Integrating the Healthcare Enterprise

IHE Cardiology
Technical Framework

Volume 2
(CARD TF-2)
Transactions

Revision 3.0 - Final Text

October 15, 2010

Contents

Foreword

Integrating the Healthcare Enterprise (IHE) is an initiative designed to stimulate the integration of the information systems that support modern healthcare institutions. Its fundamental objective is to ensure that in the care of patients all required information for medical decisions is both correct and available to healthcare professionals. The IHE initiative is both a process and a forum for encouraging integration efforts