SCP.

If the import was scheduled, the User validates the available information for the patient and the Scheduled Procedure Step/Requested Procedure and coerces the Patient/Order Information as required (see Section RAD TF-2x: Appendix A.5).

If the import was not scheduled, the User validates the available information for the patient and coerces the Patient Information as required (see Section RAD TF-2x: Appendix A.5).

It is a requirement that certain information be recorded in the image header. The details of the mapping to DICOM instances are specified in RAD TF-2x: Appendix A.5.

Per the DICOM Standard, the Importer shall create a new series for its created images (e.g., Digitization of Films) and not extend series containing source images.

4.61.4.1.2.1 Original Attributes Sequence

When coercing (i.e., replacing or deleting attributes) from the original Evidence Objects, the Importer shall create or add to the “Original Attributes Sequence” (see Table 4.61.4.1.2-1) at the top level and store the original values of those altered DICOM elements underneath it as defined in RAD TF-2x: Appendix A.5.

The Importer shall use the “Original Attribute Sequence” to preserve information about the original non-digitized data (e.g., Originating Institution, Time of the import, specific attributes from the originating Institution). The mechanism and values which are preserved is out of scope for the Technical Framework.

Table 4.61.4.1.2-1: Original Attributes Sequence

Attribute Name	Tag	Type	Attribute Description
…			
Original Attributes Sequence (Note 1,2)	(0400,0561)	R+	Sequence of Items containing all attributes that are specified by the User from the Original dataset. One or more Items may be permitted in this sequence.
>Source of Previous Values	(0400,0564)	R+	Identification of the Enterprise which originated the Films or Documents.
>Attribute Modification Datetime	(0400,0562)	R	Date and Time of the hardcopy scan
>Modifying System	(0400,0563)	R	Identification of the local Enterprise

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Attribute Name	Tag	Type	Attribute Description
>Reason for the Attribute Modification	(0400,0565)	R	Reason for the attribute modification. Defined terms are: COERCE = Replace values of attributes such as Patient Name, ID, Accession Number, for example, during import of media from an external institution, or reconciliation against a master patient index. CORRECT = Replace incorrect values, such as Patient Name or ID, for example, when incorrect worklist item was chosen or operator input error.
>Modified Attribute Sequence	(0400,0550)	R	Sequence containing a single item that contains all the Attributes that supplied by the User from the Original Films or Documents.
>>Any Attribute from the main data set that was modified			

Note 1: A new original attribute sequence is added every time the DICOM Objects are imported.

Note 2: For digitized hardcopy the "old values" would be information the operator manually enters. It is expected that there would be only one sequence in this case.

4.61.4.1.2.2 Contributing Equipment Sequence

In order to preserve the fact that these Evidence Objects have been imported into the Enterprise, the Contributing Equipment Sequence shall be used (see Table 4.61.4.1.2-2). This will allow the local Institution to make decisions based upon the fact that a set of Evidence Objects has been imported (e.g., Schedule an over-read based upon an import, delete the imported Evidence Objects after a prescribed amount of time). The behavior of how Imported Evidence Objects are used and maintained is out of scope of the IHE Technical Framework.

Table 4.61.4.1.2-2: Contributing Equipment Sequence

Attribute Name	Tag	Type	Attribute Description
Contributing Equipment Sequence	(0018,A001)	R+	See Notes 1 and 2
>Purpose of Reference Code Sequence	(0040,A170)	R	See Table 4.61.4.1.2-3
>>Include 'Code Sequence Macro' Table 8.8-1			Defined CID 7005
>Manufacturer	(0008,0070)	R	
>Institution Name	(0008,0080)	R+	
>Station Name	(0008,1010)	R+	
>Contribution DateTime	(0018,A002)	R+	

Note 1: For imported objects, a new item shall be added to the Contributing Equipment Sequence every time a DICOM Object is imported. Each item in the Contributing Equipment Sequence describes a particular piece of importing equipment. The Equipment Module attributes describe the original creator of the instances.

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Note 2: For digitized hardcopy, the Contributing Equipment Sequence shall contain a single item describing the original acquisition equipment. Since the digitizer is the equipment creating the original DICOM instance, the Equipment Module attributes describe the hardcopy digitizer.

The following table should be used to provide describe the equipment that has done the import. This information may be used by an Institution at a later time to take actions specific to data imported into the Enterprise.

Table 4.61.4.1.2-3: Context ID 7005 – Contributing Equipment Most Restrictive Use: Defined

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	MEDIM	Portable Media Importer Equipment
DCM	FILMD	Film Digitizer Equipment
DCM	DOCD	Document Digitizer Equipment
DCM	VIDD	Video Tape Digitizer Equipment

4.61.4.1.3 Expected Actions

The Image Archive will store the received DICOM objects.

The DICOM Images, Evidence Documents and Diagnostic Reports shall be stored such that they can be later retrieved (see [RAD-16], [RAD-17], [RAD-27] and [RAD-43]) in a fashion meeting the requirements defined for a DICOM Level 2 Storage SCP (refer to DICOM PS3.4 Section B.4.1).

4.61.4.1.3.1 DICOM Storage SOP Classes

The DICOM Standard defines a number of image specific storage SOP classes, as well as other DICOM SOP Classes for DICOM SR, Encapsulated PDFs, etc. All standard attributes and private elements shall be stored.

It is expected that the product's DICOM Conformance Statement will state which DICOM Storage SOP Classes it claims to support. Non-supported SOP Classes shall be rejected by the Image Manager/ Image Archive in the C-Store association. How the Institution deals with situations where DICOM Objects from the Importer cannot be stored is out of scope of the Technical Framework.

4.62 Store Dose Information [RAD-62]

4.62.1 Scope

This section describes DICOM Storage requests of Structured Report objects containing Dose objects which detail irradiation events. An Acquisition Modality sends Dose objects to an Image

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Manager/Archive for storage so they can be later used for monitoring or analysis of patient radiation exposure.

4.62.2 Actor Roles

Actor: Acquisition Modality

Role: Generate Dose objects describing irradiation events performed by the Acquisition Modality and store them to one or more receiving actors.

Actor: Image Manager/Archive

Role: Accept and Store Dose objects received from the Acquisition Modality.

Actor: Dose Information Consumer

Role: Accept and process Dose objects received from the Acquisition Modality.

Actor: Dose Information Reporter

Role: Accept and process Dose objects received from the Acquisition Modality.

4.62.3 Referenced Standard

DICOM PS3.3 Section A.35.8: X-Ray Radiation Dose SR IOD

DICOM PS3.4 Annex B: Storage Service Class

DICOM PS3.4 Section B.5.1.5: Structured Reporting Storage SOP Classes

DICOM PS3.16: X-Ray Radiation Dose SR IOD Templates

DICOM PS3.16: CT Radiation Dose SR IOD Templates

DICOM PS3.17 Annex AA: Radiation Dose Reporting Use Cases

4.62.4 Messages

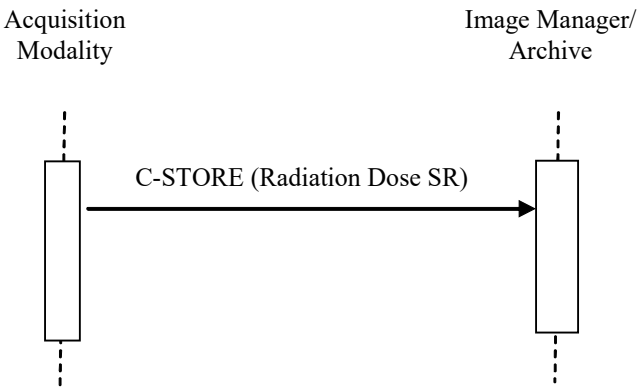

Figure 4.62.4-1: Interaction Diagram

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Note: In the above diagram, the Dose Information Consumer and the Dose Information Reporter may also receive the C-STORE message.

4.62.4.1 Store Dose Information

The Acquisition Modality shall implement the X-ray Radiation Dose SR Storage SOP Class in the role of SCU. The Image Manager/Archive, Dose Information Reporter and Dose Information Consumer shall implement the Dose Storage SOP Class in the role of SCP.

Table 4.62-1: Dose Storage SOP Classes

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.88.67	X-Ray Radiation Dose SR

4.62.4.1.1 Trigger Events

An irradiation event is a single continuous exposure of radiation. For a more precise definition including details relating to pulsed acquisition, dose modulation, dual source systems, etc. refer to DICOM PS3.16.

An Acquisition Modality shall record the relevant details for each irradiation event. These details will be included in Dose objects as described below.

Upon completion or discontinuation of a procedure step where irradiation events occurred, the Acquisition Modality shall compose an appropriate Dose Object containing all the irradiation events for the procedure step and send the Dose object to the configured destinations.

Note: The Dose Object is a DICOM Instance created in the context of the procedure step, and thus is expected to appear in the list of instances in the corresponding MPPS.

In addition to composing Dose objects upon completion or discontinuation of a procedure step, the Acquisition Modality may also compose and send a Dose object upon completion of an irradiation event. If such behavior is supported, the actor shall provide a configuration method to disable it. Such objects could enable applications like dose mapping by a workstation during a procedure. The irradiation events will duplicate events reported in the Dose object for the procedure step, but this can be detected by receiving systems since the same irradiation event UID will appear in both Dose objects.

In addition to composing Dose objects upon completion or discontinuation of a procedure step, the Acquisition Modality may also compose and send a Dose Object summarizing an entire study or series. Such objects might be preferred by systems wanting a summary of several procedure steps. If such behavior is supported, the actor shall provide a configuration method to disable it. The irradiation events will duplicate events reported in the Dose object for the procedure step, but this can be detected by receiving systems since the same irradiation event UID will appear in both Dose objects. If the Acquisition Modality does compose such additional Dose objects, it is appropriate to record the prior reports in the Predecessor Documents Sequence (0040,A360).

The Acquisition Modality shall clearly document in its DICOM Conformance Statement its capabilities for grouping irradiation events into Dose objects.

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4.62.4.1.1.1 Digitization

In the case of a system digitizing a film produced locally for which a Dose object has not been generated, it would be appropriate to create and store a Dose object along with the digital images. The digitizing system might create the report based on manual entry. An adjacent system might create the report based on information in the generated images and/or the MPPS from the film-based modality.

Digitizing films for external priors shall be handled differently. The location where the prior was originally created is responsible for recording the original dose. The digitizing system shall be configurable/controllable to digitize external films and not produce a Dose object.

4.62.4.1.2 Message Semantics

The Acquisition Modality shall use the DICOM C-STORE message to send Dose objects encoded as DICOM SR objects. These objects serve as a record of irradiation performed by the device.

The Acquisition Modality shall be capable of sending the Dose object to multiple destinations. The primary storage destination is generally an Image Manager/Archive; however, Dose Information Reporters or Dose Information Consumers may also appear as configured destinations when they need to receive timely Dose objects without having to repeatedly poll the Image Manager/Archive.

The Acquisition Modality is responsible for delivery of Dose objects to the destination in spite of intermittent connections (e.g., due to mobile modalities, network trouble, or the destination being down).

The contents of the X-Ray Radiation Dose SR objects are generally based on Baseline Template TID 10001 “Projection X-ray Radiation Dose” or Baseline Template TID 10011 “CT Radiation Dose”, but it should be noted that those templates are extensible, and the use of additional templates is not prohibited.

> Note: DICOM has extended these templates (and the templates they contain) several times since they were originally introduced and further enhancements are possible. Implementers are reminded that they are responsible for monitoring such changes and keeping their implementations current.

Acquisition Modality Actors which report on irradiation events for Modalities of type CT shall be capable of producing an SR compliant with TID 10011.

Acquisition Modality Actors which report on irradiation events for Modalities of type XR, XA, RF, MG, CR, or DX shall be capable of producing an SR compliant with TID 10001.

The Irradiation Event UID in the template allows receiving systems to recognize duplicate events. For example, the same dose event might appear in both an SR summarizing a procedure and an SR summarizing the whole study.

The following attributes are Type 2 and Type 3. Although not required, Acquisition Modalities which do not fill them in will make their Dose objects more difficult to process and analyze. If present with a value in the Dose object, these attributes shall be populated as described in Table 4.62-2.

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Table 4.62-2: Dose Context Attributes

Attribute Name	Tag	Requirement
Series Description	(0008,103E)	Shall have a value in the appropriate language for local use that means the equivalent of "Radiation Dose Information", or similar.
Referenced Performed Procedure Step Sequence	(0008,1111)	Shall list the SOP Class UID and Instance UID of the image acquisition PPS. Typically, only a single PPS is associated with a Dose object. Since DICOM only permits a single value in this sequence, in the case where a Dose object summarizes several PPS (e.g., of a whole multi-step study), this attribute shall be left empty.
Performed Procedure Code Sequence	(0040,A372)	Shall contain the codes for the acquisition procedures performed by the modality (i.e., not a code for "Create Dose Report"). Creation of the Dose object is to be considered part of the imaging procedure, not a separate procedure in itself.
Requested Procedure Description	(0032,1060)	Shall be copied from the relevant acquisition SPS (Modality Worklist entry)
Admitting Diagnoses Description	(0008,1080)	Shall be copied from the relevant acquisition SPS (Modality Worklist entry). This can facilitate checking compliance to indication-based dose policies.
Admitting Diagnoses Code Sequence	(0008,1084)	
Reason for the Requested Procedure	(0040,1002)	
Reason for Requested Procedure Code Sequence	(0040,100A)	
Patient's Weight	(0010,1030)	Shall be copied from the relevant acquisition SPS (Modality Worklist entry), if present, else obtained by operator entry and may be approximate. This may facilitate future dose estimation and analysis.
Patient's Size	(0010,1020)	I.e., height. Shall be copied from the relevant acquisition SPS (Modality Worklist entry), if present, else obtained by operator entry, and may be approximate. This may facilitate future dose estimation and analysis.
Patient's Age	(0010,1010)	Shall be filled from any valid source (e.g., computed from Patient's Birthdate and Study Date, copied from the relevant acquisition SPS (Modality Worklist entry), if present, else obtained by operator entry) and may be approximate. This may facilitate future dose estimation and analysis.
Patient's Sex	(0010,0040)	Shall be copied from the relevant acquisition SPS (Modality Worklist entry), if present, else obtained by operator entry.

In the event of a Group Case acquisition (see Section 4.6.4.1.2.3) a Dose object shall be generated, reflecting the single acquisition procedure step performed, and should take its attribute values from that image set. The procedure type would reflect the combined acquisition. Allocating subsets of the dose to the pseudo-sub-procedures of the group is not required. If the modality chooses to replicate the dose object under each component accession of the group case it shall set the Identical Documents Sequence appropriately. In either case the DIR can recognize the duplication based on the Irradiation Event UIDs.

If the Dose object is not being created by the equipment which actually administered the radiation, the equipment creating the report shall reference itself in the Contributing Equipment

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Sequence (0018,A001) and reference the irradiating equipment in the four Type 1 attributes in the Enhanced General Equipment Module (DICOM PS3.3 Section C.7.5.2).

The Acquisition Modality shall be capable of creating Dose objects for patient scans and for phantom/calibration scans.

4.62.4.1.2.1 Cross-referencing Dose Objects and Image Objects

See Section 4.8.4.1.2.4, which requires Acquisition Modalities to record the Irradiation Event UID (0008,3010) in related image instances.

The Projection X-Ray Dose Template (TID 10003) mandates that UID references be recorded in the Acquired Image element for image instances created from the irradiation event. The CT Dose Template does not include references to images since the instances sent to the Image Manager/Archive are typically generated some time after the irradiation is complete.

Note that it is possible for a study to have dose objects but no image objects. For example, due to poor quality images not being stored, or fluoroscopy images not being captured.

4.62.4.1.3 Expected Actions

The Image Manager/Archive shall support Level 2 (Full) storage, which means all DICOM Type 1, 2 and 3 attributes (public and private) are stored. It shall accept the Dose objects, store them, and make them available for query/retrieval.

The Dose Information Reporter and Dose Information Consumer shall accept the Dose objects. The Dose objects shall be processed according to the features, configuration, and business logic of the Dose Information Reporter or Dose Information Consumer product. Possibilities include display, processing, analysis, printing, export, etc. At a minimum, the Dose Information Reporter shall provide the capability to the review and do summary analysis of the dose data.

Dose Information Reporter Actors shall be capable of processing both TID 10001 and TID 10011.

When multiple Dose objects are received, the same Irradiation Event (as identified by its Irradiation Event UID) may be referenced in multiple Dose objects. It is the responsibility of the recipient to recognize such duplicate Irradiation Events when processing or generating reports based on the retrieved data.

4.63 Submit Dose Information [RAD-63]

4.63.1 Scope

This section describes DICOM STOW-RS transfers of DICOM Structured Report objects that detail irradiation events. A Dose Information Reporter sends Dose objects to a Dose Registry for subsequent compilation, monitoring and analysis of population and individual radiation exposure and current practices. Dose objects will often be de-identified prior to submission for the population use case.

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4.63.2 Actor Roles

Actor: Dose Information Reporter

Role: Submit (de-identified) Dose objects describing irradiation events performed by Acquisition Modalities or Radiopharmaceutical Activity Suppliers in its facility.

Actor: Dose Registry

Role: Accept and store Dose objects received from Dose Information Reporters.

4.63.3 Referenced Standard

DICOM PS3.3 Section A.35.8: X-Ray Radiation Dose SR IOD

DICOM PS3.3: Section A.35.14 Radiopharmaceutical Dose SR IOD

DICOM PS3.10: Media Storage and File Format

DICOM PS3.16: X-Ray Radiation Dose SR IOD Templates

DICOM PS3.16: CT Radiation Dose SR IOD Templates

DICOM PS3.16: Radiopharmaceutical Dose SR IOD Templates

DICOM PS3.17: Annex OOO: Radiopharmaceutical Radiation Dose Structured Report (Informative)

DICOM PS3.18 Section 10.5: Web Services - Store Transaction of the DICOM Studies Service (also known as STOW-RS Request/Response)

4.63.4 Messages

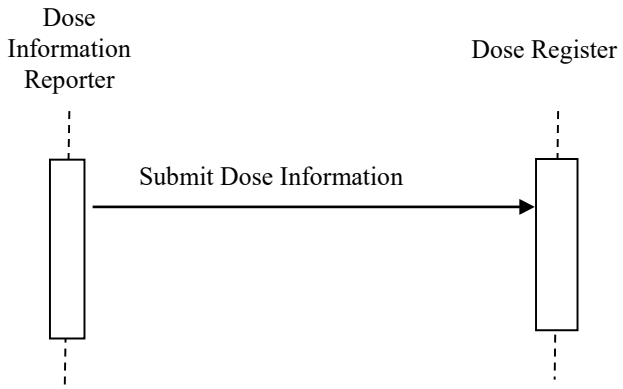

Figure 4.63.4-1: Interaction Diagram

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4.63.4.1 Submit Dose Information

4.63.4.1.1 Trigger Events

A Dose Information Reporter shall be capable of periodically submitting Dose objects accumulated since the last submission.

The Dose Information Reporter shall support submitting at a configurable interval, or upon a manual trigger, or both.

Local site policy and preferences will dictate whether periodic submissions take place, at what frequency, whether the Dose objects are first de-identified, and which Dose objects are submitted (e.g., the site might submit a random sample, or just reports for certain types of procedures, etc.)

4.63.4.1.2 Message Semantics

Except for de-identification, the Dose objects submitted by the Dose Information Reporter will generally be copies of reports received via the Store Dose Information or Retrieve Dose Information transactions.

The Dose Information Reporter shall ensure that the attributes described either in [RAD-62] in Table 4.62-2 Dose Context Attributes, or in [RAD-110] in Table 4.110.4.1.2-1 Radiopharmaceutical Administration Dose Context Attributes, are populated (i.e., not empty and not zero or some other dummy value), even if this requires a quality control step with additional manual data entry by an operator.

It may also be desirable to send the localizer images to the registry, since size estimates can be produced from these by image processing or manual measurement. An individual registry might require this, so a Dose Information Reporter may have the capability to obtain and include images with a Modality of CT and an Image Type (0008,0008) value 3 of LOCALIZER (for either non-enhanced and enhanced SOP classes).

The Dose Information Reporter shall initiate a DICOM STOW-RS request. The Dose Information Reporter is the User-Agent. The Dose Register is the Origin-Server. The Dose Information Reporter shall use the Store Instances action type. The Dose Information Reporter shall encode the instances using the binary DICOM method.

The Dose Registry shall be capable of accepting a DICOM STOW-RS request.

The Dose Registry can identify the Dose Information Reporter (for audit purposes) using the IP address of the User-Agent, or use different URL end points for each Dose Information Reporter.

The Dose Information Reporter shall use STOW-RS to submit Dose objects encoded in DICOM SR and formatted as DICOM Part 10 media files with a Transfer Syntax of Explicit VR Little Endian.

The Dose Information Reporter shall be capable of sending the Dose objects to multiple configured destinations.

The Dose Information Reporter is responsible for delivery of Dose objects in spite of intermittent connections (network trouble, or the destination system being down).

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4.63.4.1.2.1 De-identification

The Dose Information Reporter shall be capable of de-identifying Dose objects before submitting them.

There is considerable variation in what attributes need to be removed to achieve sufficient de-identification for any particular purpose. See the discussion in RAD TF-2x: Appendix I and DICOM PS3.15 Annex E.

Accordingly, this transaction does not require the removal of all text attribute values, nor the removal of all private attribute values.

The Dose Information Reporter may provide a mechanism to allow the user to configure those attributes that will be removed or replaced. At minimum the Dose Information Reporter shall support the ability to configure removal and replacement of all those attributes listed in the Basic Application Level Confidentiality Profile in DICOM PS3.15 Section E.1.1. It shall be configurable to use:

- the Retain Longitudinal Option
- Retain Patient Characteristics Option
- Retain Device Information Option
- Retain UIDs Option

This configurability is particularly important since details such as patient sex, approximate age and weight, anatomy imaged and type of procedure are typically part of population dose analysis and such analysis would be severely limited without the ability to leave such information in submitted data. If the value in the Patient Birth Date (0010,0030) is removed from a Dose object during de-identification, then the Patient Age (0010,1010) attribute shall be included with an appropriate value.

When de-identification has been performed, the Dose Information Reporter shall add to the DICOM dataset of each instance the Patient Identity Removed (0012,0062) attribute with a value of YES, and add a value for De-identification Method Code Sequence (0012,0064).

The Dose Information Reporter shall be configurable to perform no de-identification at all.

In some scenarios, it may be appropriate to perform no de-identification, such as when the Dose Registry is doing a longitudinal study for specific patients (and necessary consents and/or privacy agreements have been taken care of). In such cases, if the Patient Identity Removed (0012,0062) attribute is present in the dataset it shall not be changed before submitting the dataset; if the attribute is absent it shall be added with a value of NO.

The Dose Information Reporter shall be capable of different de-identification configuration settings for each submission destination.

In some de-identification scenarios, the UIDs might need to be replaced. This transaction does not require that the Dose Information Reporter have the ability to replace UIDs, but if UIDs are replaced, internal consistency within the exported set of instances and across multiple exports over time shall be maintained. This entails adherence to the following rules:

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- The same replacement UID is used for all composite instances of the same entity within the set, e.g., if the Study Instance UID is replaced, it is replaced with the same value in all dose objects within the same original study.
- References by UID to other instances or entities within the set are updated, e.g., references to the SOP Instance UIDs of predecessor documents, reference images and source images.
- References by UID to other instances or entities not included within the set are removed or replaced with consistent, well-formed, dummy references.

If the same instances are exported multiple times on different occasions, the identifying attributes and UIDs therein shall be replaced with the same values on each occasion. That is, this transaction requires deterministic behavior for replacement of identifying attributes and UIDs. This assures that the receiving Dose Registry can detect duplicate submissions and not accumulate the same dose multiple times. The safest way to assure detection of duplicate submissions from a single site or multiple sites is not to replace the UIDs in the first place, but local regulations or policy may not permit this.

The Dose Information Reporter performing de-identification shall not create invalid IODs. Specifically:

- Mandatory and conditional attributes may not be removed, but rather must be replaced.
- Type 1 attributes must be given a value.
- Type 2 attributes may be encoded zero length, but it is often advisable to encode a value, especially for attributes likely to be used in browsers such as Patient Name, Patient ID, Study ID and Accession Number.
- UIDs shall have valid roots and be genuinely globally unique.

The Dose Information Reporter is not required to be able to pseudonymize Dose objects. For a description of pseudonymization, see Section 4.51.4.1.4.

4.63.4.1.3 Expected Actions

The Dose Registry shall accept the received Dose objects. What it does with the Dose objects will depend on the features, configuration, and business logic of the product. Some details of several Dose Registry projects are discussed in RAD TF-1x: Appendix I – Deployment of Dose Registries.

Although the Dose Information Reporter may keep track of which Dose objects have been previously submitted to avoid duplicates or missing objects, the Dose Registry cannot depend on every object being sent, and should also be prepared to check for duplicates (by checking the Irradiation Event UIDs, though these may have been affected by de-identification during the current and previous submission, particularly if the same information is received multiple times from different Dose Information Reporters).

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4.64 Query Dose Information [RAD-64]

4.64.1 Scope

A Dose Information Reporter, Dose Information Consumer, or Acquisition Modality requests and receives from the Image Manager/Archive a list of instance metadata describing Dose objects matching a specified filter.

4.64.2 Actor Roles

Role:	Requestor: Query for a list of Dose objects.
Actor(s):	The following actors may play the role of Requestor: Dose Information Reporter Dose Information Consumer Acquisition Modality
Role:	Manager: Respond to queries for Dose objects matching the specified filter.
Actor(s):	The following actors may play the role of Manager: Image Manager/Archive

4.64.3 Referenced Standard

DICOM PS3.4 Annex C: Query/Retrieve Service Class

DICOM PS3.4 Section B.5.1.5: Structured Reporting Storage SOP Classes

DICOM PS3.3 Section A.35.8: X-Ray Radiation Dose SR IOD

DICOM PS3.3: Section A.35.14: Radiopharmaceutical Dose SR IOD

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4.64.4 Messages

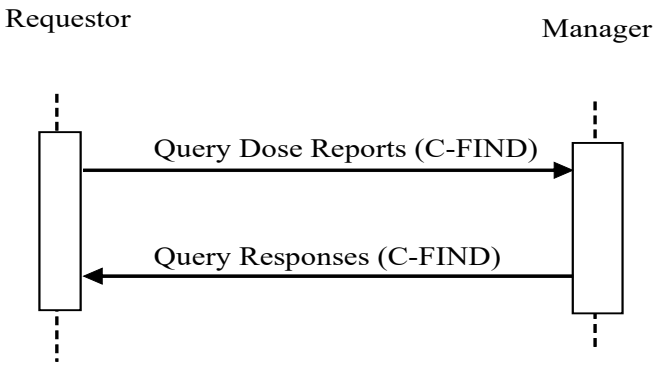

Figure 4.64.4-1: Interaction Diagram

4.64.4.1 Query Dose Information

The Query (Study Root – FIND and optionally Patient Root – FIND) SOP Classes shall be supported. Refer to DICOM PS3.4: Query/Retrieve Service Class for detailed descriptive semantics.

4.64.4.1.1 Trigger Events

The Dose Information Reporter needs to obtain information about Dose objects.

Often this will be triggered by the Dose Information Reporter preparing to produce reports, preparing to perform analyses or preparing to submit data to a dose registry based on local policies. Examples of such triggers might include generating a daily report of procedures exceeding Diagnostic Reference Levels for certain procedure types, producing a summary of dose to a particular patient over the past year, or submitting reports for all procedures performed in the past week to a national dose registry.

The Dose Information Consumer needs to obtain information about Dose objects.

Often this will be triggered by the Dose Information Consumer preparing to display or further process the contents of one or more Dose objects. Examples of such triggers might include processing the contents of a dose object together with the generated images in order to produce a dose map. Refer to the Use Cases in RAD TF-1: 22.3 “Radiation Exposure Monitoring Process Flow” for more details.

The Acquisition Modality needs to obtain administered dose information from a Dose object.

This will be triggered by the modality that will perform the imaging procedure. It will read the Dose object to determine information about the radiopharmaceutical that was administered to the patient for an imaging procedure, including the actual administered dose, and the date and times it was assayed and administered.

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4.64.4.1.2 Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes.

The Requestor shall implement the Query/Retrieve SOP Classes in the role of SCU. The Manager shall implement the Query/Retrieve SOP Classes in the role of SCP.

A C-FIND Request from the DICOM Study Root Query/Retrieve Information Model – FIND SOP Class or the DICOM Patient Root Query/Retrieve Information Model – FIND SOP Class shall be sent from the Requestor to the Manager.

The Requestor uses one or more matching keys as filter criteria to obtain the list of matching entries in the Image Manager/Archive at the selected level (Patient & Study/Series/Instance).

In addition to the required and unique keys defined by the DICOM Standard, the Dose Report Query SCU and SCP shall support the matching and return keys defined for Study, and Series level queries as defined in Section 4.14.4.1.2 and Table 4.14-1.

The Requestor (SCU) and the Manager (SCP) shall also support the Dose Report Instance-specific keys defined in Table 4.64-1.

Table 4.64-1: Dose Report Instance Specific Query Matching and Return Keys

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
Dose Report Instance Specific Level					
SOP Class UID	(0008,0016)	O	R+	O	R+
SOP Instance UID	(0008,0018)	O	R	O	R
Content Date	(0008,0023)	O	O	O	R+
Content Time	(0008,0033)	O	O	O	R+
Referenced Request Sequence	(0040,A370)				
>Study Instance UID	(0020,000D)	O	O	R+*	R+
>Accession Number	(0008,0050)	O	O	R+	R+
>Requested Procedure ID	(0040,1001)	O	O	R+	R+
>Requested Procedure Code Sequence	(0032,1064)				
>>Code Value	(0008,0100)	O	O	O	R+
>>Coding Scheme Designator	(0008,0102)	O	O	O	R+
>>Coding Scheme Version	(0008,0103)	O	O	O	R+
>>Code Meaning	(0008,0104)	O	O	O	R+
Content Template Sequence	(0040,A504)				
>Template Identifier	(0040,DB00)	O	O	R+	R+
Concept Name Code Sequence	(0040,A043)				
>Code Value	(0008,0100)	O	O	R+*	R+
>Coding Scheme Designator	(0008,0102)	O	O	R+*	R+
>Coding Scheme Version	(0008,0103)	O	O	O	R+

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Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
>Code Meaning	(0008,0104)	O	O	R+	R+

The requirement conventions for key usage in the above table are defined in Section 2.2.

4.64.4.1.2.1 Filtering Strategies

Since it may not be immediately obvious how to perform certain dose object filtering based on the available matching keys, return keys and object content, some suggestions are provided here.

Filtering can occur at three points. Matching keys allow filtering on the server side; only instances that pass the filter have metadata returned. Return keys allow filtering on the client side; only instances whose metadata passes the filter are subsequently retrieved. Finally, object attributes or content tree elements allow further client-side filtering; only retrieved instances that pass the filter are processed further.

Client-side filtering of the object attributes and content is the most flexible, but to avoid retrieving an unnecessarily large number of objects, the use of matching and return keys is very helpful.

To filter for Dose objects:

- Matching key – SOP Class UID (0008,0016) allows selection of the X-ray Radiation Dose SR Storage SOP Class or the Radiopharmaceutical Administration Radiation Dose SR Storage SOP Class.

To filter for a specific date range:

- Matching key – Study Date (0008,0020) and/or Performed Procedure Step Start Date (0040,0244) allows selection of a particular date or range.

To filter for specific modalities:

- Matching key – Modalities in Study (0008,0061) allows selection of a desired modality (e.g., CT, XA, DR, DX, CR, MX, NM, PT, SR)

  Note: Some studies might have multiple irradiating modalities so it will still be necessary to confirm the modality in the dose report. Note also that the series level Modality attribute will always be SR for dose reports.

- Return key – Template ID (0040,DB00) allows identification of either CT, Projection X-Ray, or Radiopharmaceutical Administration dose reports. Future dose reports will also be identifiable by new Template ID values, making this a potentially valuable attribute for the Archive to support as a matching key.

- Object Content Tree – Procedure Reported allows differentiation of Mammography from other types of projection x-ray

To filter for specific procedure types:

- Object Attribute – Performed Procedure Code Sequence (0040,A372) is Type 2, but if filled in the Dose object, will contain the acquisition procedures performed, allowing

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identification of the procedure. Since these are local codes and tend to change, systems will likely need to use a lookup table to map the variety of procedure/anatomy codes to a smaller set for performing analysis and reporting.

- Object Content Tree – Acquisition Protocol, if present, may also help identify the procedure type.

Note: Series Description (0008,103E) is a Type 3 attribute which, if present, in a Dose object will have a value of "Radiation Dose Information".

To filter for specific body regions:

- Object Content Tree – Target Region allows identification of body regions.

Note: Some implementations may provide a very specific region and the filter will want to generalize; other implementations may be unable to identify the exact region and will provide an overly generalized region instead.

- Object Content Tree – Anatomical Structure, if present, may also identify body regions in projection x-ray dose reports.

To filter for patient age category:

- Return key – Patient's Birth Date (0010,0030) allows identification of patients in an age range.
- Return key – Patient's Age (0010,1010) is a Type 3 attribute and an optional return key but may allow identification of some patients in an age range.

To filter for patient weight category:

- Return key – Patient's Weight (0010,1030) is a Type 3 attribute and an optional return key but may allow identification of some patients in a weight range.

To filter for patient sex:

- Return key – Patient's Sex (0010,1040) allows identification of patient's sex (e.g., for monitoring policies relating to women of childbearing age).

4.64.4.1.3 Expected Actions

The Manager receives the C-FIND request, performs the matching on the provided keys and sends the list of matching records back to the Requestor via C-FIND responses.

The Requestor may use the value of certain return keys to identify specific Dose objects for subsequent retrieval. See Section 4.64.4.1.2.1 or 4.110.4.1.2.1 for details. Some details are only available by first retrieving and then parsing the dose objects.

4.65 Retrieve Dose Information [RAD-65]

4.65.1 Scope

A Dose Information Reporter, Dose Information Consumer, or Acquisition Modality requests and receives from the Image Manager/Archive specified instances of Dose objects.

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4.65.2 Actor Roles

Actor: Dose Information Reporter

Role: Request and receive specific Dose objects from the Image Manager/Archive.

Actor: Dose Information Consumer

Role: Request and receive specific Dose objects from the Image Manager/Archive.

Actor: Acquisition Modality

Role: Request and receive specific Dose objects from the Image Manager/Archive.

Actor: Image Manager/Archive

Role: Provide specified Dose objects requested by Dose Information Reporters and Dose Information Consumers.

4.65.3 Referenced Standard

DICOM PS3.4 Annex C: Query/Retrieve Service Class

DICOM PS3.4 Section B.5.1.5: Structured Reporting Storage SOP Classes

DICOM PS3.3 Section A.35.8: X-Ray Radiation Dose SR IOD

DICOM PS3.3: Section A.35.14 Radiopharmaceutical Dose SR IOD

4.65.4 Messages

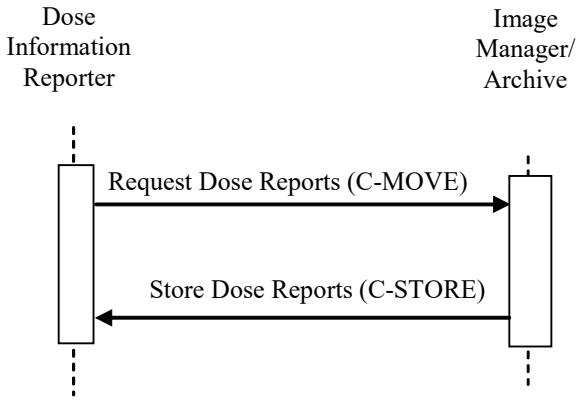

Figure 4.65.4-1: Interaction Diagram

Note: In the above diagram, the Dose Information Consumer or Acquisition Modality may also submit a C-MOVE request and receive a C-STORE message.

4.65.4.1 Retrieve Dose Information

The Retrieve (Study Root – MOVE and optionally Patient Root – MOVE) SOP Classes shall be supported. This requires that C-MOVE also be supported at the Series Level. Refer to the DICOM PS3.4 Annex C for detailed descriptive semantics.

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Actors that claim support of the Radiation Exposure Monitoring (REM) Profile or the Radiation Exposure Monitoring for Nuclear Medicine (REM-NM) shall support the SOP Classes shown in Table 4.65-1 as indicated by the Profile Supported column.

Table 4.65-1: Dose Storage SOP Classes

SOP Class UID	SOP Class Name	Profile Supported
1.2.840.10008.5.1.4.1.1.88.67	X-Ray Radiation Dose SR	REM
1.2.840.10008.5.1.4.1.1.88.68	Radiopharmaceutical Administration Radiation Dose SR	REM-NM

4.65.4.1.1 Trigger Events

The Dose Information Reporter, Dose Information Consumer, or Acquisition Modality decides it needs a specific Dose object.

4.65.4.1.2 Message Semantics

The message semantics are defined in the DICOM Query/Retrieve Service Class Section of the DICOM PS3.4: Query/Retrieve Service Class. The Dose Information Reporter, Dose Information Consumer, or Acquisition Modality is the DICOM C-Move SCU and DICOM Storage SCP and the Image Manager/Archive is the DICOM C-Move SCP and DICOM Storage SCU.

The contents of the X-Ray Radiation Dose SR objects are based on Baseline Template TID 10001 “Projection X-ray Radiation Dose” or Baseline Template TID 10011 “CT Radiation Dose”. The contents of the Radiopharmaceutical Administration Radiation Dose SR objects are based on Baseline Template TID 10021 “Radiopharmaceutical Radiation Dose”. However, it should be noted that those templates are extensible, and the use of additional templates is not prohibited.

It is the responsibility of the Image Manager/Archive to assure that the patient and procedure information is current in the Dose objects when they are retrieved from the Image Manager/Archive.

The Image Manager/Archive receives the C-MOVE request, establishes a DICOM association with the Dose Information Reporter, Dose Information Consumer or Acquisition Modality, and uses the DICOM C-STORE command to transfer the requested Dose objects.

4.65.4.1.3 Expected Actions

The Dose Information Reporter, Dose Information Consumer, or Acquisition Modality shall accept the Dose objects. The Dose objects shall be processed according to the features, configuration, and business logic of the Dose Information Reporter or Dose Information Consumer product. Possibilities include display, processing, analysis, printing, export, etc.

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Dose Information Reporters that claim support of the REM Profile shall be capable of processing both TID 10001 and TID 10011. Dose Information Reporters that claim support of the REM-NM Profile shall be capable of processing TID 10021.

The Dose Information Reporter or Dose Information Consumer shall not return an error to the Archive due to not recognizing the template used or the retrieved document content. The retrieved results may simply be discarded instead.

X-Ray Irradiation Events are identified by an Irradiation Event UID (0008,3010). Radiopharmaceutical Administration Events are identified by a Radiopharmaceutical Administration Event UID (0008,3012). The same Event may be referenced in multiple Dose objects. For example, the same dose event might appear in both an SR summarizing a procedure and an SR summarizing the whole study.

The Dose Information Reporter and Dose Information Consumer shall recognize duplicate Events based on the Event UIDs in the Dose object.

The Dose Information Reporter shall be capable of presenting some form of report to the user based on the retrieved dose information. The format, contents and analysis of such reports are not defined by the IHE. Such details should be worked out as part of the product design.

4.66 Rejection Note Stored [RAD-66]

4.66.1 Scope

In this transaction, the Acquisition Modality, Change Requester or the Evidence Creator transmits a specific DICOM Key Object Selection (Rejection Note) to the Image Manager/Image Archive for marking referenced images as “rejected”. Beforehand, a user will have:

- selected specific images to be rejected for quality reasons, including a reason for rejection, or
- corrected certain images so that the original incorrect images are to be rejected for patient safety reasons, or
- associated certain images to the correct modality worklist entry so that the original images are to be rejected for incorrect modality worklist selection reason

Alternatively, a user or the Image Manager/Archive selected specific instances to be deleted due to data retention policy expiration, including a reason for deletion.

4.66.2 Actor Roles

Actor: Acquisition Modality

Role: Flags acquired available images that are incorrect or rejected for quality reasons by creating a Rejection Note and sending it to the Image Manger/ Image Archive.

Actor: Evidence Creator

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Role: Flags images that are incorrect or rejected for quality reasons by creating a Rejection Note and sending it to the Image Archive.

Actor: Image Manager/ Image Archive

Role: Image Archive receives, processes and stores the Rejection Notes received from the Acquisition Modality, Evidence Creator or Change Requester. Image Manager/ Image Archive applies defined logic to the images that are referenced in the Rejection Note.

Actor: Change Requester

Role: Flags available instances that are (1) associated with an incorrect modality worklist entry, (2) expired for data retention policy or (3) rejected due to quality or patient safety reasons by creating a Rejection Note, and sending it to the Image Manager/Archive.

4.66.3 Referenced Standards

DICOM PS3.3 Section A.35.4: Key Object Selection Document IOD

DICOM PS3.4 Annex B: Storage SOP Class

DICOM PS3.4 Annex C: Query/Retrieve SOP Class

DICOM PS3.16 TID 2010: Key Object Selection

DICOM PS3.16 CID 7011: Rejected for Quality Reasons

4.66.4 Messages

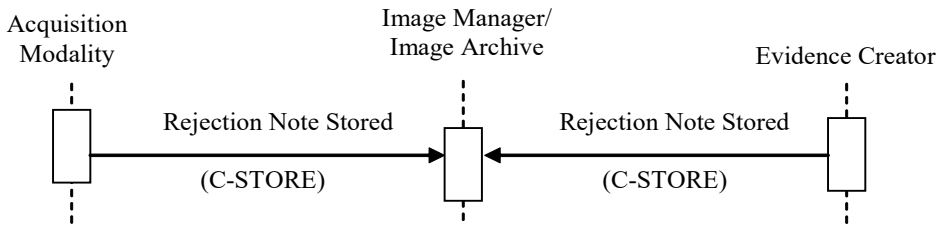

Figure 4.66.4-1: Interaction Diagram: Rejection Note Stored

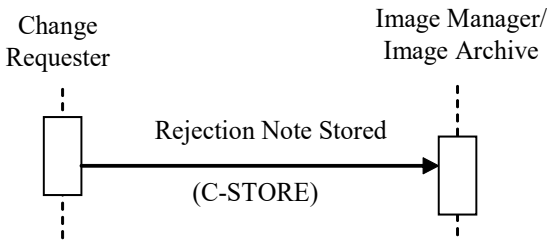

Figure 4.66.4-2: Interaction Diagram: Rejection Note Stored in IOCM

This transaction relates to the “DICOM C-STORE” event between the Acquisition Modality, the Evidence Creator, or the Change Requester and the Image Manager/Archive in the above

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interaction diagram. The Acquisition Modality, the Evidence Creator or the Change Requester is the DICOM Storage SCU and the Image Manager/Archive is the DICOM Storage SCP.

The following table summarizes Key Object Selection Document Titles usage in different profiles:

Table 4.66.4-1: Profile Supported Key Object Selection Document Title

KOS Document Title	MAWF	IOCM
(113001, DCM, “Rejected for Quality Reasons”)	X	X
(113037, DCM, “Rejected for Patient Safety Reasons”)	X	X
(113038, DCM, “Incorrect Modality Worklist Entry”).		X
(113039, DCM, “Data Retention Policy Expired”)		X

4.66.4.1 Rejection Note Stored (for Quality Reasons)

4.66.4.1.1 Trigger Events

An operator at the Acquisition Modality, the Evidence Creator or the Change Requester detects that certain images just acquired are of insufficient quality. She marks these images using the capability provided by the systems implementing these actors. Thereby, she generates a Rejection Note which the Acquisition Modality, Evidence Creator or the Change Requester sends to the Image Manager/Archive.

4.66.4.1.2 Message Semantics

The Acquisition Modality, Evidence Creator or Change Requester shall create a new Key Object Selection instance in a new Series of the rejected images’ Study. Integration-critical values shall be filled as defined in the Evidence Document Attribute Mapping (RAD TF-2x: Appendix A.2). The instance shall be constructed as defined in DICOM PS3.3 and 3.4, and shall have the following values in the DICOM template TID 2010:

- A Key Object Selection Document Title code of (113001, DCM, "Rejected for Quality Reasons").
- At least one Document Title Modifier code from DICOM Context Group 7011.
- References to all rejected instances are specified as Content Items with value type of COMPOSITE, IMAGE or WAVEFORM in the Content Sequence (0040,A730).

4.66.4.1.3 Expected Actions

The Image Manager/Archive receives the Key Object Selection with the Document Title valued (113001, DCM, "Rejected for Quality Reasons") and shall store it. The Image Manager/ Image Archive shall support the two behaviors listed below. The behavior chosen shall be configurable.

- Regular use: For the Key Object Selection instance and all instances referenced therein, the Image Manager /Archive shall return SOP Instance UIDs in Query Responses and the instances in Patient, Study, Series, or Instance level retrievals.

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- Hide rejected instances: For the rejected instances referenced in the Key Object Selection, the Image Manager/Archive shall neither return SOP Instance UIDs in Query Responses nor return the instances in Patient, Study, Series, or Instance level retrievals. If the request includes optional Additional Query/Retrieve Attributes defined in Table 4.66.4.1.3-1, then the returned value(s) of the requested attributes shall reflect the absence of hidden rejected instances.

Table 4.66.4.1.3-1: Additional Query/Retrieve Attributes

Attribute Name	Tag
Number of Patient Related Studies	(0020,1200)
Number of Patient Related Series	(0020,1202)
Number of Patient Related Instances	(0020,1204)
Number of Study Related Series	(0020,1206)
Number of Series Related Instances	(0020,1209)
Number of Study Related Instances	(0020,1208)
Modalities in Study	(0008,0061)
SOP Classes in Study	(0008,0062)
Alternate Representation Sequence	(0008,3001)

For example, the following study has two original series and a Rejection Note for Quality Reason that references all instances in Series 2

- Series 1: Modality = MR, 200 objects
- Series 2: Modality = US, 80 objects
- Series 3: Modality = KO (Rejection Note), 1 object (references all 80 objects in Series 2)

When the Image Manager receives a C-FIND request for this study and the request specifies the additional Number of Study Related Series (0020,1206), Number of Study Related Instances (0020,1208) and Modalities in Study (0008,0061) attributes, then using the Regular Use behavior, the Image Manager will return the following result with respect to the additional Query/Retrieve attributes:

Table 4.66.4.1.3-2: Regular Use Behavior - Example Attribute Values

Attribute Name	Value
Number of Study Related Series	3
Number of Study Related Instances	281
Modalities in Study	MR \ US \ KO

When using the Hide Rejected Instances behavior, the Image Manager will return the following result with respect to the additional Query/Retrieve attributes:

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Table 4.66.4.1.3-3: Hide Rejected Instances Behavior - Example Attribute Values

Attribute Name	Value
Number of Study Related Series	3 if empty series is returned, or 2 if empty series is not returned
Number of Study Related Instances	201
Modalities in Study	MR \ KO

If the complete series is rejected according to the specified behavior as described above, then the Image Manager/Archive may or may not return the empty series in the C-FIND response when it receives a SERIES level C-FIND request.

4.66.4.1.3.1 Access to Rejected Instances

The contents of this section are required for Image Manager/Archive Actors in the Imaging Object Change Management Profile.

The Image Manager/Archive shall provide two Application Entities for each C-FIND service and each C-MOVE service; one AE associated with the Regular Use behavior, and one AE associated with the Hide Rejected Instances behavior (see Section 4.66.4.1.3).

The Image Manager/Archive shall be configurable to restrict access to the “Regular Use” Application Entity to a limited set of calling AE Titles.

4.66.4.2 Rejection Note Stored (for Patient Safety Reasons)

4.66.4.2.1 Trigger Events

An operator at the Acquisition Modality, the Evidence Creator or the Change Requester detects that certain just acquired images or just created evidence documents are incorrect. She corrects these images or evidence documents using the capability provided by the systems implementing these actors. Thereby, she generates a Rejection Note which the Acquisition Modality, Evidence Creator or Change Requester sends to the Image Manager/Archive.

4.66.4.2.2 Message Semantics

The Acquisition Modality, the Evidence Creator or the Change Requester shall be able to let a user correct one or more attributes in images that are displayed or in evidence documents that are applied.

- The user shall be able to store new, corrected images or evidence documents at the Acquisition Modality as defined in Section 4.8.4.1.2 or at the Evidence Creator as defined in Section 4.18.4.1.2.

The Acquisition Modality, Evidence Creator or Change Requester shall create a new Key Object Selection instance in a new Series of the incorrect instances' Study. Integration-critical values shall be filled as defined in the Evidence Document Attribute Mapping (RAD TF-2x: Appendix A.2). The instance shall be constructed as defined in DICOM PS3.3 and 3.4, and shall:

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- Have the Key Object Selection Document Title value (113037, DCM, "Rejected for Patient Safety Reasons")
    - References to all incorrect instances and derived instances (e.g., FOR PRESENTATION and FOR PROCESSING) are specified as Content Items with value type of COMPOSITE, IMAGE or WAVEFORM in the Content Sequence (0040,A730).

This Key Object Selection instance shall be stored to the Image Manager/Archive. It serves as a trigger to disallow routine use of these incorrect instances that it references.

4.66.4.2.3 Expected Actions

The Image Manager/Archive receives the Key Object Selection (KOS) instance with the Document Title value (113037, DCM, "Rejected for Patient Safety Reasons") and shall store it.

The Image Manager/Archive shall hide the referenced incorrect instances and specifically shall not provide the incorrect instances in responses to an image query/ retrieve transaction [RAD-14, RAD-16] or presentation state query/retrieve transaction [RAD-15], [RAD-17].

If the complete series is rejected, then the Image Manager/Archive may or may not return the empty series in the C-FIND response when it receives a SERIES level C-FIND request.

4.66.4.2.3.1 Additional Requirements for Image Manager/Archive in IOCM

The Image Manager/Archive shall not accept subsequent occurrence of instances that have been hidden.

4.66.4.3 Rejection Note Stored (for Incorrect Modality Worklist)

4.66.4.3.1 Trigger Events

An operator at the Change Requester (grouped with an Acquisition Modality or Image Manager/Archive) detects that certain images just acquired and transmitted are associated with an incorrect modality worklist entry. She corrects the images to the correct modality worklist entry using the capability provided by the systems implementing these actors. Thereby, she generates a Rejection Note and sends it to the Image Manager/Archive.

4.66.4.3.2 Message Semantics

The Change Requester shall enable a user to associate one or more objects in the study with the correct modality worklist entry. The Change Requester shall create a new Key Object Selection instance in a new Series of the study referencing the instances associated with the incorrect modality worklist entry. Integration-critical values shall be filled as defined in the Evidence Document Attribute Mapping (RAD TF-2x: Appendix A.2). The instance shall be constructed as defined in DICOM PS3.3 and 3.4, and shall have the following values in the DICOM template TID 2010:

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- A Key Object Selection Document Title code of (113038, DCM, “Incorrect Modality Worklist Entry”).
- References to all instances associated with the incorrect modality worklist entry are specified as Content Items with value type of COMPOSITE, IMAGE or WAVEFORM in the Content Sequence (0040,A730).

4.66.4.3.3 Expected Actions

The Image Manager/Archive receives the Key Object Selection (KOS) instance with the Document Title values (113038, DCM, “Incorrect Modality Worklist Entry”) and shall store it.

The Image Manager/Archive shall hide the incorrect instances and specifically shall not provide the incorrect instances referenced in this KOS in responses to an image query/retrieve transaction [RAD-14], [RAD-16] or presentation state query/retrieve transaction [RAD-15], [RAD-17].

The Image Manager/Archive shall not accept subsequent occurrence of instances that have been hidden.

If the complete series is rejected, then the Image Manager/Archive may or may not return the empty series in the C-FIND response when it receives a SERIES level C-FIND request.

4.66.4.4 Rejection Note Stored (for Data Retention Expiry)

4.66.4.4.1 Trigger Events

A manual or automatic procedure in the Change Requester (grouped with Image Manager/Archive) determines that certain instances exceed the required period of data retention and automatically deletes them locally. Based on configuration, the Change Requester communicates the expiry of instances to an external Image Manager/Archive (e.g., Centralized Archive). Thereby, it generates a Rejection Note and sends to the external Image Manager/Archive.

4.66.4.4.2 Message Semantics

The Change Requester shall create a new Key Object Selection instance in a new Series for each study with the expired instances. Integration-critical values shall be filled as defined in the Evidence Document Attribute Mapping (RAD TF-2x: Appendix A.2). The instance shall be constructed as defined in DICOM PS3.3 and 3.4, and shall have the following values in the DICOM template TID 2010:

- A Key Object Selection Document Title code of (113039, DCM, “Data Retention Policy Expired”).
- References to all instances within the study that have exceeded the required data retention period are specified as Content Items with value type of COMPOSITE, IMAGE or WAVEFORM in the Content Sequence (0040,A730).

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4.66.4.4.3 Expected Actions

The Image Manager/Archive receives the Key Object Selection (KOS) instance with the Document Title values (113039, DCM, "Data Retention Policy Expired") and shall store it.

The Image Manager/Archive will decide, depending on its local data retention policies, whether to act on the information in the KOS and how to act. If it chooses to act on the KOS, it may delete the expired instances referenced in the KOS.

If the complete content of a series is deleted, the Image Manager/Archive may or may not also delete the series itself.

If the Image Manager/Archive later receives instances that have been previously deleted due to the expiry of data retention period and not deleted due to other reasons, then the Image Manager/Archive may choose to decide that the Data Retention Policy Expired rejection is no longer in force. If it so decides, it shall:

- store the instances as defined in one of the corresponding instance stored transactions [(RAD-8], [RAD-9], [RAD-18], [RAD-19], [RAD-29], [RAD-43], [RAD-61])
- return the referenced instances in subsequent query or retrieve requests
- not return the Rejection Note corresponding to the Data Retention Policy Expired rejection that is no longer in force

4.67 Media Information Stored [RAD-67]

This transaction is currently in the Extensions to PDI Trial Implementation Supplement.

4.68 Provide and Register Imaging Document Set – MTOM/XOP [RAD-68]

4.68.1 Scope

The Provide and Register Imaging Document Set – MTOM/XOP transaction passes a Repository Submission Request from an XDS-I Imaging Document Source to an XDS Document Repository.

This transaction is derived from the Provide and Register Document Set-b [ITI-41] transaction of the IHE IT Infrastructure Technical Framework. It adds new document content types as well as additional semantics and constraints on the metadata defined in [ITI-41].

A Provide and Register Imaging Document Set – MTOM/XOP transaction carries:

- Metadata describing zero or more new documents (Metadata describing zero documents may be used to describe folders containing references to documents that were previously submitted)
- Within metadata, one DocumentEntry object per document

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- One Submission Set definition along with the linkage to new documents and references to existing documents
- Zero or more Folder definitions along with linkage to new or existing documents.
- Zero or more documents

4.68.2 Actor Roles

Actor: Imaging Document Source

Role: Submits document(s) with associated metadata to an XDS Document Repository.

Actor: Document Repository

Role: Receives documents and associated metadata and:

- Stores the documents
- Augments submitted metadata with repository information to enable later retrieval of documents
- Forwards the enhanced metadata to the XDS Document Registry.

4.68.3 Referenced Standards

For a list of the standards inherited from the underlying Provide and Register Document Set-b [ITI-41] transaction; see ITI TF-2: 3.41.3.

In addition, the following standards are used to define the radiology-specific content:

DICOM PS3.3 Section A.35.4: Key Object Selection Document IOD (KOS)

DICOM PS3.16: Content Mapping Resource

DICOM PS3.18 Section 10.4: Web Services - Retrieve Transaction of the DICOM Studies Service (also known as Web Access to DICOM Persistent Objects (WADO))

PDF/A ISO 19005-1. Document management - Electronic document file format for long-term preservation - Part 1: Use of PDF (PDF/A)

HL7 CDA Release 2.0 (denoted HL7 CDA R2, or just CDA, in subsequent text)

HL7 Implementation Guide for CDA® Release 2: Imaging Integration; Basic Imaging Reports in CDA and DICOM; Diagnostic Imaging Reports (DIR) – Universal Realm, Release 1, March 2009.

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4.68.4 Messages

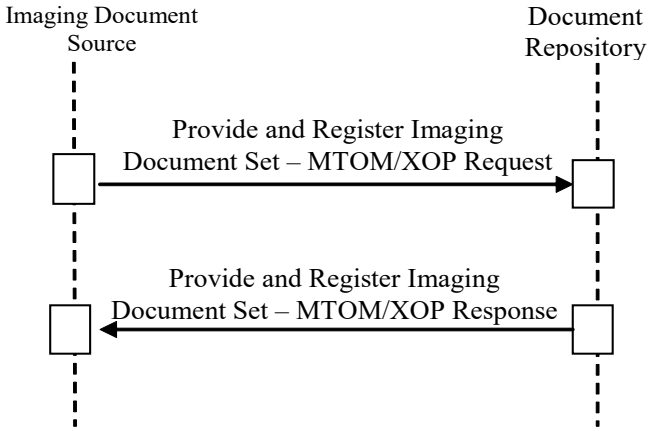

Figure 4.68.4-1: Interaction Diagram

4.68.4.1 Provide and Register Imaging Document Set – MTOM/XOP Request message

An Imaging Document Source sends documents and associated metadata to a Document Repository. This message is an extension of the Provide and Register Document Set-b [ITI-41] transaction as defined in ITI TF-2: 3.41.

4.68.4.1.1 Trigger Events

The triggers for this transaction are:

- The Imaging Document Source is instructed to submit a set of one or more new imaging documents for sharing, or
- A previously submitted document or the contents of a previously submitted manifest changes, requiring the Imaging Document Source to submit an update.

4.68.4.1.2 Message Semantics

This transaction extends the message semantics of the Provide and Register Document Set-b [ITI-41] transaction by specifying additional document content types, to allow the sharing of the following types of documents:

1. Sets of DICOM SOP instances
2. Imaging diagnostic reports

To support these content types and their usage, additional requirements and constraints on the Document Sharing Metadata are specified.

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The Provide and Register Imaging Document Set – MTOM/XOP Request message semantics are specified in the following subsections:

1. Sharing of Persistent DICOM Instances via a Manifest document
2. Sharing of radiology diagnostic report in PDF or CDA Structured or CDA Wrapped Text formats
3. XDS-I.b Document Sharing Metadata bindings
4. Use of the Document Sharing Submission Set concept in sharing of radiology imaging information.

The wsdl definition for this Provide-and-Register transaction sent by the XDS-I Imaging Document Source is no different than the Provide-and-Register transaction sent by the XDS.b Document Source in [ITI-41]. An informative wsdl definition for the Provide-and-Register transaction can be found online at: XDS.b_DocumentRepository.wsdl

4.68.4.1.2.1 Sharing of Set of DICOM Instances

The XDS-I Imaging Document Source creates a manifest that describes and collects references to DICOM SOP instances that are intended for sharing. The manifest, a Key Object Selection (KOS) Document Instance, is the actual document provided to the XDS Document Repository and registered at the XDS Document Registry.

As specified in IHE ITI XDS.b Integration Profile, the structure of the message between the XDS Document Source and the XDS Document Repository is an MTOM/ XOP formatted message. In this transaction, the source actor is the XDS-I Imaging Document Source, but the above requirement still applies. The KOS Document Instance is encoded in the message as a DICOM Part 10 File format having a MIME type of "application/dicom".

The Imaging Document Source shall ensure that the DICOM SOP Instances referenced from within the manifest are available to be retrieved.

If the XDS-I Imaging Document Source makes one or more SOP Instances unavailable that are referenced in a published manifest, then it shall submit a new manifest as a replacement for the published manifest already in the XDS Document Repository and XDS Document Registry (see ITI TF-3: 4.2.2.2 "Document Relationships"). The new manifest shall have the updated list of DICOM SOP Instances with the unavailable instances removed. If the XDS-I Imaging Document Source makes all referenced DICOM SOP Instances unavailable in a published manifest, then it may consider implementing the Remove Imaging Document Option (see RAD TF-1: 18.2.5).

4.68.4.1.2.1.1 Manifest KOS Document

The references to the DICOM SOP Instances shall be included in the Current Requested Procedure Evidence Sequence (0040,A375) attribute of the KOS Manifest Document.

The Imaging Document Source shall support a number of attributes in Current Requested Procedure Evidence Sequence (0040,A375), which are represented in the Hierarchical SOP Instance Reference Macro, as described in the following table:

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Table 4.68.4.1.2.1.1-1: Attributes of Hierarchical SOP Instance Reference Macro in KOS Manifest Document

Attribute Name	Tag	Imaging Document Source
Study Instance UID	(0020,000D)	R
Referenced Series Sequence	(0008,1115)	R
> Series Instance UID	(0020,000E)	R
> Retrieve AE Title	(0008,0054)	R+
> Retrieve Location UID	(0040,E011)	R+
> Storage Media File-Set ID	(0088,0130)	O
> Storage Media File-Set UID	(0088,0140)	O
> Referenced SOP Sequence	(0008,1199)	R
>> Referenced SOP Class UID	(0008,1150)	R
>> Referenced SOP Instance UID	(0008,1155)	R

Some of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+). Specifically, the Imaging Document Source shall include its own identification in the Retrieve AE Title (0008,0054) and Retrieve Location UID (0040,E011) attributes. These attributes will enable subsequent retrieval of the DICOM objects referenced within the KOS manifest.

4.68.4.1.2.2 Sharing of Report

Since text reports address many of the weaknesses of PDF reports and vice versa, it is required that the Imaging Document Source shall support shared reports in at least one of the following three formats:

- CDA Imaging Report with Structured Headings
- CDA Wrapped Text Report
- PDF Report

To maximize interoperability of the chosen formats:

- For a PDF Report:
  - A specific PDF version is not specified, but use of PDF/A (ISO 19005-1) is recommended.
- For a CDA Imaging Report with Structured Headings:
  - The CDA R2 Header and Body shall conform to the HL7 Clinical Document Architecture Release 2.0. The report content shall be encoded in the StructuredBody element and shall use Section elements identified with a code and there shall be no nonXMLBody element. It is recommended that the CDA R2 Body also conform to the “HL7 Standard for CDA® Release 2: Imaging Integration; Basic Imaging Reports in CDA and DICOM, Release 1”.

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- For a CDA Wrapped Text Report:
  - The CDA R2 Header shall conform to the HL7 Clinical Document Architecture Release 2.0. The CDA Body shall be text encoded with UTF-8 UNICODE format. Refer to Section 4.68.4.1.2.3.5 for constraints on the CDA wrapper.

A report (no matter what document format is chosen) can be shared with or without image reference(s).

If a shared report includes image reference(s), it can embed selected images in its PDF format or it can include fully resolved hyperlinks that point to the selected images; these hyperlinks can be interactively clickable (e.g., PDF) or can be processed or copied (e.g., text).

The Imaging Document Source that provides and registers the shared report is responsible for formatting the hyperlink to reference relevant images. The referenced images within a shared imaging report are meant to be accessed without the need for specialized (e.g., DICOM) viewing applications.

The hyperlink that references the selected image shall be formatted as a DICOM WADO URI. Since the sharing environment is inherently cross-enterprise, the secured version of HTTP (i.e., HTTPS) shall be used when formatting the hyperlink.

The Imaging Document Source is required to ensure that image references are valid links.

Even though significant images can be shared as non-DICOM format (embedded picture in PDF report or hyperlinks in PDF or Text report), it is required that sharing of a large set of DICOM images be achieved by sharing a set of DICOM SOP instances by providing and registering a manifest document. This is to avoid registration of a large number of individual documents in the XDS Document Registry.

4.68.4.1.2.3 Document Sharing Metadata

The Provide and Register Imaging Document Set – MTOM/XOP Request message shall include the metadata attributes that will be forwarded by the Document Repository to the XDS Document Registry using the Register Document Set-b [ITI-42] transaction.

The Imaging Document Source supplies all necessary metadata attributes of a DocumentEntry.

4.68.4.1.2.3.1 Metadata Attributes: Author Information and Document Creation Time

In XDS, a registered document directly contains the clinical information of interest for sharing. Therefore, its metadata for registration can be populated directly from the document content. For example, a discharge letter is submitted to the XDS Document Repository, so its author and creation information is populated into the Document metadata.

In XDS-I.b, the Manifest document submitted to the XDS Document Repository usually does not directly constitute clinical information of interest for sharing, but rather is a set of references to such clinical information. Thus, the metadata of the Manifest document shall be related to the referenced source content or its creation process, to reflect the clinical nature of the shared

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information. This affects the metadata attributes including, but not limited to, author (and sub-attributes authorSpecialty, authorInstitution, authorPerson, authorRole), creationTime, and title.

If the Manifest references source data from multiple authors, then one primary author, source data creation time and document title shall be chosen. Note that this metadata shall be populated from the part of the source data that most closely represents the main content for sharing in order to best support a user query to the XDS Document Registry for finding this data. For example, a Manifest referencing a current report and study as well as a prior report and study, will register metadata populated from the current report (which is the clinical content of interest for sharing).

In cases where the data to be shared is transformed from its original format (e.g., DICOM) to another format (e.g., PDF) in advance of sending it to the XDS Document Repository, the metadata of such newly generated shared information shall be populated from the original source data (e.g., DICOM data).

In summary, XDS-I.b Document Sharing Metadata always reflects the main clinical content of a shared document, which may be described directly in the document, or in the source data referenced within the document, or in the source data from which the document is transformed.

4.68.4.1.2.3.2 DocumentEntry Metadata

Table 4.68.4.1.2.3-1 lists Document Sharing DocumentEntry metadata attributes that are either further constrained by XDS-I.b, or have XDS-I.b specific instructions for how the XDS-I Imaging Document Source is expected to populate them. Unless otherwise specified, the "optionality" of the attributes listed in the table below is the same as required for the XDS Document Source.

For a full description of all the metadata attributes associated with a Document Sharing document, see ITI TF-3: Table 4.2.3.2-1 "DocumentEntry Metadata Attribute Definition".

Table 4.68.4.1.2.3-1: XDS-I.b-specific Metadata Requirements

DocumentEntry Metadata Attribute	XDS-I.b-specific Requirements
creationTime	This attribute value shall be populated by the XDS-I Imaging Document Source to record the date and time at which the clinical content conveyed in the shared document is created. If the published document is a DICOM object or is transformed from a DICOM information object, this attribute value should be taken from the tags Instance Creation Date (0008,0012) and Instance Creation Time (0008,0013) of the DICOM object.
eventCodeList	This attribute is required to be included in the metadata if known by the XDS-I Imaging Document Source. In other words, it is "promoted" from an optional (O) attribute in XDS to a "required if known" (R2) attribute in XDS-I.b. This attribute shall be populated by the Imaging Document Source to describe both the Acquisition Modality and Anatomic Region. • Acquisition Modality: The eventCodeList shall contain a code from the DICOM Content Mapping Resource DICOM PS3.16 Context Group CID 29 for each distinct acquisition modality with which images were acquired in the study. In cases where a study contains images from multiple acquisition modalities, multiple codes shall be included in the eventCodeList. Each modality code's displayName shall be populated with the corresponding Code Meaning text from Context Group CID 29.

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DocumentEntry Metadata Attribute	XDS-I.b-specific Requirements
	Notes: The XDS-I Imaging Document Source needs to consider all series in the Submission Set to determine the complete set of modality codes. The Acquisition Modality (0008,0060) attribute for some objects in the study may contain values that do not represent imaging modalities (e.g., SR, Presentation States, Segmentations, etc.). There is no corresponding entry for these values in CID 29 and these values shall not be represented in the eventCodeList. • Anatomic Region: the eventCodeList shall contain code(s) from the DICOM Content Mapping Resource DICOM PS3.16 Context Group CID 4. Each anatomic region code's displayName shall be populated with the corresponding Code Meaning text from Context Group CID 4. For example, for a lung CT study which contains 3 CT acquisition series, one SR series, and one Segmentation series, will have a two entries in eventCodeList: a single entry for Acquisition Modality using the code triplet "(CT, DCM, Computed Tomography) and an entry for Anatomic Region using the code triplet; "(39607008, SCT, Lung)". See Note 1.
formatCode	This attribute shall be populated by the XDS-I Imaging Document Source as follows: • Shall use "1.2.840.10008.5.1.4.1.1.88.59" (DICOM KOS SOP Class UID) as the Format Code Value and "1.2.840.10008.2.6.1" (DICOM UID Registry UID) as the Format Coding Scheme OID for a DICOM Manifest document. • Shall use "urn:ihe:rad:TEXT" for a CDA Wrapped Text Report • Shall use "urn:ihe:rad:PDF" for a PDF Report • Shall use "urn:ihe:rad:CDA:ImagingReportStructuredHeadings:2013" for a CDA Imaging Report with Structured Headings unless overridden by a requirement in a Content Profile (such as IHE Cardiology CIRC or CRC).
mimeType	This attribute shall be populated by the XDS-I Imaging Document Source from one of the following values: • "application/dicom" for a DICOM Manifest document • "text/xml" for a CDA Wrapped Text Report • "text/xml" for a CDA Imaging Report with Structured Headings • "application/pdf" for a PDF Report
practiceSettingCode	This attribute shall be populated by the XDS-I Imaging Document Source describe the high-level imaging specialty such as (309964003, SCT, "Radiology"), (309950003, SCT, "Pathology"), or (309915006, SCT, "Cardiology"). The list of acceptable values is constrained by the organization managing the XDS Document Registry (i.e., the XDS Affinity Domain). It is strongly recommended to use the values from the DICOM Content Mapping Resource DICOM PS3.16 Context Group CID 7030. See Note 1.
referenceIdList	The list items can describe both the Accession Number and Study Instance UID. The Data Type for referenceIdList is CXi, as specified in ITI TF-3: Table 4.2.3.1.7-2. **Accession Number:** The Accession Number identifies the Imaging Service Request. The Accession Number value may be found in the Originating HL7 Imaging Order Message (OMI) Imaging Procedure Control (IPC) Segment, Sequence 1 for Accession Identifier, or in the DICOM attribute Accession Number (0008,0050). The referendIdList may be populated with the Accession Number and assigning authority. Only the CXi.1, CXi.4 and CXi.5 components shall be valued. For DICOM mapping, see Section 4.68.4.1.2.3.3.5.

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DocumentEntry Metadata Attribute	XDS-I.b-specific Requirements
	The referencedIdList may contain multiple entries for Accession Number, e.g., for images from a grouped acquisition or when images are acquired and read in different facilities. **Study Instance UID:** The Study Instance UID uniquely identifies an imaging study. Only the CXi.1 and CXi.5 components shall be valued: • CXi.1 - shall be the Study Instance UID • CXi.5 – shall be urn:ihe:iti:xds:2016:studyInstanceUID. An example encoding two Accession Numbers and a Study Instance UID in the referenceIdList is as follows: <rim:Slot name="urn:ihe:iti:xds:2013:referenceIdList "> <rim:ValueList> <rim:Value> 642356235^^^&1.2.3.4.5.6&ISO^urn:ihe:iti:xds:2013:accession </rim:Value> <rim:Value> STN-238432^^^&1.2.3.4&ISO^urn:ihe:iti:xds:2013:accession </rim:Value> <rim:Value> 2.16.5.4.3.2.1.0^^^^urn:ihe:iti:xds:2016:studyInstanceUID </rim:Value> </rim:ValueList> </rim:Slot>
serviceStartTime	This attribute shall be populated by the Imaging Document Source for a date and time that indicates the imaging service start time. As an example, the Imaging Document Source could take the value of Study Date (0008,0020) and Study Time (0008,0030) from the associated DICOM study
sourcePatientInfo	This attribute allows multiple values for different pieces of patient demographics. See ITI TF-3: 4, Metadata used in Document Sharing Profiles, and specifically Table 4.2.3.2-1 in ITI TF-3: 4.2.3.2. As an example, this information can be transformed from DICOM Patient's Name (0010,0010), Patient's Birth Date (0010,0030), and Patient's Sex (0010,0040).
typeCode	This attribute shall be populated by the XDS-I Imaging Document Source from a code in the Procedure Code Sequence (0008,1032) of the performed procedure with which the document is associated. In certain special cases previously defined in other IHE Profiles some sort of user intervention will be necessary to select the single Procedure Code used to populate this attribute. For example, handling the "Group Case" as defined in Scheduled Workflow will require the user to select a single, pre-coordinated procedure code that represents the multiple Requested Procedures that were acquired as a single study. The coding system of the Radiology Imaging performed Procedure Code will be designated by the XDS Affinity Domain and shared by all XDS-I Imaging Document Sources in the XDS Affinity Domain. Note: As specified in RAD TF-2x: Appendix A, Table A.1-1, if the procedure is changed from the Requested Procedure Code Sequence (0032,1064), the Procedure Code Sequence (0008,1032) in the image is recommended to be absent or empty. Therefore, if the Procedure Code Sequence is absent, it is recommended that the Requested Procedure Code Sequence never be used because the procedure may have been altered.

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DocumentEntry Metadata Attribute	XDS-I.b-specific Requirements
uniqueId	This attribute shall contain the Document unique ID generated by the XDS-I Imaging Document Source. It shall be an ISO OID. For a DICOM Manifest document, this attribute value shall be the same as the SOP Instance UID of the corresponding DICOM KOS object. In the event that **any** information in the manifest changes and it needs to be resubmitted from the XDS-I Imaging Document Source to the XDS Document Repository, the XDS-I Imaging Document Source shall generate a new SOP Instance UID for the DICOM KOS object to ensure that its submission to the XDS Document Repository will succeed. For a CDA Imaging Report with Structured Headings or a CDA Wrapped Text Report, this value shall be formulated from the HL7 CDA R2 header as follows: *ClinicalDocument/id@root.ClinicalDocument/id@extension*

Note 1: The specification for Coding Scheme in coded attributes in Document Sharing metadata permits use of either a Coding Scheme Designator (a short string such as SCT) or a Coding Scheme UID (an OID such as 2.16.840.1.113883.6.96). Thus, (39607008, SCT, "Lung") is equivalent to (39607008, 2.16.840.1.113883.6.96, "Lung").

See ITI TF-3: 4.2.3.1.2 and DICOM PS3.16 Table 8-1.

Implementations may choose to support mapping from one to the other. Because senders of XDS-I metadata may use a Coding Scheme Designator or a Coding Scheme UID, recipients should be able to receive both.

4.68.4.1.2.3.3 Transformation of DICOM VR to Document Sharing Metadata Data Types

A number of Document Sharing metadata attributes use HL7 data types for value representation. Some of the metadata attributes may be transformed from data elements of the corresponding DICOM SOP Instance. In this section, transformations of DICOM VR (Value Representation) to the HL7 data types used in Document Sharing metadata are described.

Note that term HL7 Data Type in the following transformations refers to their specified usage in Document Sharing metadata as defined in ITI TF-3: 4.2.3.1.7 "Metadata Attribute Data types".

4.68.4.1.2.3.3.1 CX – Extended Composite ID

Table 4.68.4.1.2.3-2 describes the transformation of data element of DICOM VR to CX data type as specified in ITI TF-3: 4.2.3.1.7 "Metadata Attribute Data Types".

Table 4.68.4.1.2.3-2: CX Data type mapping

CX Data Component	Component Name	DICOM VR	Comment
1	ID Number	LO	This attribute represents the value of Patient ID issued by an Assigning Authority as indicated in component 3. In DICOM, it is data element (0010,0020) when used with sourcePatientId.
4.2	Assigning Authority – Universal ID	UT	This attribute represents the universal or unique identifier for the Patient ID Assigning Authority. In DICOM it is data element of the Issuer of Patient ID

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CX Data Component	Component Name	DICOM VR	Comment
			Qualifiers Sequence (0010,0024) >Universal Entity ID (0040,0032) when used with sourcePatientId. If this attribute is not present or the Assigning Authority – Universal ID Type is not ISO, then the XDS-I Imaging Document Source shall use its local configuration to populate this subcomponent, to indicate the Patient ID Domain, from which the Patient ID value in component 1 has been issued. This component shall be an ISO OID
4.3	Assigning Authority – Universal ID Type	CS	This component represents the standard defining the format of the Universal Entity ID. In DICOM it is data element of the Issuer of Patient ID Qualifiers Sequence (0010,0024) >Universal Entity ID Type (0040,0033). If this attribute is not present or the Assigning Authority – Universal ID Type is not ISO, then the XDS-I Imaging Document Source shall use its local configuration to populate this subcomponent, to indicate the Patient ID Domain, from which the Patient ID value in component 1 has been issued. This component shall be "ISO"

HL7 CX data components not listed in the table are not used in Document Sharing metadata and shall be left empty.

4.68.4.1.2.3.3.2 DTM – Date / Time

HL7 DTM Data Type can be represented in the following regular expression:

YYYY[MM[DD[HH[MM[SS]]]]]

This can be transformed from DICOM elements of VR DA (format: YYYYMMDD) and TM (format: HHMMSS.fraction).

4.68.4.1.2.3.3.3 XCN – Extended Composite ID Number and Name for Person

Table 4.68.4.1.2.3-3 describes the transformation of DICOM VR of PN to XCN data type as specified for Document Sharing metadata:

Table 4.68.4.1.2.3-3: XCN Data type mapping

XCN Data Component	Component Name	DICOM Data Element	Comment
1	ID Number		The XDS-I Imaging Document Source shall use its local configuration or personnel directory service to populate this component.
2	Family Name	1st Component of PN	An example of transcoding a data element of VR PN into XCN, is when
3	Given Name	2nd Component of PN	

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XCN Data Component	Component Name	DICOM Data Element	Comment
4	Second or Further Given Names or Initials thereof	3rd Component of PN	(0008,1070) Operator's Name is used for authorPerson and (0010,0010) is used for Patient Name
5	Suffix	5th Component of PN	
6	Prefix	4th Component of PN	
7	Degree		This attribute component is not included in DICOM.

HL7 XCN data components not listed in the table are not used in Document Sharing metadata and shall be left empty.

4.68.4.1.2.3.3.4 XON – Extended Composite Name and Identification Number for Organization

Table 4.68.4.1.2.3-4 describes the transformation of DICOM Data Elements to XON data type as specified for Document Sharing metadata:

Table 4.68.4.1.2.3-4: XON Data type mapping

XON Data Component	Component Name	DICOM VR	Comment
1	Organization Name	LO	Institution Name (0008,0080) or Institution Code Sequence (0008,0082) >Code Meaning (0008,0104) If not populated, the XDS-I Imaging Document Source may use its local configuration to populate this component.
6.2	Assigning Authority Universal Id	SH	Institution Code Sequence (0008,0082) >Coding Scheme Designator (0008,0102) This component shall be an ISO OID. If not populated, the Imaging Document Source may use its local configuration to populate this component.
6.3	Assigning Authority Universal Id Type		Shall have the value "ISO" if XON.6.2 has a value
10	Organization Identifier	SH	Institution Code Sequence (0008,0082) >Code Value (0008,0104) The XDS-I Imaging Document Source may use its local configuration to populate this component.

HL7 XON data components not listed in the table are not used in Document Sharing metadata and shall be left empty.

4.68.4.1.2.3.3.5 CXi – Extended Composite ID of a Reference Object for Accession Number

Table 4.68.4.1.2.3-5 describes the transformation of data element of DICOM VR to CXi data type as specified in ITI TF-3: Table 4.2.3.1.7-2 "Data Types".

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Table 4.68.4.1.2.3-5: CXi Data type mapping

CXi Data Component	Component Name	DICOM VR	Comment
1	ID Number	LO	Accession Number (0008,0050). For a grouped acquisition study, this field will be empty in the top level DataSet, but may be obtained from within Request Attributes Sequence (0040,0275)
4.2	Assigning Authority – Universal ID	UT	Issuer of Accession Number Sequence (0008,0051) >Universal Entity ID (0040,0032). If this attribute is not present or the Assigning Authority – Universal ID Type is not ISO, then the XDS-I Imaging Document Source shall use its local configuration to populate this subcomponent, to indicate the Assigning Authority, from which the Accession Number value in component 1 has been issued. This component shall be an ISO OID.
4.3	Assigning Authority – Universal ID Type	CS	Issuer of Accession Number Sequence (0008,0051) >Universal Entity ID Type (0040,0033). If this attribute is not present or the Assigning Authority – Universal ID Type is not ISO, then the XDS-I Imaging Document Source must use its local configuration to populate this subcomponent, to indicate the Assigning Authority, from which the Accession Number value in component 1 has been issued This component shall be "ISO"
5	Identifier Type Code	CS	Shall be "urn:ihe:iti:xds:2013:accession"

4.68.4.1.2.3.4 Document Sharing Metadata Values represented as HL7 v2.5 Data Types

Document Sharing metadata that is represented as an HL7 v2.5 data type will require transformation from its corresponding HL7 CDA R2 header component. Table 4.68.4.1.2.3-6 guides this transformation and indirectly imposes requirements on the configuration of and/or user interaction with implementations supporting this transaction. Additionally, this table further restricts the HL7 CDA R2 specification. IDs in metadata that correspond to IDs in the CDA header (as II types) are required to have both a root and an extension attribute.

Table 4.68.4.1.2.3-6: HL7 v2.5 and CDA Data type mapping

XDS/ XDS-I.b Metadata			HL7 CDA Header	
HL7 v2.5 Data Type	**Subcomponent index**	**Subcomponent name**	**HL7 CDA R2 Data element**	**HL7 CDA R2 Sub-element or attribute**
CX (see Note 1)			II	
	1	Id number	II	@extension

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XDS/ XDS-I.b Metadata			HL7 CDA Header	
HL7 v2.5 Data Type	**Subcomponent index**	**Subcomponent name**	**HL7 CDA R2 Data element**	**HL7 CDA R2 Sub-element or attribute**
	4.2	AssigningAuthority.uid	II	@root
CXi (see Note 1)			II	
	1	Id number	II	@extension
	4.2	AssigningAuthority.uid	II	@root
DTM	1 (only)	Date/Time	TS or IVL_TS	@value (NOTE: format is compatible with DTM)
XCN			II and PN	
	1	Id number	II	@extension
	2.1	FamilyName.surnName	PN	Family
	3	Given Name	PN	Given
	4	Second (middle) Name	PN	Given
	5	Suffix	PN	Suffix
	6	Prefix	PN	Prefix
	9.2	AssigningAuthority.uid	II	@root
XON			II and ON	
	1	Organization Name		
	6.1	AssigningAuthority.namespace	II	@assigningAuthorityName
	6.2 (see Note 2)	AssigningAuthority.uid	II	@root
	6.3 (see Note 3)	Assigning Authority Universal Id Type	II	
	10	Organization Identifier	II	@extension

Note 1: See ITI TF-3: Table 4.2.3.1.7-2 for restrictions on the formatting of the CX and CXi datatype.

Note 2: This field is required if XON.10 is valued and not an OID.

Note 3: This field is required if XON.10 is valued and not an OID and shall have the value "ISO".

4.68.4.1.2.3.5 CDA Wrapper – CDA Wrapped Text Report Option

This section outlines the content of the HL7 CDA R2 wrapper for the text content. We note here that requirements specified below are to ensure the presence of a minimum amount of wrapper data in order to enhance description and facilitate sharing of the document. It should be noted

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that the "nullFlavor" value expresses missing values in the CDA, e.g., it may be appropriate if such information cannot be derived from DICOM objects.

Implementers of the “CDA Wrapped Text Report” Profile Option can and should make use of additional annotation within the CDA header to provide richer context. The examples in the following sections contain the minimal amount of wrapper data, as specified, and in many cases do make use of additional CDA header elements for enriched context.

To the extent possible, the specification for the CDA wrapper for the report text has been made consistent with the CDA metadata specified in the ITI XDS Scanned Documents (XDS-SD) Profile (see ITI TF-3: 5.2.2 and 5.2.3) and has been replicated here for the readers’ convenience.

Elements and attributes that apply to the XDS-SD use case(s) but not to the use case of sharing an electronically transmitted radiology report have been omitted, where allowed by the CDA R2 specification. Descriptions for how to populate certain elements and attributes consistent with the “sharing a text-based radiology report” use case have been included.

4.68.4.1.2.3.5.1 Wrapper Format – HL7 CDA R2

The CDA metadata wrapper for plain text reports is the same as defined in the ITI XDS-SD Profile (see the metadata specification table in ITI TF-3: 5.2.3) with the exceptions described below and in the following subsections:

- The ClinicalDocument/dataEnterer element, as it is defined in XDS-SD, does not apply to the report sharing use case and thus may be omitted.

4.68.4.1.2.3.5.1.1 ClinicalDocument Child-less Elements

The requirements for the ClinicalDocument Child-less elements for CDA-wrapped plain text reports is the same as defined in the ITI XDS-SD Profile (see ITI TF-3: 5.2.3.1), with the following exceptions/ clarifications:

- The ClinicalDocument/templateId element shall be 1.3.6.1.4.1.19376.1.2.21
- The ClinicalDocument/code element shall be set with the following attribute values:
  - code=“11528-7”
  - codeSystem=“2.16.840.1.113883.6.1”
  - codeSystemName=“LOINC”
  - displayName=“Radiology Report”/>
- The ClinicalDocument/effectiveTime shall denote the time at which the CDA text document was recorded. At a minimum, the time shall be precise to the day and shall include the time zone offset from GMT.

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Example:

```
<ClinicalDocument xmlns="urn:hl7-org:v3">
  <typeId extension="POCD_HD000040" root="2.16.840.1.113883.1.3"/>
  <templateId root="1.3.6.1.4.1.19376.1.2.21">
  <id root="1.3.6.4.1.4.1.2835.2.7777"/>
  <code code="11528-7"  codeSystem="2.16.840.1.113883.6.1"
     codeSystemName="LOINC" displayName="Radiology Report"/>
  <title>Chest X-Ray</title>
  <effectiveTime value="20050329224411+0500"/>
  <confidentialityCode code="N" codeSystem="2.16.840.1.113883.5.25"/>
  <languageCode code="en-US"/>
```

4.68.4.1.2.3.5.1.2 ClinicalDocument/recordTarget

The requirements and example for the ClinicalDocument/recordTarget element for CDA-wrapped plain text reports is the same as defined in the ITI Cross-Enterprise Sharing of Scanned Documents (XDS-SD) Profile (see ITI TF-3: 5.2.3.2).

4.68.4.1.2.3.5.1.3 ClinicalDocument/author (original)

The requirements and example for the ClinicalDocument/author element (that represents the original author of the report) for CDA-wrapped plain text reports is the same as defined in the ITI XDS-SD Profile (see ITI TF-3: 5.2.3.3).

4.68.4.1.2.3.5.1.4 ClinicalDocument/author (reporting system)

The requirements for the ClinicalDocument/author element (that represents the reporting system and software used to produce the report content) for CDA-wrapped plain text reports is the same as defined in the ITI XDS-SD Profile (see ITI TF-3: 5.2.3.4), with the following exceptions/ clarifications:

- When reading the XDS-SD specification, references to scanned, scanning, scanned content etc. refer to reporting, report content etc. in this context.
- When reading the XDS-SD specification concerning the ClinicalDocument/author/assignedAuthor/assignedAuthoringDevice/code element references to CDA-wrapped PDF can be ignored since they do not apply to the radiology report sharing use case.

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Example:

```
<author>
  <time value="20050329224411+0500"/>
  <assignedAuthor>
     <templateId root="1.3.6.1.4.1.19376.1.2.20.2"/>
    <id root="1.3.6.4.1.4.1.2835.2.1234"/>
    <assignedAuthoringDevice>
    <code code="WSD" displayName="Workstation" codeSystem="
    1.2.840.10008.2.16.4" />
       <manufacturerModelName>SOME REPORTING NAME AND MODEL
       </manufacturerModelName>
        <softwareName> REPORTING SOFTWARE NAME v0.0</softwareName>
    </assignedAuthoringDevice>
    <representedOrganization>
       <id root="1.3.6.4.1.4.1.2835.2"/>
       <name>SOME REPORTING Facility</name>
        <addr>
          <streetAddressLine>21 North Ave</streetAddressLine>
          <city>Burlington</city>
          <state>MA</state>
          <postalCode>01803</postalCode>
          <country>USA</country>
        </addr>
     </representedOrganization>
  </assignedAuthor>
</author>
```

4.68.4.1.2.3.5.1.5 ClinicalDocument/custodian

The requirements and example for the ClinicalDocument/custodian element for CDA-wrapped plain text reports are the same as defined in the ITI XDS-SD Profile (see ITI TF-3: 5.2.3.6). Its context is left up to the reporting facility to define in accordance with local policies and to reflect the entity responsible for the report content. In most cases this will be the reporting facility.

4.68.4.1.2.3.5.1.6 ClinicalDocument/legalAuthenticator

The requirements and example for the ClinicalDocument/legalAuthenticator element for CDA-wrapped plain text reports are the same as defined in the ITI XDS-SD Profile (see ITI TF-3: 5.2.3.7) and its context is left up to the reporting facility to define in accordance with local policies.

4.68.4.1.2.3.5.1.7 ClinicalDocument/documentationOf

The requirements and example for the ClinicalDocument/documentationOf element for CDA-wrapped plain text reports are the same as defined in the ITI XDS-SD Profile (see ITI TF-3: 5.2.3.8).

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4.68.4.1.2.3.5.1.8 ClinicalDocument/component/nonXMLBody

This ClinicalDocument/component/nonXMLBody element shall be present and used to wrap the text content. The requirements for the nonXMLBody are the same as defined in the ITI XDS-SD Profile (see ITI TF-3: 5.2.3.9), with the following exceptions/ clarifications:

- When reading the XDS-SD specification, references to scanned, scanning, scanned content etc. refer to reporting, report content etc. in this context.
- When reading the XDS-SD specification concerning the ClinicalDocument/component/nonXMLBody element, references to CDA-wrapped PDF can be ignored since they do not apply to the radiology report sharing use case.
- The XDS-SD specification requires Base 64 encoding for the value of the ClinicalDocument/component/nonXMLBody/text element, even if the unencoded text consists of characters that can be encoded legally within XML (i.e., ClinicalDocument/component/nonXMLBody/text@representation is required to be "B64" rather than "TXT"); currently, this XDS-SD requirement is not overridden, though it contrasts with the use of unencoded text in the CDA Imaging Report with Structured Headings Option, in which text occurs in various structured elements (e.g., component/TextObservation/text), rather than in a nonXMLBody element.

Example (report text content is in the same language as the wrapper):

```
  <component>
    <nonXMLBody>
      <text mediaType="text/plain" representation="B64">
UmFkaW9sb2d5IFJlcG9ydCBmb3IgSmFuZSBEb2UKQ29uY2x1c2lvbjogTm9ybWFsLgo=
     </text>
    </nonXMLBody>
  </component>
</ClinicalDocument>
```

4.68.4.1.2.4 Use of Document Sharing Submission Set

4.68.4.1.2.4.1 Linking Report to Set of DICOM Instances

Figure 4.68.4.1.2.4-1 shows examples of three Submission Sets:

- Submission Set 1 includes a report and a manifest that are stored in the XDS Document Repository. The manifest references DICOM instances that are archived in the Image Manager/Image Archive. The DocumentEntry.referenceIdList metadata attributes for the manifest and the report includes the same fully qualified Accession Number associated with the originating Requested Procedure for the prior.
- Submission Set 2 includes one single manifest. The referenceIdList metadata attribute for the manifest includes the fully qualified Accession Number associated with the originating Requested Procedure for the current study.

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- Submission Set 3 includes a single report. The referenceIdList metadata attribute for the report includes the fully qualified Accession Number associated with the originating Requested Procedure for the current study, since it was generated by interpreting the images referenced by the manifest in Submission Set 2. Submission Set 3 references the manifest from Submission Set 2, and the report and manifest from Submission Set 1 since the earlier report, the images referenced by the earlier manifest, and images referenced by the current manifest were used for the interpretation.

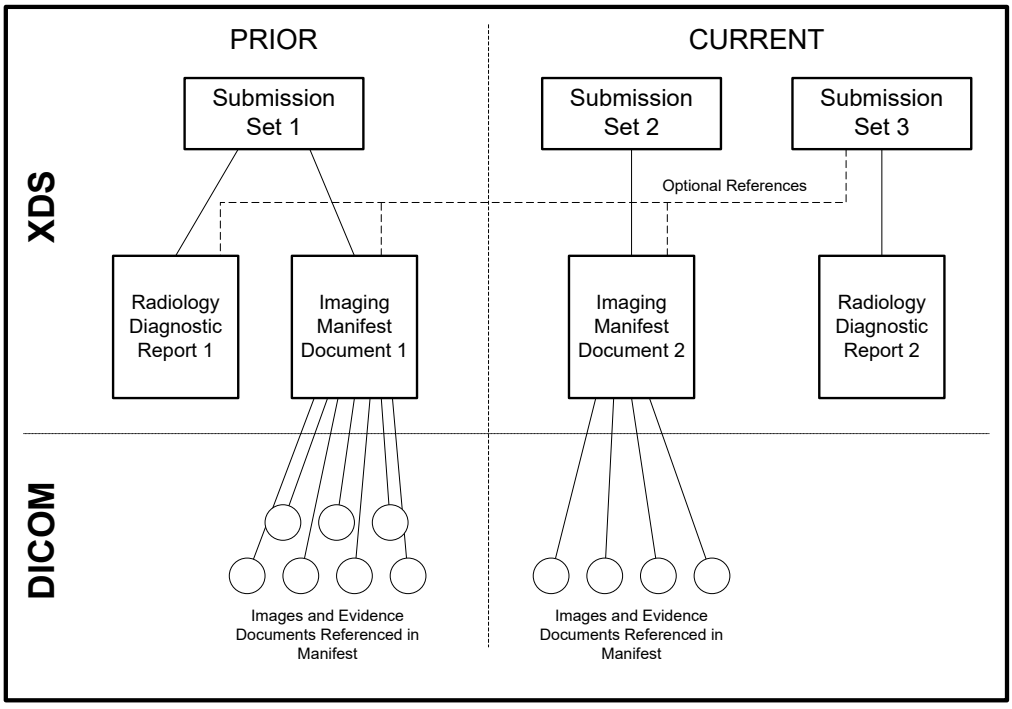

Figure 4.68.4.1.2.4-1: Imaging Information Sharing Submission Set

If the submitted reports and image manifests are for the same Requested Procedure, then the metadata for the report and for the image manifest may include the same fully qualified Accession Number in the referenceIdList. This will enable the unambiguous association of reports to the set of DICOM instances related to the Requested Procedure.

4.68.4.1.2.4.2 Linking Report to prior report

A Submission Set containing a report can reference the manifest DocumentEntry for a set of images published in a prior submission if the prior images were used in creating the interpretation. Likewise, the new Submission Set can reference a report DocumentEntry from a previous submission. The Accession Number(s) of the prior images and reports will be different from the Accession Number(s) for the current images and reports.

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4.68.4.1.3 Expected Actions

The Document Repository will receive this message and will process it according to the requirements specified in ITI TF-2: 3.41.4.1.3.

4.68.4.2 Provide and Register Imaging Document Set – MTOM/XOP Response message

The XDS Document Repository sends a Provide and Register Imaging Document Set – MTOM/XOP Response message when the processing of a Provide and Register Imaging Document Set – MTOM/XOP Request message is complete. The specification of the trigger events, message semantics and expected actions are the same as those specified in ITI TF-2: 3.41.4.2.

The conditions of failure and possible error messages are given in the ebRS standard. The XDS-I Imaging Document Source shall handle all error messages detailed for the Provide and Register Document Set-b [ITI-41] transaction in ITI TF-3: Table 4.2.4.1-2 “Error Codes”.

4.69 Retrieve Imaging Document Set [RAD-69]

4.69.1 Scope

This transaction is used to retrieve DICOM instances thar are referenced within and XDS-I.b DICOM manifest.

4.69.2 Actor Roles

Actor: Imaging Document Consumer

Role: requests a set of DICOM instances from an Imaging Document Source or from a remote community through an Initiating Imaging Gateway.

Actor: Responding Imaging Gateway

Role: requests a set of DICOM instances from Imaging Document Source(s) in its local community.

Actor: Imaging Document Source

Role: returns requested DICOM instances.

Actor: Initiating Imaging Gateway

Role: routes a request for DICOM instances to local Imaging Document Source(s) or a remote Responding Imaging Gateway.

4.69.3 Referenced Standards

For a list of the standards inherited from the underlying Retrieve Document Set [ITI-43] transaction, see ITI TF-2: 3.43.3.

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4.69.4 Messages

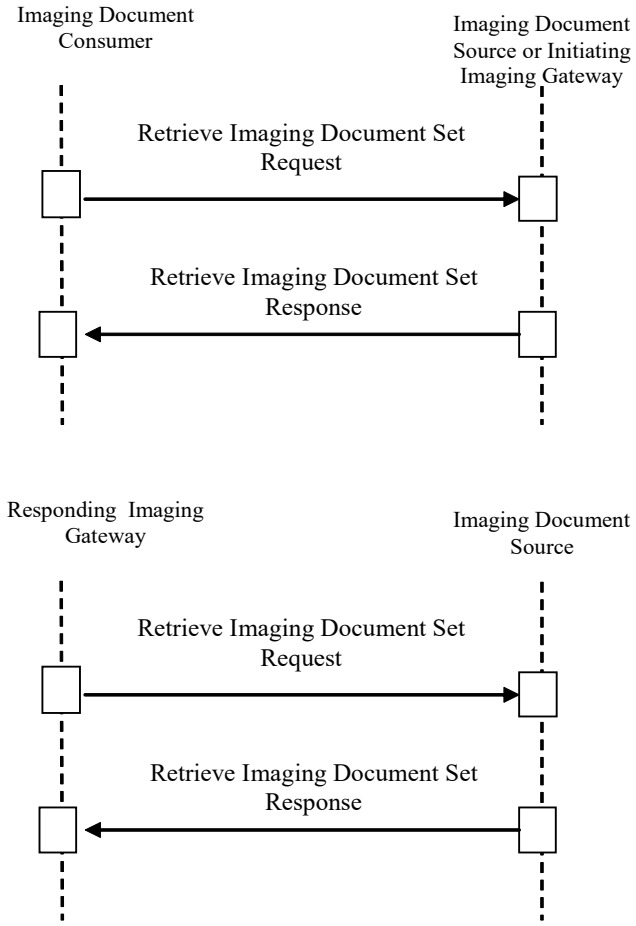

Figure 4.69.4-1: Interaction Diagrams

4.69.4.1 Retrieve Imaging Document Set Request message

This message is an extension of the Retrieve Document Set transaction as defined in ITI TF-2: 3.43.

4.69.4.1.1 Trigger Events

An Imaging Document Consumer wishes to retrieve a set of DICOM instances that are referenced within one or more DICOM Manifests; see Section 4.68.4.1.2.1 “Sharing a Set of DICOM instances”.

An Initiating Imaging Gateway receives a Retrieve Imaging Document Set [RAD-69] request, and forwards it to one or more Imaging Document Source(s) in its community.

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A Responding Imaging Gateway receives a Cross Gateway Retrieve Imaging Document Set [RAD-75] request and initiates a Retrieve Imaging Document Set request to the Imaging Document Source(s) in its community.

4.69.4.1.2 Message Semantics

The Retrieve Imaging Document Set messages is a SOAP 12 message in MTOM/XOP format; see Section 4.69.5 “Protocol Requirements”.

The Retrieve Imaging Document Set Request shall carry the following information:

- A required repositoryUniqueId that identifies the Imaging Document Source from which the DICOM instance is to be retrieved. This value shall either be “computed” based on the Retrieve AE Title (0008,0054) attribute(s) present in the DICOM manifest or be populated from the Retrieve Location UID (0040,E011) attribute(s) that is present in the DICOM manifest. For a description of how this “computation” can be achieved, see RAD TF-2x: Appendix G.3.
- A required list of one or more documentUniqueIds. These values correspond to the SOP Instance UIDs referenced within the DICOM manifest.
- A required list of one or more DICOM transfer syntax UIDs that the Imaging Document Consumer is capable of processing.
- A required Study Instance UID value that identifies the study containing the DICOM instances to be retrieved. The Study Instance UID is extracted from the DICOM manifest.
- A required Series Instance UID value that identifies the series containing the DICOM images/ objects to be retrieved. The Series Instance UID is extracted from the DICOM manifest.
- A homeCommunityId that identifies the community holding the DICOM instances, required if:
  - the Retrieve Imaging Document Set request is from an XCA-I Imaging Document Consumer to an XCA-I Initiating Imaging Gateway, or
  - the Retrieve Imaging Document Set request is from an XCA-I Responding Imaging Gateway to an Imaging Document Source in its community.

The repositoryUniqueId and homeCommunityId associated with the requested DICOM instances can be different, allowing a single request to identify multiple Imaging Document Sources.

4.69.4.1.3 Expected Actions

An Imaging Document Source shall generate a Retrieve Imaging Document Set Response message; see Section 4.69.4.2.

The Initiating Imaging Gateway:

- shall initiate a [RAD-75] transaction to the Responding Imaging Gateway corresponding to the homeCommunityId value in the [RAD-69] request

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- shall generate a Retrieve Imaging Document Set Response message; see Section 4.69.4.2

4.69.4.2 Retrieve Imaging Document Set Response message

4.69.4.2.1 Trigger Events

This message is triggered by receipt of a Retrieve Imaging Document Set Request Message.

4.69.4.2.2 Message Semantics

The semantics of the Retrieve Imaging Document Set Response Message are identical to those inherited from the [ITI-43] transaction and are specified in ITI TF-2: 3.43.4.2.2.

4.69.4.2.3 Expected Actions

The Imaging Document Source or Initiating Imaging Gateway shall return the requested DICOM instances and a status code or an error code. The status codes, conditions of failure, and possible error messages are given in the ebRS standard and detailed in ITI TF-3: Table 4.2.4.2-4 "[ITI-43] Retrieve Document Set and [ITI-39] Cross Gateway Retrieve Responses".

Note: A Responding Imaging Gateway may have suppressed failures resulting in the Initiating Imaging Gateway reporting a success.

The Imaging Document Source shall encode the pixel data using one of the DICOM transfer syntaxes included in the Retrieve Imaging Document Set Request Message. If the Imaging Document Source cannot encode the pixel data using any of the requested transfer syntaxes then an error status shall be returned.

If the request contains a transfer syntax of 1.2.840.10008.1.2.4.94 (DICOM JPIP Referenced Transfer Syntax) or 1.2.840.10008.1.2.4.95 (DICOM JPIP Referenced Deflate Transfer Syntax), and the Imaging Document Source supports the requested transfer syntax, the following behavior is expected:

- If the DICOM Image Object(s) already have the same JPIP transfer syntax as the one indicated in the request, the Retrieve Imaging Document Set Response shall include the DICOM Image Objects unchanged.
- If the DICOM Image Object(s) have a transfer syntax that differs from that of the request, the Retrieve Imaging Document Set Response shall include the DICOM image with the transfer syntax changed to the requested transfer syntax. In addition, the pixel data Attribute (7Fe0,0010) tag will have been removed and replaced with a Pixel Data Provider URL (0028,7FE0) tag. The URL represents the JPIP request and will include the specific target information.
- Upon receipt of this Retrieve Imaging Document Set Response, the Imaging Document Consumer may request the pixel data from the pixel data provider using the supplied URL. Additional parameters required by the application may be appended to the URL when accessing the pixel data provider.

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- For example, a JPIP request for a 200 by 200 pixel rendition of the entire image can be constructed from the Pixel Data Provider URL as follows:
  - Pixel Data Provider URL (0028,7FE0) = https://server.xxx/jpipserver.cgi?target=imgxyz.jp2,
  - URL Generated by the application = https://server.xxx/jpipserver.cgi?target=imgxyz.jp2&fsiz=200,200

In XCA-I, the Initiating Imaging Gateway can act as a JPIP proxy and accept the JPIP request from the Imaging Document Consumer and make the corresponding request to the Imaging Document Source. If a direct route is available from the Imaging Document Consumer to the Imaging Document Source, the Imaging Document Consumer is allowed to make a direct JPIP request to the Imaging Document Source, assuming security considerations are observed.

4.69.4.3 Asynchronous Web Services Exchange Method

An Image Document Consumer that supports the Asynchronous Web Services Option shall use the Asynchronous Web Services Exchange method if the Initiating Imaging Gateway also supports the Asynchronous Web Services Option.

The Initiating Imaging Gateway that supports the Asynchronous Web Services Option, shall respond to an Image Document Consumer using the use the Asynchronous Web Services Exchange method.

A Responding Imaging Gateway shall use the Asynchronous Web Services Exchange method if the Image Document Source supports the Asynchronous Web Services Option.

The Image Document Source that supports the Asynchronous Web Services Option, shall respond to an Image Document Consumer using the Asynchronous Web Services Exchange method.

The Image Document Consumer or the Responding Imaging Gateway supporting this method shall use the non-anonymous response EPR in the WS-Addressing replyTo header.

The Initiating Imaging Gateway, Responding Imaging Gateway, the Image Document Source and the Image Document Consumer shall support the Asynchronous Web Services Methods in the ITI TF-2: Appendix V: Web Services for IHE Transactions, which also includes additional considerations for implementers.

4.69.5 Protocol Requirements

Implementers of this transaction shall comply with all requirements described in ITI TF-2: Appendix V: Web Services for IHE Transactions.

The Retrieve Imaging Document Set transaction shall use SOAP12 and MTOM with XOP encoding (labeled MTOM/XOP in this specification). See ITI TF-2: Appendix V.8 for details.

The Imaging Document Source or Initiating Imaging Gateway shall:

- Accept the Retrieve Imaging Document Set Request message in MTOM/XOP format.

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- Generate the Retrieve Imaging Document Set Response message in MTOM/XOP format

The Imaging Document Consumer shall:

- Generate the Retrieve Imaging Document Set Request message in MTOM/XOP format.
- Accept the Retrieve Imaging Document Set Response message in MTOM/XOP format.

WSDL Namespace Definitions

iherad	urn:ihe:rad:xdsi-b:2009
ihe	urn:ihe:iti:xds-b:2007
rs	urn:oasis:names:tc:ebxml-regrep:xsd:rs:3.0
lcm	urn:oasis:names:tc:ebxml-regrep:xsd:lcm:3.0
query	urn:oasis:names:tc:ebxml-regrep:xsd:query:3.0

These are the requirements for the Retrieve Imaging Document Set transaction presented in the order in which they would appear in the WSDL definition:

- The following types shall be imported (xsd:import) in the /definitions/types section:
  - namespace=”urn:ihe:rad:xdsi-b:2009”, schema=” XDSI.b_ImagingDocumentSource.xsd”
  - The baseline XDS.b schema (namespace=”urn:ihe:iti:xds-b:2007”, schema=” XDS.b_DocumentRepository.xsd”)
- The /definitions/message/part/@element attribute of the Retrieve Imaging Document Set Request message shall be defined as “iherad:RetrieveImagingDocumentSetRequest”
- The /definitions/message/part/@element attribute of the Retrieve Imaging Document Set Response message shall be defined as “ihe:RetrieveDocumentSetResponse”
- The /definitions/portType/operation/input/@wsaw:Action attribute for the Retrieve Imaging Document Set Request message shall be defined as “urn:ihe:rad:2009:RetrieveImagingDocumentSet”
- The /definitions/portType/operation/output/@wsaw:Action attribute for the Retrieve Imaging Document Set Response message shall be defined as “urn:ihe:iti:2007:RetrieveDocumentSetResponse”

These are the requirements that affect the wire format of the SOAP message. The other WSDL properties are only used within the WSDL definition and do not affect interoperability. Full sample request and response messages are in Section 4.69.5.1 Sample SOAP Messages.

For informative WSDL for the Imaging Document Source and Responding Imaging Gateway see an example on the IHE Google Drive under IHE Documents > TF_Implementation_Material > Rad.

The <iherad:RetrieveImagingDocumentSetRequest/> element for use with the Retrieve Imaging Document Set Request Message is defined as:

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- One or more <iherad:StudyRequest/> elements each of which includes a "studyInstanceUID" attribute identifying the study associated with the DICOM images/ objects being retrieved. Each <iherad:StudyRequest/> element shall contain:
  - One or more <iherad:SeriesRequest/> elements each of which includes a "seriesInstanceUID" attribute identifying the series associated with the DICOM images/ objects being retrieved. Each <iherad:SeriesRequest/> element shall contain:
    - One or more <ihe:DocumentRequest/> elements, each one representing an individual document that the Imaging Document Consumer or Responding Imaging Gateway wants to retrieve from the Imaging Document Source. Each <ihe:DocumentRequest/> element contains:
      - A required <ihe:RepositoryUniqueId/> element that identifies the Imaging Document Source from which the document is to be retrieved. This value corresponds to XDSDocumentEntry.repositoryUniqueId.
      - A required <ihe:DocumentUniqueId/> element that identifies the document within the Imaging Document Source. This value corresponds to the SOP Instance UID referenced within the DICOM manifest.
      - A conditionally required <ihe:HomeCommunityId/> element that corresponds to the home attribute of the Identifiable class in ebRIM. The element shall be populated if the request is to an Initiating Imaging Gateway. Otherwise, it may be absent.
- A required <iherad:TransferSyntaxUIDList/> element which contains a list of one or more <ihe:TransferSyntaxUID> elements. Each of the <iherad:TransferSyntaxUID> elements represent one of the transfer syntax encodings that the Imaging Document Consumer is capable of processing.

This allows the Imaging Document Consumer to specify one or more documents to retrieve from the Imaging Document Source or Initiating Imaging Gateway.

The <ihe:RetrieveDocumentResponse/> element for use with the Retrieve Imaging Document Set Response Message is defined as:

- A required /ihe:RetrieveDocumentSetResponse/rs:RegistryResponse element
- A conditionally required sequence, if a matching document exists with <ihe:DocumentResponse/> elements containing:
  - A conditionally required <ihe:HomeCommunityId/> element. The value of this element shall be the same as the value of the /RetrieveImagingDocumentSetRequest/StudyRequest/SeriesRequest/DocumentRequest/HomeCommunityId element in the Retrieve Document Set Request Message. If the <ihe:HomeCommunityId/> element is not present in the Retrieve Document Set Request Message, this value shall not be present.

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- A required <ihe:RepositoryUniqueId/> that identifies the Imaging Document Source from which the document is to be retrieved. The value of this element shall be the same as the value of the /RetrieveImagingDocumentSetRequest/StudyRequest/SeriesRequest/DocumentRequest/RepositoryUniqueId element in the original Retrieve Imaging Document Set Request Message. This value corresponds to RetrieveLocation UID in the DICOM manifest.
- A required <ihe:DocumentUniqueId/> that identifies the document within the Imaging Document Source. The value of this element shall be the same as the value of the /RetrieveImagingDocumentSetRequest/StudyRequest/SeriesRequest/DocumentRequest/DocumentUniqueId element in the original Retrieve Imaging Document Set Request Message. This value corresponds to the SOP Instance UID referenced within the DICOM manifest.
- A required <ihe:Document/> element that contains the retrieved document as an XOP Infoset.
- A required <ihe:mimeType/> element that indicates the MIME type of the retrieved document

The /RetrieveDocumentSetResponse/rs:RegistryResponse/@status attributes provides the overall status of the request: It shall contain one of the following values:

```
urn:oasis:names:tc:ebxml-regrep:ResponseStatusType:Success
urn:ihe:iti:2007:ResponseStatusType:PartialSuccess
urn:oasis:names:tc:ebxml-regrep:ResponseStatusType:Failure
```

See ITI TF-3: Table 4.2.4.2-4 "[ITI-43] Retrieve Document Set and [ITI-39] Cross Gateway Retrieve Responses" for the interpretation of these values.

For each document requested in a /RetrieveImagingDocumentSetRequest/StudyRequest/SeriesRequest/DocumentRequest element:

- If a warning is reported when retrieving the document, then a /RetrieveDocumentSetResponse/rs:RegistryResponse/rs:RegistryErrorList/rs:RegistryError element shall be returned with:
  - @severity is urn:oasis:names:tc:ebxml-regrep:ErrorSeverityType:Warning
  - @errorCode is specified
  - @codeContext contains the warning message
  - @location contains the DocumentUniqueId of the document requested
- The document shall be returned in an instance of /RetrieveDocumentSetResponse/DocumentResponse/Document as an XOP Infoset. The returned document and warning are correlated via the DocumentUniqueId.

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- If an error is reported when retrieving a document, then a /RetrieveDocumentSetResponse/rs:RegistryResponse/rs:RegistryErrorList/ rs:RegistryError element shall be returned with:
  - @severity is urn:oasis:names:tc:ebxml-regrep:ErrorSeverityType:Error
  - @errorCode is specified
  - @codeContext contains the error message
  - @location contains the DocumentUniqueId of the document requested
- No corresponding RetrieveDocumentSetResponse/DocumentResponse element shall be returned
- If the document is successfully retrieved (without warning) then no /RetrieveDocumentSetResponse/rs:RegistryResponse/rs:RegistryErrorList/ rs:RegistryError element shall be present and a /RetrieveDocumentSetResponse/DocumentResponse/Document element shall be returned containing the document as an XOP Infoset.

The /RetrieveDocumentSetResponse/rs:RegistryResponse/rs:ResponseSlotList element is not used in this transaction.

The /RetrieveDocumentSetResponse/rs:RegistryResponse/@requestId attribute is not used in this transaction.

A full XML Schema Document for the XDS.b and XDS-I.b types is available online at: the IHE Google Drive under IHE Documents > TF_Implementation_Material > Rad (for XDS-I.b) and the IHE Google Drive under IHE Documents > TF_Implementation_Material > ITI (for XDS.b).

4.69.5.1 Sample SOAP Messages

The samples in the following two sections show a typical SOAP request and its relative SOAP response. The sample messages also show the WS-Addressing headers <Action/>, <MessageID/>, <ReplyTo/>…; these WS-Addressing headers are populated according to the ITI TF-2: Appendix V: Web Services for IHE Transactions. The body of the SOAP message is omitted for brevity; in a real scenario the empty element will be populated with the appropriate metadata.

Samples presented in this section are also available in the IHE Google Drive under IHE Documents > TF_Implementation_Material > Rad.

4.69.5.1.1 Sample Retrieve Imaging Document Set SOAP Request

4.69.5.1.1.1 Synchronous Web Services Exchange

```
<?xml version="1.0" encoding="UTF-8"?>
<s:Envelope
  xmlns:s="http://www.w3.org/2003/05/soap-envelope"
  xmlns:a="http://www.w3.org/2005/08/addressing">
  <s:Header>
```


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```
    <a:Action s:mustUnderstand="1">urn:ihe:rad:2009:RetrieveImagingDocumentSet </a:Action>
    <a:MessageID>urn:uuid:0fbfdced-6c01-4d09-a110-2201afedaa02</a:MessageID>
    <a:ReplyTo s:mustUnderstand="1">
      <a:Address>http://www.w3.org/2005/08/addressing/anonymous</a:Address>
    </a:ReplyTo>
    <a:To >http://localhost:2647/XdsService/IHEXDSIDocSource.svc</a:To>
  </s:Header>
  <s:Body>
    <iherad:RetrieveImagingDocumentSetRequest xmlns:iherad="urn:ihe:rad:xdsi-b:2009"
    xmlns:ihe="urn:ihe:iti:xds-b:2007">
      <iherad:StudyRequest studyInstanceUID="1.3.6.1.4...101">
        <iherad:SeriesRequest seriesInstanceUID="1.3.6.1.4...201">
          <ihe:DocumentRequest>
            <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
            <ihe:DocumentUniqueId>1.3.6.1.4...2300</ihe:DocumentUniqueId>
          </ihe:DocumentRequest>
          <ihe:DocumentRequest>
            <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
            <ihe:DocumentUniqueId>1.3.6.1.4...2301</ihe:DocumentUniqueId>
          </ihe:DocumentRequest>
        </iherad:SeriesRequest>
      </iherad:StudyRequest>
      <iherad:TransferSyntaxUIDList>
        <iherad:TransferSyntaxUID> 1.2.840.10008.1.2.1</iherad:TransferSyntaxUID>
        <iherad:TransferSyntaxUID> 1.2.840.10008.1.2.4.57</iherad:TransferSyntaxUID>
        <iherad:TransferSyntaxUID> 1.2.840.10008.1.2.4.70</iherad:TransferSyntaxUID>
      </iherad:TransferSyntaxUIDList>
    </iherad:RetrieveImagingDocumentSetRequest>
  </s:Body>
</s:Envelope>
```

4.69.5.1.1.2 Asynchronous Web Services Exchange

```
<?xml version="1.0" encoding="UTF-8"?>
<s:Envelope xmlns:s="http://www.w3.org/2003/05/soap-envelope"
  xmlns:a="http://www.w3.org/2005/08/addressing">
  <s:Header>
    <a:Action s:mustUnderstand="1">urn:ihe:rad:2009:RetrieveImagingDocumentSet</a:Action>
    <a:MessageID>urn:uuid:0fbfdced-6c01-4d09-a110-2201afedaa02</a:MessageID>
    <a:ReplyTo s:mustUnderstand="1">
      <a:Address>http://192.168.2.4:9080/XcaService/ImagingDocumentConsumer.svc</a:Address>
    </a:ReplyTo>
    <a:To >http://localhost:2647/XdsService/IHEXDSIDocSource.svc</a:To>
  </s:Header>
  <s:Body>
    <iherad:RetrieveImagingDocumentSetRequest xmlns:iherad="urn:ihe:rad:xdsi-b:2009"
      xmlns:ihe="urn:ihe:iti:xds-b:2007">
      <iherad:StudyRequest studyInstanceUID="1.3.6.1.4...101">
        <iherad:SeriesRequest seriesInstanceUID="1.3.6.1.4...201">
          <ihe:DocumentRequest>
            <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
            <ihe:DocumentUniqueId>1.3.6.1.4...2300</ihe:DocumentUniqueId>
          </ihe:DocumentRequest>
          <ihe:DocumentRequest>
            <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
            <ihe:DocumentUniqueId>1.3.6.1.4...2301</ihe:DocumentUniqueId>
          </ihe:DocumentRequest>
        </iherad:SeriesRequest>
      </iherad:StudyRequest>
      <iherad:TransferSyntaxUIDList>
        <iherad:TransferSyntaxUID>1.2.840.10008.1.2.1</iherad:TransferSyntaxUID>
        <iherad:TransferSyntaxUID>1.2.840.10008.1.2.4.57</iherad:TransferSyntaxUID>
        <iherad:TransferSyntaxUID>1.2.840.10008.1.2.4.70</iherad:TransferSyntaxUID>
      </iherad:TransferSyntaxUIDList>
    </iherad:RetrieveImagingDocumentSetRequest>
```

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```
  </s:Body>
</s:Envelope>
```

4.69.5.1.2 Sample Retrieve Document Set SOAP Response

4.69.5.1.2.1 Synchronous Web Services Exchange

```
<?xml version="1.0" encoding="UTF-8"?>
<s:Envelope
  xmlns:s="http://www.w3.org/2003/05/soap-envelope"
  xmlns:a="http://www.w3.org/2005/08/addressing">
  <s:Header>
    <a:Action s:mustUnderstand="1">urn:ihe:iti:2007:RetrieveDocumentSetResponse</a:Action>
    <a:RelatesTo>urn:uuid:0fbfdced-6c01-4d09-a110-2201afedaa02</a:RelatesTo>
  </s:Header>
  <s:Body>
    <ihe:RetrieveDocumentSetResponse xmlns:ihe="urn:ihe:iti:xds-b:2007"
      xmlns:rs="urn:oasis:names:tc:ebxml-regrep:xsd:rs:3.0">
      <rs:RegistryResponse status="urn:oasis:names:tc:ebxml-regrep:ResponseStatusType:Success"/>
      <ihe:DocumentResponse>
        <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
        <ihe:DocumentUniqueId>1.3.6.1.4...2300</ihe:DocumentUniqueId>
        <ihe:mimeType>application/dicom</ihe:mimeType>
        <ihe:Document>UjBsR09EbGhjZ0dTQUxNQUFBUUNBRU1tQ1p0dGUXhEUzhi</ihe:Document>
      </ihe:DocumentResponse>
      <ihe:DocumentResponse>
        <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
        <ihe:DocumentUniqueId>1.3.6.1.4...2301</ihe:DocumentUniqueId>
        <ihe:mimeType>application/dicom</ihe:mimeType>
        <ihe:Document>UjBsR09EbGhjZ0dTQUxNQUFBUUNBRU1tQ1p0dU1GUCx4hu</ihe:Document>
      </ihe:DocumentResponse>
    </ihe:RetrieveDocumentSetResponse>
  </s:Body>
</s:Envelope>
```

4.69.5.1.2.2 Asynchronous Web Services Exchange

```
<?xml version="1.0" encoding="UTF-8"?>
<s:Envelope
  xmlns:s="http://www.w3.org/2003/05/soap-envelope"
  xmlns:a="http://www.w3.org/2005/08/addressing">
  <s:Header>
    <a:Action s:mustUnderstand="1">urn:ihe:iti:2007:RetrieveDocumentSetResponse</a:Action>
    <a:MessageID>urn:uuid:D6C21225-8E7B-454E-9750-821622C099DB</a:MessageID>
    <a:RelatesTo>urn:uuid:0fbfdced-6c01-4d09-a110-2201afedaa02</a:RelatesTo>
    <a:To
s:mustUnderstand="1">http://localhost:2647/XdsService/DocumentConsumerReceiver.svc</a:To>
  </s:Header>
  <s:Body>
    <ihe:RetrieveDocumentSetResponse xmlns:ihe="urn:ihe:iti:xds-b:2007"
      xmlns:rs="urn:oasis:names:tc:ebxml-regrep:xsd:rs:3.0">
      <rs:RegistryResponse status="urn:oasis:names:tc:ebxml-regrep:ResponseStatusType:Success"/>
      <ihe:DocumentResponse>
        <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
        <ihe:DocumentUniqueId>1.3.6.1.4...2300</ihe:DocumentUniqueId>
        <ihe:mimeType>application/dicom</ihe:mimeType>
        <ihe:Document>UjBsR09EbGhjZ0dTQUxNQUFBUUNBRU1tQ1p0dGUXhEUzhi</ihe:Document>
      </ihe:DocumentResponse>
      <ihe:DocumentResponse>
        <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
        <ihe:DocumentUniqueId>1.3.6.1.4...2301</ihe:DocumentUniqueId>
        <ihe:mimeType>application/dicom</ihe:mimeType>
        <ihe:Document>UjBsR09EbGhjZ0dTQUxNQUFBUUNBRU1tQ1p0dU1GUCx4hu</ihe:Document>
      </ihe:DocumentResponse>
    </ihe:RetrieveDocumentSetResponse>
```

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```
  </s:Body>
</s:Envelope>
```

4.70 Image Manager Instances Stored [RAD-70]

This transaction is currently in the Multiple Image Manager/Archive (MIMA) Trial Implementation Supplement.

4.71 Image Manager Storage Commitment [RAD-71]

This transaction is currently in the Multiple Image Manager/Archive (MIMA) Trial Implementation Supplement.

4.72 Image Manager Instances Query [RAD-72]

This transaction is currently in the Multiple Image Manager/Archive (MIMA) Trial Implementation Supplement.

4.73 Image Manager Instances Retrieval [RAD-73]

This transaction is currently in the Multiple Image Manager/Archive (MIMA) Trial Implementation Supplement.

4.74 Replacement Instances Stored [RAD-74]

4.74.1 Scope

In the Replacement Instances Stored transaction, the Change Requester sends to the Image Manager/Archive new instances (images, presentation states, key image notes, etc.) that represent versions of existing instances that have been corrected in some way (e.g., corrected demographics, view information, or updated annotations).

Acquisition of additional SOP Instances, such as if correction of a Modality Worklist Selection requires additional SOP Instances to be acquired, is out of scope of this transaction, as this is covered by the Scheduled Workflow Profile.

4.74.2 Actor Roles

Actor: Change Requester

Role: Transmit updated instances to Image Manager/Archive.

Actor: Image Manager/Archive

Role: Accept updated instances from Change Requester.

4.74.3 Referenced Standard

DICOM PS3.4 Annex B: Storage Service Class.

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4.74.4 Messages

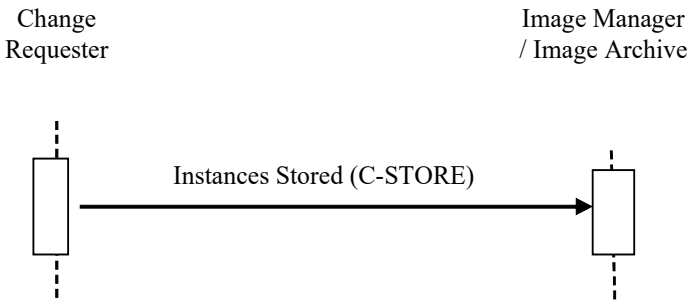

Figure 4.74.4-1: Interaction Diagram

4.74.4.1 Instances Stored

4.74.4.1.1 Trigger Events

The Change Requester has created new replacement instances and needs to send them to the Image Manager/Archive.

4.74.4.1.2 Message Semantics

The Change Requester uses the DICOM C-STORE message to transfer the new instances. The Change Requester is the DICOM Storage SCU and the Image Manager/Archive is the DICOM Storage SCP.

A replacement instance created by the Change Requester shall:

- Have the same SOP Class as the replaced instance
- Belong to a new series
- Set the header information according to the correct modality worklist entry if correction is the result of new modality worklist selection (see Section 4.74.4.1.2.1)
- Update the Critical Attributes as described in Table 4.74.4.1.2-1

Table 4.74.4.1.2-1: Critical Attributes for Replacement Instances

DICOM Attribute	DICOM Tag	Type	Description
Study Instance UID	(0020,000D)	R	Use Study Instance UID of the target study [IHE-1]
Series Instance UID	(0020,000E)	R	Generate new UID [IHE-2]
SOP Instance UID	(0008,0018)	R	Generate new UID [IHE-3]
Contributing Equipment Sequence	(0018,A001)	RC	Identification of the equipment that creates the replacement instances Required if the Change Requester is not the same as the original creator of the replaced instances.

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DICOM Attribute	DICOM Tag	Type	Description
> Purpose of Referenced Code Sequence	(0040,A170)	R	Describes the purpose for which the related equipment is being referenced. Use an appropriate code from Table 4.74.4.1.2-2
> Manufacturer	(0008,0070)	R	Manufacturer of the Change Requester
> Institution Name	(0008,0080)	R+	Institution where the Change Requester locates
> Station Name	(0008,1010)	R+	AE Title of the Change Requester
> Contribution DateTime	(0018,A002)	R+	The creation date and time of the replacement instances

IHE-1: The new instances shall be associated with the study that they are targeted for. Therefore, if the new instance replaces an existing instance within the same study, then the Study Instance UID shall remain the same. On the other hand, if the new instance is created due to correction of the modality worklist entry, then the Study Instance UID shall be the Study Instance UID associated with the correct modality worklist entry.

IHE-2: New Series Instance UID means that the newly created instance will not reuse any existing Series Instance UID. According to DICOM, an existing series can only be expanded with new objects if the new objects are created by the same equipment while the procedure step is still in progress. This is not the case for IOCM. As a result, a new series is required for the replacement instances.

IHE-3: New SOP Instance UID means that the instance is a new instance, not the same existing instance with updated header information. See Section 4.74.4.1.2.1 for details about replacement of SOP Instance UID.

Table 4.74.4.1.2-2: Codes for Contributing Equipment

Code Value	Code Scheme Designator	Code Meaning
DCM	109103	Modifying Equipment

A Change Requester grouped with an Acquisition Modality shall also support the semantics defined in Modality Images Stored [RAD-8] and Modality Presentation State Stored [RAD-9].

A Change Requester grouped with an Evidence Creator shall also support the semantics defined in the Creator Images Stored [RAD-18] and Creator Presentation State Stored [RAD-19].

A Change Requester grouped with an Image Manager/Archive that supports the Scheduled Workflow Multiple Identity Resolution Option, shall also support the semantics defined in Image Manager Instances Stored [RAD-70].

4.74.4.1.2.1 Correction of Scheduled Procedure Information

Correction of scheduled procedure information in the corrected instances will be based on information from the modality worklist entry when the Change Requester is an Acquisition Modality. When a Change Requester is an Image Manager/Archive, it can get the same information from the Procedure Scheduled [RAD-4] transaction. The following text will refer only to the modality worklist case. The use of [RAD-4] information should be understood. Note that when using Table 4.74.4.1.2.1-1 and Tables defined in RAD TF-2x: Appendix A.1, the Modality Worklist column refers to the correct Modality Worklist item, and the Image/Standalone IOD and MPPS IOD columns are for the replacement SOP Instances and their corresponding MPPS.

During correction of scheduled procedure information, the Change Requester shall create new instances from the originally acquired instances which replace these original instances.

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Two alternative scenarios can follow, depending upon whether or not the acquired images are relevant to the actual scheduled procedure for the correct patient. Regardless, of which scenario occurs, if additional images need to be acquired for the actual scheduled procedure for the correct patient then this shall be done according to Scheduled Workflow.

If it is determined that the originally acquired images are relevant to the actual scheduled procedure for the correct patient, or if a new scheduled procedure has been created on the DSS/OF for these images, then the patient and procedure attribute values can be taken from this scheduled information. The required mapping of attributes shall be as defined in RAD TF-2x: Appendix A.1, unless the mapping rules are overridden by the attribute mapping defined in in Table 4.74.4.1.2.1-1.

Table 4.74.4.1.2.1-1: Critical Attributes Mapping Exception

DICOM attribute	Modality Worklist	Filling values for:	
	(return attribute values)	Image/ Standalone IOD	MPPS IOD
Performed Protocol Code Sequence (0040,0260)	n.a.	Copy from the Original Instance or Original MPPS. The Performed Procedure Step for a corrected SOP Instance will still be that of the originally selected Modality Worklist item (and thus may not correspond to the correct one).	Copy from the Original Instance or Original MPPS. The Performed Procedure Step for a corrected SOP Instance will still be that of the originally selected Modality Worklist item (and thus may not correspond to the correct one).
Performed Procedure Step ID (0040,0253)	n.a.	Copy from the Original Instance or Original MPPS.	
Performed Procedure Step Start Date (0040,0244)	n.a.	Copy from the Original Instance or Original MPPS.	Copy from the Original Instance or Original MPPS.
Performed Procedure Step Start Time (0040,0245)	n.a.	Copy from the Original Instance or Original MPPS.	Copy from the Original Instance or Original MPPS.
Performed Procedure Step Description (0040,0254)	n.a.	Copy from the Original Instance or Original MPPS.	Copy from the Original Instance or Original MPPS.
Protocol Name (0018,1030)	n.a.	Copy from the Original Instance or Original MPPS.	**Performed Series Sequence** (0040,0340) Copy from the Original Instance or Original MPPS.

Alternatively, if the originally acquired images are not relevant to the actual scheduled procedure for the correct patient, and no new scheduled procedure has been created on the DSS/OF for these images, then the images could be manually corrected as for an unscheduled exam.

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4.74.4.1.2.2 Maintenance of Instance Referential Integrity

Since SOP Instance UIDs are sometimes used as references in other related instances (e.g., Referenced Images Sequence in GSPS objects), the Change Requester shall ensure the consistency of SOP Instance references for all instances that it is aware of (e.g., possesses) and for SOP Classes for which it claims support in this respect in its DICOM Conformance Statement, irrespective of the source of the instances, and irrespective of whether or not the Change Requester is grouped with an Acquisition Modality, Evidence Creator or Image Manager/Archive. For example, if the Change Requester replaces the original object Image1 (SOP Instance UID 1.2.3) by replacement object Image2 (SOP Instance UID 1.2.3.1), then the Change Requester shall also correct existing GSPS object GSPS1 that has a reference to Image1 by replacing it with a new GSPS object GSPS2 that has the corrected reference to Image2.

A Change Requester may not have sufficient understanding of the structure of the underlying references in the IOD to maintain referential integrity. At minimum, a Change Requester shall be capable of correcting SOP Instance UID references within Images, Presentation States, Key Image Notes and Structured Reports. The Change Requester is not required to maintain the referential integrity of references within Private Attributes.

A Change Requester shall not replace SOP Instance UID references in the Rejection Note itself and shall not replace the SOP Instance UIDs of the instances that are being rejected.

As an example, if the Change Requester maintains a map of rejected SOP Instance UIDs to replacement UIDs, if any, the Change Requester may replace all references in all instances to rejected UIDs with replacement UIDs to maintain referential integrity without needing to inherently understand the entire structure of the IOD for a SOP Class and irrespective of whether the instance is known at the time of the change request being received or subsequently.

The receiving Image Manager/Archive is not required to correct the content of other instances it has stored in order to maintain the referential integrity within a study based on receipt of a Rejection Note or replacement instances, though it is not prohibited from attempting to do so. If the Image Manager/Archive receives instances for the same study from sources other than those grouped with the Change Requester, then it is possible that the references to some instances may be incorrect (e.g., When GSPS instances are not rejected in the Rejection Note but received from an Evidence Creator not grouped with the Change Requester, such GSPS instances may reference rejected image instances and the Image Manager Archive has no means of determining what the UIDs of the replacement instances are, if any).

Note: A receiving Image Manager/Archive should be wary of removing an instance that references rejected instances, since the other content of the referring instance may still be useful. E.g., the referring instance might be a report with measurements that need to be retained, even though it contains references to rejected images. It may be appropriate to raise an exception and require human intervention in such cases.

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4.74.4.1.3 Expected Actions

The Image Manager/Archive shall store the received DICOM objects such that they can be later retrieved (see Retrieve Images [RAD-16]) in a fashion meeting the requirements defined for a DICOM Level 2 Storage SCP (Refer to DICOM PS3.4 Section B.4.1).

4.75 Cross Gateway Retrieve Imaging Document Set [RAD-75]

4.75.1 Scope

This transaction is used to retrieve DICOM instances from a remote community.

4.75.2 Actor Roles

Actor: Initiating Imaging Gateway

Role: requests DICOM instances from a remote community.

Actor: Responding Imaging Gateway

Role: returns the requested DICOM instances.

4.75.3 Referenced Standard

For a list of the standards inherited from the underlying Retrieve Document Set [ITI-43] transaction; see ITI TF-2: 3.43.3.

4.75.4 Messages

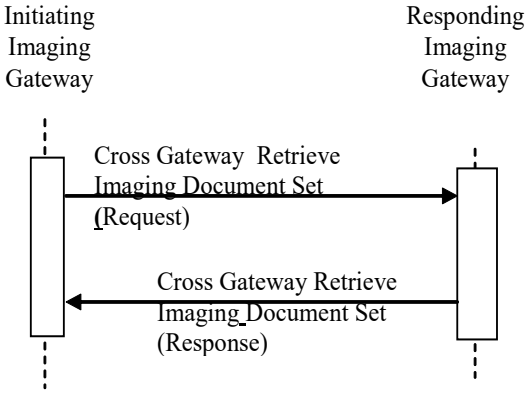

Figure 4.75.4-1: Interaction Diagram

4.75.4.1 Cross Gateway Retrieve Imaging Document Set

The Cross Gateway Retrieve Imaging Document Set uses the same syntax and standards as the Retrieve Imaging Document Set transaction specified in [RAD-69]. See Section 4.69.

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4.75.4.1.1 Trigger Events

This message is initiated by the Initiating Imaging Gateway to retrieve Imaging Document Set(s) from another community represented by a Responding Imaging Gateway. The triggers for the Initiating Imaging Gateway include:

- a Retrieve Imaging Document Set [RAD-69] request initiated by an Imaging Document Consumer within the Initiating Imaging Gateway's community.
- Prefetch logic as a result of a retrieval of a DICOM manifest

4.75.4.1.2 Message Semantics

The message semantics for Cross Gateway Retrieve Imaging Document Set are the same as Retrieve Imaging Document Set [RAD-69] Request Message. See Section 4.69.4.1.2.

4.75.4.1.3 Expected Actions

The Responding Imaging Gateway shall determine the Imaging Document Source(s) which hold the DICOM instances requested and initiate a [RAD-69] transaction to those Imaging Document Sources.

If more than one Imaging Document Source is contacted, the Responding Imaging Gateway shall consolidate the results from the multiple sources into one response to the Initiating Imaging Gateway. If both successes and failures are received, the Responding Imaging Gateway may choose to use PartialSuccess status to reflect both failure and success. The Responding Imaging Gateway may alternatively choose to suppress the failures and report only successes.

Every RegistryError element returned in the response shall have the location attribute set to the homeCommunityId of the Responding Imaging Gateway.

The Responding Imaging Gateway shall return consolidated responses according to message semantics for the Retrieve Imaging Document Set Response message in Section 4.69.4.2.2.

4.75.4.2 Asynchronous Web Service Method

An Initiating Imaging Gateway that supports the Asynchronous Web Services Option shall use the Asynchronous Web Services Exchange method.

The Responding Imaging Gateway shall respond to an Initiating Imaging Gateway using the Asynchronous Web Service Method.

The Initiating Imaging Gateway supporting this method shall use the non-anonymous response EPR in the WS-Addressing replyTo header.

The Initiating and Responding Imaging Gateways shall support the Asynchronous Web Services Methods in the ITI TF-2: Appendix V.5: Web Services for IHE Transactions, which also includes additional considerations for implementers.

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4.75.5 Protocol Requirements

The Cross Gateway Retrieve Imaging Document Set request and response protocol requirements are identical to the Retrieve Imaging Document Set Transaction except as noted below.

Table 4.75.5-1: WSDL Namespace Definitions

Soap	http://schemas.xmlsoap.org/wsdl/soap/
soap12	http://schemas.xmlsoap.org/wsdl/soap12/
Wsaw	http://www.w3.org/2006/05/addressing/wsdl/
Xsd	http://www.w3.org/2001/XMLSchema
Iherad	urn:ihe:rad:xdsi-b:2009
Ihe	urn:ihe:iti:xds-b:2007
Rs	urn:oasis:names:tc:ebxml-regrep:xsd:rs:3.0
Lcm	urn:oasis:names:tc:ebxml-regrep:xsd:lcm:3.0
Query	urn:oasis:names:tc:ebxml-regrep:xsd:query:3.0

Responding Imaging Gateway: These are the requirements for the Cross Gateway Retrieve Imaging Document Set transaction presented in the order in which they would appear in the Responding Imaging Gateway WSDL definition:

- The following types shall be imported (xsd:import) in the /definitions/types section:
  - namespace=”urn:ihe:rad:xdsi-b:2009”, schema=”XDSI.b_ImagingDocumentSource.xsd”

    The baseline XDS.b schema (namespace=”urn:ihe:iti:xds-b:2007”, schema=”XDS.b_DocumentRepository.xsd”)
- The /definitions/message/part/@element attribute of the Cross Gateway Retrieve Imaging Document Set Request message shall be defined as “iherad:RetrieveImagingDocumentSetRequest”
- The /definitions/message/part/@element attribute of the Cross Gateway Retrieve Imaging Document Set Response message shall be defined as “urn:ihe:iti:2007:RetrieveDocumentSetResponse”

Attributes shall be set as described below Table 4.75.5-2.

To support Asynchronous Web Services Exchange on the Imaging Document Consumer or the Responding Imaging Gateway, the Imaging Document Source or the Initiating Imaging Gateway shall support the use of a non-anonymous response EPR in the WS-Addressing replyTo header.

Table 4.75.5-2: Requirements for portType and Binding attributes

Attribute	Web Service Exchange
/definitions/portType/operation@name	RespondingGateway_CrossGatewayRetrieveImagingDocumentSet

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Attribute	Web Service Exchange
/definitions/portType/operation/input/@wsaw:Action	urn:ihe:rad:2011:CrossGatewayRetrieveImagingDocumentSet
/definitions/portType/operation/output/@wsaw:Action	urn:ihe:rad:2011:CrossGatewayRetrieveImagingDocumentSetResponse
/definitions/binding/operation/soap12:operation/@soapAction	urn:ihe:rad:2011:CrossGatewayRetrieveImagingDocumentSet

These are the requirements that affect the wire format of the SOAP message. The other WSDL properties are only used within the WSDL definition and do not affect interoperability. Full sample request and response messages are in Section 4.75.5.1 Sample SOAP Messages.

For informative WSDL for the Responding Gateway see ITI TF-2: Appendix W.

The <iherad:RetrieveImagingDocumentSetRequest/> element is defined in Section 4.69.5. When used within the Cross Gateway Retrieve Imaging Document Set the <ihe:HomeCommunityId/> element is required.

A full XML Schema Document, the WSDL and sample messages for the XCA-I types, are available in the IHE Google Drive under IHE Documents > TF_Implementation_Material > Rad.

4.75.5.1 Sample SOAP Messages

The samples in the following two sections show a typical SOAP request and its relative SOAP response. The sample messages also show the WS-Addressing headers <Action/>, <MessageID/>, <ReplyTo/>…; these WS-Addressing headers are populated according to the W3C WS-Addressing standard. The body of the SOAP message is omitted for brevity; in a real scenario the empty element will be populated with the appropriate metadata.

Samples presented in this section are also available in the IHE Google Drive under IHE Documents > TF_Implementation_Material > Rad.

4.75.5.1.1 Sample Cross Gateway Retrieve Imaging Document Set SOAP Request

4.75.5.1.1.1 Synchronous Web Services Exchange

```
<?xml version="1.0" encoding="UTF-8"?>
<s:Envelope
    xmlns:s="http://www.w3.org/2003/05/soap-envelope"
    xmlns:a="http://www.w3.org/2005/08/addressing">
  <s:Header>
    <a:Action
s:mustUnderstand="1">urn:ihe:rad:2011:CrossGatewayRetrieveImagingDocumentSet</a:Action>
    <a:MessageID>urn:uuid:0fbfdced-6c01-4d09-a110-2201afedaa02</a:MessageID>
    <a:ReplyTo>
      <a:Address>http://www.w3.org/2005/08/addressing/anonymous</a:Address>
    </a:ReplyTo>
    <a:To s:mustUnderstand="1" >http://localhost:2647/XcaService/IHEXCAIGateway.svc</a:To>
  </s:Header>
<s:Body>
    <iherad:RetrieveImagingDocumentSetRequest xmlns:iherad="urn:ihe:rad:xdsi-b:2009"
    xmlns:ihe="urn:ihe:iti:xds-b:2007">
```


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```
      <iherad:StudyRequest studyInstanceUID="1.3.6.1.4...101">
        <iherad:SeriesRequest seriesInstanceUID="1.3.6.1.4...201">
          <ihe:DocumentRequest>
            <ihe:HomeCommunityId>urn:oid:1.2.3.4</ihe:HomeCommunityId>
            <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
            <ihe:DocumentUniqueId>1.3.6.1.4...2300</ihe:DocumentUniqueId>
          </ihe:DocumentRequest>
          <ihe:DocumentRequest>
            <ihe:HomeCommunityId>urn:oid:1.2.3.4</ihe:HomeCommunityId>
            <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
            <ihe:DocumentUniqueId>1.3.6.1.4...2301</ihe:DocumentUniqueId>
          </ihe:DocumentRequest>
        </iherad:SeriesRequest>
      </iherad:StudyRequest>
      <iherad:TransferSyntaxUIDList>
        <iherad:TransferSyntaxUID> 1.2.840.10008.1.2.1</iherad:TransferSyntaxUID>
        <iherad:TransferSyntaxUID> 1.2.840.10008.1.2.4.57</iherad:TransferSyntaxUID>
        <iherad:TransferSyntaxUID> 1.2.840.10008.1.2.4.70</iherad:TransferSyntaxUID>
      </iherad:TransferSyntaxUIDList>
    </iherad:RetrieveImagingDocumentSetRequest>
  </s:Body>
</s:Envelope>
```

4.75.5.1.1.2 Asynchronous Web Services Exchange

```
<?xml version="1.0" encoding="UTF-8"?>
<s:Envelope
    xmlns:s="http://www.w3.org/2003/05/soap-envelope"
    xmlns:a="http://www.w3.org/2005/08/addressing">
  <s:Header>
    <a:Action s:mustUnderstand="1">urn:ihe:rad:2011:CrossGatewayRetrieveImagingDocumentSet
</a:Action>
    <a:MessageID>urn:uuid:0fbfdced-6c01-4d09-a110-2201afedaa02</a:MessageID>
    <a:ReplyTo>
      http://192.168.2.4:9080/XcaiService/InitiatingImagingGatewayReceiver.svc
    </a:ReplyTo>
    <a:To s:mustUnderstand="1">http://localhost:2647/XcaiService/IHEXCAIGateway.svc</a:To>
  </s:Header>
<s:Body>
    <iherad:RetrieveImagingDocumentSetRequest xmlns:iherad="urn:ihe:rad:xdsi-b:2009"
      xmlns:ihe="urn:ihe:iti:xds-b:2007">
      <iherad:StudyRequest studyInstanceUID="1.3.6.1.4...101">
        <iherad:SeriesRequest seriesInstanceUID="1.3.6.1.4...201">
          <ihe:DocumentRequest>
            <ihe:HomeCommunityId>urn:oid:1.2.3.4</ihe:HomeCommunityId>
            <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
            <ihe:DocumentUniqueId>1.3.6.1.4...2300</ihe:DocumentUniqueId>
          </ihe:DocumentRequest>
          <ihe:DocumentRequest>
            <ihe:HomeCommunityId>urn:oid:1.2.3.4</ihe:HomeCommunityId>
            <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
            <ihe:DocumentUniqueId>1.3.6.1.4...2301</ihe:DocumentUniqueId>
          </ihe:DocumentRequest>
        </iherad:SeriesRequest>
      </iherad:StudyRequest>
      <iherad:TransferSyntaxUIDList>
        <iherad:TransferSyntaxUID> 1.2.840.10008.1.2.1</iherad:TransferSyntaxUID>
        <iherad:TransferSyntaxUID> 1.2.840.10008.1.2.4.57</iherad:TransferSyntaxUID>
        <iherad:TransferSyntaxUID> 1.2.840.10008.1.2.4.70</iherad:TransferSyntaxUID>
      </iherad:TransferSyntaxUIDList>
    </iherad:RetrieveImagingDocumentSetRequest>
  </s:Body>
</s:Envelope>
```

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4.75.5.1.2 Sample Cross Gateway Retrieve Imaging Document Set SOAP Response

4.75.5.1.2.1 Synchronous Web Services Exchange

```
<?xml version="1.0" encoding="UTF-8"?>
<s:Envelope xmlns:s="http://www.w3.org/2003/05/soap-envelope"
xmlns:a="http://www.w3.org/2005/08/addressing">
  <s:Header>
    <a:Action
s:mustUnderstand="1">urn:ihe:rad:2011:CrossGatewayRetrieveImagingDocumentSetResponse</a:Action>
    <a:RelatesTo>urn:uuid:0fbfdced-6c01-4d09-a110-2201afedaa02</a:RelatesTo>
  </s:Header>
  <s:Body>
    <ihe:RetrieveDocumentSetResponse xmlns:ihe="urn:ihe:iti:xds-b:2007"
      xmlns:rs="urn:oasis:names:tc:ebxml-regrep:xsd:rs:3.0">
      <rs:RegistryResponse status="urn:oasis:names:tc:ebxml-regrep:ResponseStatusType:Success"/>
      <ihe:DocumentResponse>
        <ihe:HomeCommunityId>urn:oid:1.2.3.4</ihe:HomeCommunityId>
        <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
        <ihe:DocumentUniqueId>1.3.6.1.4...2300</ihe:DocumentUniqueId>
        <ihe:mimeType>application/dicom</ihe:mimeType>
        <ihe:Document>UjBsR09EbGhjZ0dTQUxNQUFBUUNBRU1tQ1p0dGUXhEUzhi</ihe:Document>
      </ihe:DocumentResponse>
      <ihe:DocumentResponse>
        <ihe:HomeCommunityId>urn:oid:1.2.3.4</ihe:HomeCommunityId>
        <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
        <ihe:DocumentUniqueId>1.3.6.1.4...2301</ihe:DocumentUniqueId>
        <ihe:mimeType>application/dicom</ihe:mimeType>
        <ihe:Document>UjBsR09EbGhjZ0dTQUxNQUFBUUNBRU1tQ1p0dU1GUCx4hu</ihe:Document>
      </ihe:DocumentResponse>
    </ihe:RetrieveDocumentSetResponse>
  </s:Body>
</s:Envelope>
```

4.75.5.1.2.2 Asynchronous Web Services Exchange

```
<?xml version="1.0" encoding="UTF-8"?>
<s:Envelope
  xmlns:s="http://www.w3.org/2003/05/soap-envelope"
  xmlns:a="http://www.w3.org/2005/08/addressing">
  <s:Header>
    <a:Action
s:mustUnderstand="1">urn:ihe:rad:2011:CrossGatewayRetrieveImagingDocumentSetResponse</a:Action>
    <a:MessageID>urn:uuid:D6C21225-8E7B-454E-9750-821622C099DB</a:MessageID>
    <a:RelatesTo>urn:uuid:0fbfdced-6c01-4d09-a110-2201afedaa02</a:RelatesTo>
    <a:To s:mustUnderstand="1">
http://192.168.2.4:9080/XcaiService/InitiatingImagingGatewayReceiver.svc </a:To>
  </s:Header>
  <s:Body>
    <ihe:RetrieveDocumentSetResponse xmlns:ihe="urn:ihe:iti:xds-b:2007"
      xmlns:rs="urn:oasis:names:tc:ebxml-regrep:xsd:rs:3.0">
      <rs:RegistryResponse status="urn:oasis:names:tc:ebxml-regrep:ResponseStatusType:Success"/>
      <ihe:DocumentResponse>
        <ihe:HomeCommunityId>urn:oid:1.2.3.4</ihe:HomeCommunityId>
        <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
        <ihe:DocumentUniqueId>1.3.6.1.4...2300</ihe:DocumentUniqueId>
        <ihe:mimeType>application/dicom</ihe:mimeType>
        <ihe:Document>UjBsR09EbGhjZ0dTQUxNQUFBUUNBRU1tQ1p0dGUXhEUzhi</ihe:Document>
      </ihe:DocumentResponse>
      <ihe:DocumentResponse>
        <ihe:HomeCommunityId>urn:oid:1.2.3.4</ihe:HomeCommunityId>
        <ihe:RepositoryUniqueId>1.3.6.1.4...1000</ihe:RepositoryUniqueId>
```

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```
        <ihe:DocumentUniqueId>1.3.6.1.4...2301</ihe:DocumentUniqueId>
        <ihe:mimeType>application/dicom</ihe:mimeType>
        <ihe:Document>UjBsR09EbGhjZ0dTQUxNQUFBUUNBRU1tQ1p0dU1GUCx4hu</ihe:Document>
      </ihe:DocumentResponse>
    </ihe:RetrieveDocumentSetResponse>
  </s:Body>
</s:Envelope>
```

4.76 Query for Studies [RAD-76]

This transaction is currently in the Import Reconciliation Workflow (IRWF.b) Trial Implementation Supplement.

4.77 Query for Patient ID [RAD-77]

This transaction is currently in the Import Reconciliation Workflow (IRWF.b) Trial Implementation Supplement.

4.78 Request Filling of Order [RAD-78]

This transaction is currently in the Import Reconciliation Workflow (IRWF.b) Trial Implementation Supplement.

4.79 Import Instructions Request [RAD-79]

This transaction is currently in the Import Reconciliation Workflow (IRWF.b) Trial Implementation Supplement.

4.80 [RAD-80] – [RAD-102]

These transactions are currently in the Post-Acquisition Workflow (PAWF) Trial Implementation Supplement

4.103 Retrieve Imaging Report Template [RAD-103]

4.103.1 Scope

This transaction is used to retrieve a template from a Report Template Manager in the proper format.

4.103.2 Actor Roles

Table 4.103.2-1: Actor Roles

Role:	**Requester:** Requests a template or templates from the Responder
Actor(s):	The following actor may play the role of Requester: • Report Creator
Role:	**Responder:** Provides a template or templates in response to the request

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Actor(s):	The following actor may play the role of Responder: • Report Template Manager

Transaction text specifies behavior for each role. The behavior of specific actors may also be specified when it goes beyond that of the general role.

4.103.3 Referenced Standards

- IETF RFC2616 HyperText Transfer Protocol HTTP/1.1
- Extensible Markup Language (XML) 1.0 (Second Edition). W3C Recommendation 6 October 2000. http://www.w3.org/TR/REC-xml.
- Dublin Core Metadata Element Set, standardized as ISO Standard 15836: 2009 and ANSI/NISO Standard Z39.85-2012. http://dublincore.org/documents/dces/

4.103.4 Messages

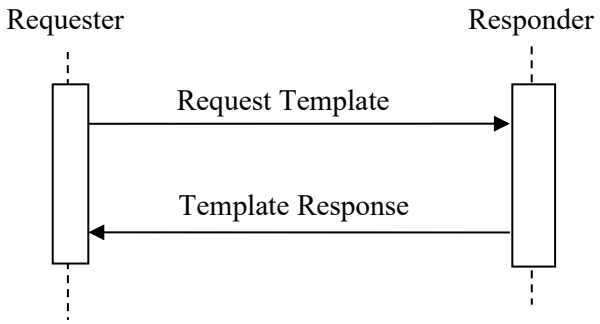

Figure 4.103.4-1: Interaction Diagram

4.103.4.1 Request Template Message

The Requester sends a message to the Responder indicating the templates it would like to receive.

A Responder shall support handling such messages from more than one Requester. A Requester may choose to support making requests to more than one Responder.

4.103.4.1.1 Trigger Events

1. A Requester needs to collect templates for later use in anticipation of reporting in the future.
5. The user of a Requester, such as a Report Creator, invokes a template.
6. A Requester needs to retrieve a template that has been referenced by another template.

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4.103.4.1.2 Message Semantics

The message is an HTTP GET request.

The HTTP request shall include the following parameters to identify the template to be returned. All parameter names and values are case-sensitive.

Table 4.103.4.1.2-1: HTTP Path Parameters

Parameter Name	REQ	Description	Values
`templateUID`	R	Identifies template's UID as known to both actors, expressed by the dcterms.identifier element shown in RAD TF-3: Table 8.1.1-1.	This value shall be a properly defined Object identifier (OID) as specified in ITI TF-2x: Appendix B.

The only binding required for both the Requester and Responder is the binding to the HTTP-GET. In this binding the sample message will be formatted as follows:

`http://<location>/IHETemplateService/<templateUID>`

The `<location>` part of the URL shall contain the host name, an optional port address, and may be followed by an optional path. The remainder of the URL, including `IHETemplateService` and the following request parameters shall not be changed. See the discussion about location in ITI TF-2: 3.11.4.1.2 Message Semantics.

If necessary, the Requester may perform the request to the web service utilizing HTTPS protocol. The Responder shall respond using HTTPS if requested.

The Responder may return HTTP redirect responses to a request. The Requester can expect to receive an error response, or the data requested, or a request to look elsewhere for the data. The Requester shall follow redirects, but if a loop is detected, it may report an error.

4.103.4.1.3 Expected Actions

The Responder shall parse the request and create a response containing the templates meeting the parameters of the request in the proper format. If multiple requests are received, each is handled in sequence.

The Responder shall provide a response message header containing the appropriate status code indicating success, warning, or failure as shown in Table 4.103.4.1.3-1.

Table 4.103.4.1.3-1: HTTP Responses

Service Status	HTTP1.1 Status Codes	Description
Failure (see Note 2)	503 – Busy	This indicates that the Responder was unable to provide the template because it was out of resources.

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Service Status	HTTP1.1 Status Codes	Description
	404 – Not Found	This indicates that the Responder was unable to provide the template because it did not exist on the responder at the time of the request.
	401 — Unauthorized	This indicates that the Responder refused to provide a template because authentication credentials were not provided or not sufficient.
	400 – Bad Request	This indicates that the Responder was unable to provide the template because the template UID is missing or corrupt.
Success	200 – OK	This indicates that the request was successful and the Responder will provide the template.

Note 1: Other HTTP response codes may be returned by the Responder, indicating conditions outside of the scope of this transaction.

Note 2: It is recommended that the Responder complement the returned error code with a human readable description of the error condition.

If an error condition cannot be automatically recovered, at a minimum, the error should be displayed to the user by the Requester.

The Requester may wish to request any templates that are embedded in the response (see RAD TF-3: 8.1.4) immediately, rather than retrieve embedded templates on demand later when the Responder may not be available.

4.103.4.2 Template Response Message

The Responder transmits the requested templates to the Requester.

4.103.4.2.1 Trigger Events

The Template Response message is created in response to a Responder receiving a Request Template message.

4.103.4.2.2 Message Semantics

The message is a document in a HTTP GET response.

4.103.4.2.3 Expected Actions

The Responder shall format the document according to content definition in RAD TF-3: 8.1, and return it in the HTTP response. The document shall be processed according to the features, configuration, and business logic of the Requester. Possibilities include making the template accessible to the user.

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4.103.5 Security Considerations

Although the content of templates is not typically protected information, for consistency with other transactions on the client, which likely will involve protected information, it is reasonable to expect support for HTTPS.

4.103.5.1 Security Audit Considerations

None

4.104 Store Imaging Report Template [RAD-104]

4.104.1 Scope

This transaction is used to store templates in the proper format on another system.

4.104.2 Actor Roles

Table 4.104.2-1: Actor Roles

Role:	**Sender:** Sends and requests storage of templates
Actor(s):	The following actors may play the role of Sender: • Report Template Creator • Report Template Manager
Role:	**Receiver:** Receives and stores templates
Actor(s):	The following actor may play the role of Receiver: • Report Template Manager

Transaction text specifies behavior for each role. The behavior of specific actors may also be specified when it goes beyond that of the general role.

4.104.3 Referenced Standards

- IETF RFC2616 HyperText Transfer Protocol HTTP/1.1
- Extensible Markup Language (XML) 1.0 (Second Edition). W3C Recommendation 6 October 2000. http://www.w3.org/TR/REC-xml.
- Dublin Core Metadata Element Set, standardized as ISO Standard 15836: 2009 and ANSI/NISO Standard Z39.85-2012. http://dublincore.org/documents/dces/

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4.104.4 Messages

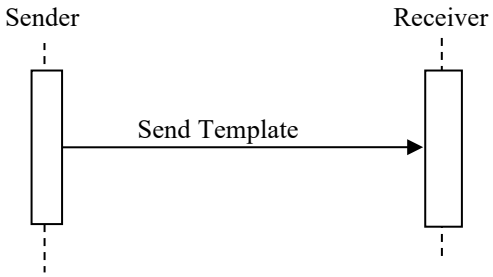

Figure 4.104.4-1: Interaction

4.104.4.1 Send Template Message

The Sender provides the template to a Receiver.

A Receiver shall support handling such messages from more than one Sender. A Sender may choose to support storing templates to more than one Receiver.

4.104.4.1.1Trigger Events

1. A Report Template Manager (acting as a Sender) needs to transmit a template to another Report Template Manager (acting as a Receiver) for storage.
2. A Report Template Creator (acting as a Sender) needs to store a template that it has created or updated.

4.104.4.1.2 Message Semantics

The message is an HTTP PUT request. The Sender shall format the document according to content definition in RAD TF-3: 8.1.

The HTTP request shall include the following parameters to identify the template to be stored. All parameter names and values are case-sensitive.

Table 4.104.4.1.2-1: HTTP Path Parameters

Parameter Name	REQ	Description	Values
`templateUID`	R	Identifies template's UID as known to both actors.	This value shall be a properly defined Object identifier (OID) as specified in ITI TF-2: Appendix B. The value of **`templateUID`** shall match the value of the dcterms.identifier attribute in the report template's metadata. See RAD TF-3: Table 8.1.1-1. If the Sender has changed the **`body`** element of an existing report template, it shall create a new **`templateUID`** for the template.

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			If the Sender updates elements in the **head** element of a report template, it is permitted to retain the value of **templateUID**. Note 1: Replacement of templates is intended to allow the Sender to update metadata (for example changing the status from ACTIVE to RETIRED) but is not intended to permit modification of the template content itself. If the content of the **body** element of the template was modified, the Sender will have assigned a new value for **dcterms.identifier**.

The only binding required for both the Sender and Receiver is the binding to the HTTP-PUT. In this binding the sample message will be formatted as follows:

`http://<location>/IHETemplateService/<templateUID>`

The `<location>` part of the URL shall contain the host name, an optional port address, and may be followed by an optional path. The remainder of the URL, including `IHETemplateService` and the following request parameters shall not be changed.

If necessary, the Sender may perform the request to the web service utilizing HTTPS protocol. In this case, the Receiver shall respond using HTTPS.

The Receiver may return HTTP redirect responses to a request. The Sender can expect to receive an error response, or the data requested, or a request to look elsewhere for the data. The Sender shall follow redirects, but if a loop is detected, it may report an error.

4.104.4.1.3 Expected Actions

The Receiver shall accept the request to store the template. If multiple requests are received, each is handled in sequence.

The Receiver shall store all metadata in the `head` element along with the complete contents of the report template contained in the `body` element. See RAD TF-3: 8.1.

- If the **dcterms.identifier** of the template does not already exist on the Receiver, the Receiver shall store the complete contents of the new template.

If the **dcterms.identifier** of the template already exists on the Receiver, the Receiver shall replace the existing template with the received template, including any updated values for the metadata attributes.

The Receiver shall provide a response message header containing the appropriate status code indicating success, warning, or failure as shown in Table 4.104.4.1.3-1.

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Table 4.104.4.1.3-1: HTTP Responses

Service Status	HTTP1.1 Status Codes	Description
Failure (see Note 2)	503 – Busy	This indicates that the Responder was unable to store the template because it was out of resources.
	422 – Unprocessable Entity	This indicates that the Responder was unable to store the template because the template does not conform to RAD TF-3: 8.1.
	401 — Unauthorized	This indicates that the Responder refused to store the template because authentication credentials were not provided or not sufficient.
	400 – Bad Request	This indicates that the Responder was unable to store the template because the template UID is missing or corrupt or did not match the value of the **`dcterms.identifier`** attribute in the report template's metadata. See RAD TF-3: Table 8.1.1-1.
Success	200 – OK	This indicates that the request was successful and the Responder has stored the template.

Note 1: Other HTTP response codes may be returned by the Receiver, indicating conditions outside of the scope of this transaction.

Note 2: It is recommended that the Receiver complement returned error code with a human readable description of the error condition.

If an error condition cannot be automatically recovered, at a minimum, the error should be displayed to the user by the Sender.

4.104.5 Security Considerations

Although the content of templates is not typically protected information, for consistency with other transactions on the client, which likely will involve protected information, it is reasonable to expect support for HTTPS.

4.104.5.1 Security Audit Considerations

None

4.105 Query Imaging Report Template [RAD-105]

4.105.1 Scope

This transaction is used to query templates from a Report Template Manager in the proper format.

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4.105.2 Actor Roles

Table 4.105.2-1: Actor Roles

Role:	**Requester:** Requests a filtered list of templates from the Responder
Actor(s):	The following actor may play the role of Requester: • Report Creator
Role:	**Responder:** Provides a list of templates in response to the request
Actor(s):	The following actor may play the role of Responder: • Report Template Manager

Transaction text specifies behavior for each role. The behavior of specific actors may also be specified when it goes beyond that of the general role.

4.105.3 Referenced Standards

- IETF RFC2616 HyperText Transfer Protocol HTTP/1.1
- Extensible Markup Language (XML) 1.0 (Second Edition). W3C Recommendation 6 October 2000. http://www.w3.org/TR/REC-xml.
- Dublin Core Metadata Element Set, standardized as ISO Standard 15836: 2009 and ANSI/NISO Standard Z39.85-2012. http://dublincore.org/documents/dces/

4.105.4 Messages

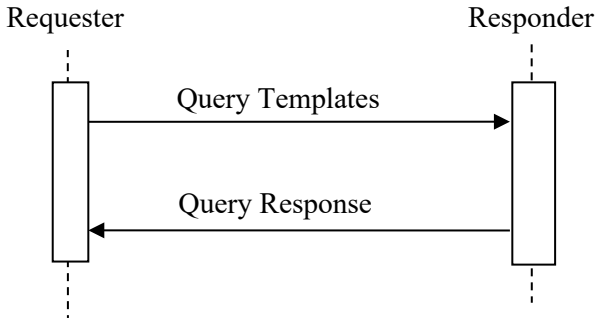

Figure 4.105.4-1: Interaction Diagram

4.105.4.1 Query Templates Message

The Requester sends a message to the Responder indicating the list of templates it would like to receive.

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A Responder shall support handling such messages from more than one Requester. A Requester may choose to support making requests to more than one Responder.

4.105.4.1.1 Trigger Events

12480 1. A Requester needs to find templates for later use in anticipation of selecting an appropriate template for reporting in the future.

7. The user of a Requester, such as a Report Creator, invokes a template query.

4.105.4.1.2 Message Semantics

The message is an HTTP GET request.

12485 To filter the template matches to be returned, the HTTP request shall include one or more of the following parameters. All parameter names and values are case-sensitive.

All parameters shall be supported by the Responder, and are optional for the Requester.

Table 4.105.4.1.2-1: HTTP Query Parameters

Parameter Name	REQ	Description	Values
`title`	O	Wildcard query of the `dcterms.title` tag.	This value shall be a string.
`Identifier`	O	Exact query of the `dcterms.identifier` tag.	This value shall be a properly defined Object identifier (OID) as specified in ITI TF-2: Appendix B.
`creator`	O	Wildcard query of the `dcterms.creator` tag.	This value shall be a string.
`Publisher`	O	Wildcard query of the `dcterms.publisher` tag.	This value shall be a string.
`License`	O	Wildcard query of the `dcterms.license` tag.	This value shall be a string.
`Lower_date`	O	Query the date of the template for values on or after the specified lower date. See Note 1.	This value shall be encoded in the XML primitive date format. Multiple instances of this parameter are not permitted.
`Upper_date`	O	Query the date of the template for values on or before the specified upper date. See Note 1.	This value shall be encoded in the XML primitive date format. Multiple instances of this parameter are not permitted.
`Language`	O	Wildcard query of the `dcterms.language` tag.	This value shall be an ISO 639 two-letter language code.
`Top_level_flag`	O	Exact query of the `top-level-flag` tag.	This value shall be an xsd:Boolean.
`Status`	O	Exact query of the `status` tag.	This value shall be one of: `DRAFT`, `ACTIVE`, or `RETIRED`

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Parameter Name	REQ	Description	Values
code_value	O	Exact query of the entry/coding_schemes/coding_scheme designator tag and entry/term/code value tag.	This value shall be a string containing the coding scheme from which the code value was drawn, and the code value itself separated by a colon. See Note 2.
Code_meaning	O	Wildcard query of the entry/term/code meaning tag.	This value shall be a string.
Limit	O	Limits the results returned to a maximum number. If omitted, all matching results shall be returned.	This value shall be an integer.
Offset	O	Skips the first number of matching results. If omitted, no results will be skipped.	This value shall be an integer.
Sort	O	Returns the results in alphabetical order of a specified field. If omitted, results are ordered by title.	This value shall be a string, being one of the query parameters aside from limit, offset, or sort.

Note 1: **Lower_date** and **upper_date** are used to constrain the date of the template. For example, a **lower_date** of 2010-01-01 and an **upper_date** of 2010-12-31 will return all templates with a date in the year 2010. The query is inclusive of the date specified. If the value passed is not in XML primitive date format, an HTTP 400 error will be returned.

Note 2: When searching for code value, the coding system must also be specified. This is done by concatenating the **coding_scheme_designator**, a colon, and the **code_value**. For example, when searching in RadLex (2.16.840.1.113883.6.256) for Computed Tomography (RID10321), the **code_value** to be queried for would be "2.16.840.1.113883.6.256:RID10321".

The only binding required, for both the Requester and Responder, is the binding to the HTTP-GET. In this binding the Requester shall format the Query Templates message as follows:

```
http://<location>/IHETemplateService/?[parameter1_name]=[parameter1 value]&
[parameter2_name]=[parameter2 value]
```

The <location> part of the URL shall contain the host name of the Responder, an optional port address, and may be followed by an optional path. The remainder of the URL, including IHETemplateService and the following request parameters shall not be changed. See the discussion about location in ITI TF-2: 3.11.4.1.2 Message Semantics.

If no search parameters are provided, all **ACTIVE** templates match.

For the parameters specified as wildcard search, a template matches if the text string in the parameter value appears in the corresponding attribute of the template. Wildcard matching is insensitive to case. For example, searching the title for "abdomen" would match templates with "CT Abdomen".

Specifying multiple, different parameters indicates an AND relation, meaning that both parameter values must be present for the template to match. For example, requesting that the title contains "CT" and the publisher contains "Hospital" would return only templates that met both of those criteria. However, specifying the same parameter multiple times indicates an OR relation, where only one of the parameter values must be present in the template. For example,

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requesting that the title contains “CT” or the title contains “US” would return templates that match either of those criteria.

The Requester may perform the request to the web service utilizing HTTPS protocol. The Responder shall respond using HTTPS if requested.

The Responder may return HTTP redirect responses to a request. The Requester can expect to receive an error response, or the data requested, or a request to look elsewhere for the data. The Requester shall follow redirects, but if a loop is detected, it may report an error.

4.105.4.1.3 Expected Actions

The Responder shall parse the request and create a response containing the template headers matching the parameters of the request as specified in Section 4.105.4.2.2.

The Responder shall handle multiple requests.

The Responder shall return the appropriate status code indicating success, warning, or failure as shown in Table 4.105.4.1.3-1.

Table 4.105.4.1.3-1: HTTP Responses

Service Status	HTTP1.1 Status Codes	Description
Failure (see Note 2)	503 – Busy	This indicates that the Responder was unable to perform the query because it was out of resources.
	401 — Unauthorized	This indicates that the Responder refused to return results because authentication credentials were not provided or not sufficient.
	400 – Bad Request	This indicates that the Responder was unable to provide the template list because one or more of the parameters are corrupt.
Success	200 – OK	This indicates that the request was successful and the Responder will list matching templates.

Note 1: Other HTTP response codes may be returned by the Responder, indicating conditions outside of the scope of this transaction.

Note 2: It is recommended that the Responder complement the returned error code with a human readable description of the error condition.

4.105.4.2 Template Response Message

The Responder transmits the requested template headers to the Requester.

4.105.4.2.1 Trigger Events

The Template Response message is created in response to a Responder receiving a Query Templates message.

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4.105.4.2.2 Message Semantics

The Template Response message is an HTTP GET response.

The Template Response Message is expressed in XML.

A Responder shall format the response as described below. The Template Response message:

1. Shall begin with exactly one [1..1] XML declaration: `<?xml version="1.0" encoding="UTF-8"?>` declaring the character set used.
2. Shall contain exactly one [1..1] `templates` element.
    a. The **`templates`** element may contain [0..*] **`template`** elements, one for each matching report template.
        i. The **`template`** element shall contain an **`href`** attribute to indicate a URL to retrieve the template.
        ii. The **`template`** element shall contain exactly one [1..1] `title` element containing the name of the template.
        iii. The **`template`** element shall contain exactly one [1..1] `meta` element declaring the character set used: `<meta charset="UTF-8">`.
        iv. The `template` element may contain style information formatted according to HTML5 standards, using the `style` element for internal CSS style elements and the `link` element for CSS files.
        v. The **`template`** element shall contain one or more [1..*] **`meta`** elements encoding Dublin Core metadata attributes for the template, as shown in Table 4.104.4.2.2-1.
            1. The **`name`** property of the **`meta`** element will be used to specify the template attribute.
            2. For Dublin Core template attributes, the "**`dcterms`**" namespace shall be used.
            3. The **`content`** property of the **`meta`** element will be used to specify the value of the template attribute.
        vi. The **`template`** element shall contain exactly one [1..1] `script` element containing the entire contents of the `script` element for the template.
        vii. The **`template`** element shall comply with all other HTML5 constraints.

Note: The intent of each template node is to contain the contents of the head node of the actual template.

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```
<?xml version="1.0" encoding="UTF-8"?>
<templates>
   <template href="http://<location>/IHETemplateService/1.2.3.4.5">
      <title content="CT Brain"</title>
      <meta charset="UTF-8">
      <meta name="dcterms.title" content="CT Brain" />
      <meta name="dcterms.identifier" content="1.2.3.4.5" />
      <meta name="dcterms.type" content="IMAGE_REPORT_TEMPLATE" />
      <meta name="dcterms.language" content="en" />
      <meta name="dcterms.publisher" content="Radiological Society of North
America (RSNA)" />
      <meta name="dcterms.rights" content="May be used freely, subject to
license agreement" />
      <meta name="dcterms.license"
content="http://www.radreport.org/license.pdf" />
      <meta name="dcterms.date" content="2012-03-28" />
      <meta name="dcterms.creator" content="Flanders AE, et al." />
      <meta name="dcterms.contributor" content="Bozkurt S [coder]" />
      <meta name="dcterms.contributor" content="Kahn CE Jr [editor]" />
      <meta name="dcterms.contributor" content="American Society of
Neuroradiology (ASNR)" />
      <script>
         <template_attributes>
            <top-level-flag>true</top-level-flag>
            <status>ACTIVE</status>
            <coding_schemes>
               <coding_scheme name="RADLEX"
designator="2.16.840.1.113883.6.256" />
            </coding_schemes>
            <term type="modality">
               <code meaning="computed tomography" value="RID10321"
scheme="RADLEX" />
            </term>
            <term type="body part">
               <code meaning="brain" value="RID6434" scheme="RADLEX" />
            </term>
         </template_attributes>
      </script>
   </template>

   <!—Additional template elements may appear here→

</templates>
```

Figure 4.105.4.2.2-1: Example of the Template Response message

4.105.4.2.3 Expected Actions

The Requester shall process the returned responses in a manner that is specific to its application. IHE does not mandate application-specific behavior but this may include, for example, rendering for the user the metadata received in the response and enabling the user to subsequently retrieve one of the templates using [RAD-103].

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If more sophisticated queries are required – more than what is provided for in Section 4.105.4.1.2, it is expected that the Responder will be capable of processing a large set of template responses and performing further filtering internally.

If the Requester receives an HTTP response code other than 200-OK, and cannot automatically recover, at a minimum, the Requester should display the error to the user.

4.105.5 Security Considerations

Although the content of templates is not typically protected information, for consistency with other transactions on the client, which likely will involve protected information, it is reasonable to expect support for HTTPS.

4.105.5.1 Security Audit Considerations

None.

4.106 Invoke Image Display [RAD-106]

This transaction is currently in the Invoke Image Display (IID) Trial Implementation Supplement.

4.107 WADO-RS Retrieve [RAD-107]

This transaction is currently in the Web-based Image Access (WIA) Trial Implementation Supplement.

4.108 Store Instances over the Web [RAD-108]

This transaction is currently in the Web-based Image Capture (WIC) Trial Implementation Supplement.

4.109 Open Event Channel [RAD-109]

This transaction is currently in the AI Workflow for Imaging (AIW-I) Trial Implementation Supplement.

4.110 Store Radiopharmaceutical Activity Information [RAD-110]

4.110.1 Scope

This section describes DICOM Storage requests of Structured Report objects containing DICOM Radiopharmaceutical Radiation Dose SR object (RRDSR) objects which detail radiopharmaceutical administration events. A Radiopharmaceutical Activity Supplier sends DICOM RRDSR objects to an Image Manager/Archive for storage so they can be later used for monitoring or analysis of patient radiation exposure.

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4.110.2 Actor Roles

Actor: Radiopharmaceutical Activity Supplier

Role: Generate DICOM RRDSR objects describing irradiation events performed by the Radiopharmaceutical Activity Supplier and store them to one or more receiving actors.

Actor: Image Manager/Archive.

Role: Accept and store DICOM RRDSR objects received from the Radiopharmaceutical Activity Supplier.

Actor: Dose Information Consumer

Role: Accept and process DICOM RRDSR objects received from the Radiopharmaceutical Activity Supplier.

Actor: Dose Information Reporter

Role: Accept and process DICOM RRDSR objects received from the Radiopharmaceutical Activity Supplier.

4.110.3 Referenced Standard

DICOM PS 3.3 Section A.35.14: Radiopharmaceutical Dose SR IOD

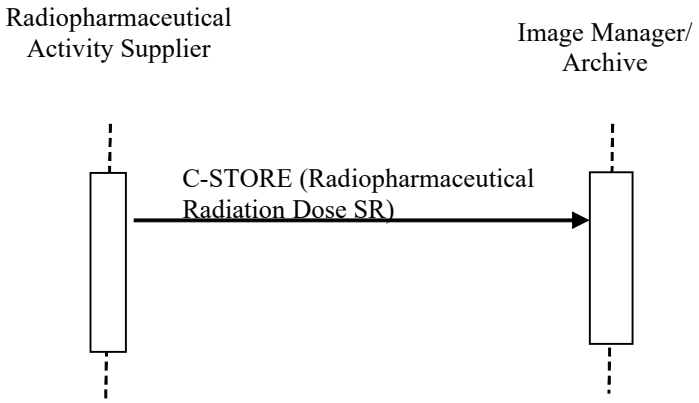
DICOM PS 3.4 Annex B: Storage Service Class

DICOM PS 3.4 Section B.5.1.5: Structured Reporting Storage SOP Classes

DICOM PS 3.16: Radiopharmaceutical Dose SR IOD Templates

DICOM PS 3.17 Annex OOO: Radiopharmaceutical Radiation Dose Structured Report (Informative)

4.110.4 Messages



Note: In the above diagram, the Dose Information Consumer and the Dose Information Reporter may also receive the C-STORE message.

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Figure 4.110.4-1: Interaction Diagram

4.110.4.1 Store Radiopharmaceutical Dose Information

The Radiopharmaceutical Activity Supplier shall implement the Radiopharmaceutical Radiation Dose SR Storage SOP Class in the role of SCU. The Image Manager/Archive, Dose Information Reporter and Dose Information Consumer shall implement the Dose Storage SOP Class in the role of SCP.

Table 4.110.4.1-1: Radiopharmaceutical Dose Storage SOP Classes

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.88.68	Radiopharmaceutical Radiation Dose SR

4.110.4.1.1 Trigger Events

A radiopharmaceutical administration is one radioactive pharmaceutical administered to a patient.

A Radiopharmaceutical Activity Supplier shall record the relevant details for each radiopharmaceutical administration event. These details will be included in Radiopharmaceutical Radiation Dose Structured Reports as described below.

The Radiopharmaceutical Activity Supplier shall compose an appropriate DICOM RRDSR Object containing the radiopharmaceutical administration event and send the DICOM RRDSR object to the configured destinations.

When two or more radiopharmaceuticals are administered, each constitutes a separate administration event, and corresponds to a separate RRDSR.

4.110.4.1.2 Message Semantics

The Radiopharmaceutical Activity Supplier Actor shall use the DICOM C-STORE message to send DICOM RRDSR objects encoded as DICOM SR objects. These objects serve as a record of irradiation performed by the device.

The Radiopharmaceutical Activity Supplier shall be capable of sending the Dose object to multiple destinations. The primary storage destination is generally an Image Manager/Archive. However, Dose Information Reporters or Dose Information Consumers may also appear as configured destinations when they need to receive timely DICOM RRDSR objects without having to repeatedly poll the Image Manager/Archive.

The Radiopharmaceutical Activity Supplier is responsible for delivery of DICOM RRDSR objects to the destination in spite of intermittent connections (e.g., due to mobile modalities, network trouble, or the destination being down).

Radiopharmaceutical Activity Suppliers which report on radiopharmaceutical administration events shall be capable of producing an SR compliant with TID 10021.

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The Radiopharmaceutical Administration Event UID in the template allows receiving systems to recognize duplicate events.

The Synchronization Module shall be included in the RRDSR.

Table 4.110.4.1.2-1 describes how some attributes in the RRDSR shall be populated by the Radiopharmaceutical Activity Supplier:

Table 4.110.4.1.2-1: Radiopharmaceutical Administration Dose Context Attributes

Attribute Name	Tag	Requirement
Series Description	(0008,103E)	Shall have a value in the appropriate language for local use that means the equivalent of "Radiation Dose Information", or similar.
Referenced Performed Procedure Step Sequence	(0008,1111)	Shall be empty.
Performed Procedure Code Sequence	(0040,A372)	Shall be copied from the Requested Procedure Code Sequence in the Modality Worklist, unless the procedure is changed, in which case this shall be empty.
Referenced Request Sequence (0040,A370) >Requested Procedure Description	(0032,1060)	Shall be copied from the relevant acquisition Modality Worklist entry
Admitting Diagnoses Description	(0008,1080)	Shall be copied from the relevant acquisition Modality Worklist entry. This can facilitate checking compliance to indication-based dose policies.
Admitting Diagnoses Code Sequence	(0008,1084)	
Referenced Request Sequence (0040,A370) >Reason for the Requested Procedure	(0040,1002)	
Referenced Request Sequence (0040,A370) >Reason for Requested Procedure Code Sequence	(0040,100A)	
Patient's Weight	(0010,1030)	Shall be populated with a value that is not zero. May be copied from the relevant acquisition Modality Worklist entry, if present, only if it is not provided by the Radiopharmaceutical Activity Supplier (e.g., via operator entry). The intent is to use the most recent date, though the date of the weight measurement is not provided by the Worklist entry.
Patient's Size	(0010,1020)	I.e., height. Shall be populated with a value that is not zero. May be copied from the relevant acquisition Modality Worklist entry, if present, only if it is not provided by the Radiopharmaceutical Activity Supplier (e.g., via operator entry).
Patient's Age	(0010,1010)	Shall be present. May be filled from any valid source (e.g., computed from Patient's Birthdate and Study Date, copied from the relevant acquisition Modality Worklist entry, if present, only if it is not

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Attribute Name	Tag	Requirement
		provided by the Radiopharmaceutical Activity Supplier (e.g., via operator entry).
Patient's Sex	(0010,0040)	Shall be present. May be copied from the relevant acquisition Modality Worklist entry, if present, only if it is not provided by the Radiopharmaceutical Activity Supplier via operator entry.

4.110.4.1.2.1 Cross-referencing DICOM RRDSR Objects and Image Objects

See RAD TF-2: 4.8.4.1.2.10, which requires Acquisition Modalities to record the Radiopharmaceutical Administration Event UID (0008,3012) in related image instances.

The Radiopharmaceutical Radiation Dose Template (TID 10021) does not include references to images since the instances sent to the Image Manager/Archive are typically generated some time after the irradiation is complete.

Note that it is possible for a study to have DICOM RRDSR objects but no image objects. For example, a radioactive iodine uptake test, or thyroid uptake test, involves administration of radioactive iodine but does not include an imaging step (i.e., no acquisition modality).

4.110.4.1.3 Expected Actions

The Image Manager/Archive shall support Level 2 (Full) storage, which means all DICOM Type 1, 2 and 3 attributes (public and private) are stored. It shall accept the DICOM RRDSR objects, store them, and make them available for query/retrieval.

The Dose Information Reporter and Dose Information Consumer shall accept the DICOM RRDSR objects. The DICOM RRDSR objects shall be processed according to the features, configuration, and business logic of the Dose Information Reporter or Dose Information Consumer product. Possibilities include display, processing, analysis, printing, export, etc. At a minimum, the Dose Information Reporter shall provide the capability to the review and do summary analysis of the dose data.

Dose Information Reporter Actors shall be capable of processing DICOM TID 10021.

When multiple DICOM RRDSR objects are received, the same Radiopharmaceutical Administration Event (as identified by its Radiopharmaceutical Administration Event UID) may be referenced in multiple DICOM RRDSR objects. It is the responsibility of the recipient to recognize such duplicate Radiopharmaceutical Administration Events when processing or generating reports based on the retrieved data.

4.111 [RAD-111] – [RAD-120]

These transactions are currently in the Cross-Enterprise Reading Workflow Definition (XRR-WD) Trial Implementation Supplement

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4.121 Store Protocol [RAD-121]

This transaction is currently in the Managing Acquisition Protocols (MAP) Trial Implementation Supplement.

4.122 Query Protocol [RAD-122]

This transaction is currently in the Managing Acquisition Protocols (MAP) Trial Implementation Supplement.

4.123 Retrieve Protocol [RAD-123]

This transaction is currently in the Managing Acquisition Protocols (MAP) Trial Implementation Supplement.

4.124 Transfer Multiple Events [RAD-124]

This transaction is currently in the Standardized Operational Log of Events (SOLE) Trial Implementation Supplement.

4.125 Store Protocol Approval [RAD-125]

This transaction is currently in the Managing Acquisition Protocols (MAP) Trial Implementation Supplement.

4.126 Query Protocol Approval [RAD-126]

This transaction is currently in the Managing Acquisition Protocols (MAP) Trial Implementation Supplement.

4.127 Retrieve Protocol Approval [RAD-127]

This transaction is currently in the Managing Acquisition Protocols (MAP) Trial Implementation Supplement.

4.128 Send Imaging Result [RAD-128]

This transaction is currently in the Results Distribution (RD) Trial Implementation Supplement.

4.129 QIDO-RS Query [RAD-129]

This transaction is currently in the Web-based Image Access (WIA) Trial Implementation Supplement, and it is updated in the AI Results (AIR) Trial Implementation Supplement.

4.130 Get Encounter Imaging Context [RAD-130]

This transaction is currently in the Encounter-Based Imaging Workflow (EBIW) Trial Implementation Supplement.

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4.131 Store Encounter Images [RAD-131]

This transaction is currently in the Encounter-Based Imaging Workflow (EBIW) Trial Implementation Supplement.

4.132 Notify of Imaging Results [RAD-132]

This transaction is currently in the Encounter-Based Imaging Workflow (EBIW) Trial Implementation Supplement.

4.133 Query for Patient Studies [RAD-133]

This transaction is currently in Import and Display of External Priors (IDEP) Trial Implementation Supplement.

4.134 Study Root Query for Patient ID [RAD-134]

This transaction is currently in Import and Display of External Priors (IDEP) Trial Implementation Supplement.

4.135 Send Import Notification [RAD-135]

This transaction is currently in Import and Display of External Priors (IDEP) Trial Implementation Supplement.

4.136 Display Analysis Results [RAD-136]

This transaction is currently in the AI Results (AIR) Trial Implementation Supplement.

4.137 Query Analysis Results [RAD-137]

This transaction is currently in the AI Results (AIR) Trial Implementation Supplement.

4.138 Store Contrast Information [RAD-138]

This transaction is currently in the Contrast Administration Management (CAM) Trial Implementation Supplement.

4.139 Query Contrast Information [RAD-139]

This transaction is currently in the Contrast Administration Management (CAM) Trial Implementation Supplement.

4.140 Retrieve Contrast Information [RAD-140]

This transaction is currently in the Contrast Administration Management (CAM) Trial Implementation Supplement.

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4.141 Store Multimedia Report [RAD-141]

This transaction is currently in the Interactive Multimedia Report (IMR) Trial Implementation Supplement.

4.142 Display Multimedia Report [RAD-142]

This transaction is currently in the Interactive Multimedia Report (IMR) Trial Implementation Supplement.

4.143 Find Multimedia Report [RAD-143]

This transaction is currently in the Interactive Multimedia Report (IMR) Trial Implementation Supplement.

4.144 Retrieve Rendered Multimedia Report [RAD-144]

This transaction is currently in the Interactive Multimedia Report (IMR) Trial Implementation Supplement.

4.145 Send Procedural Observation [RAD-145]

This transaction is currently in the Prioritization of Worklists for Reporting (POWR) Trial Implementation Supplement.

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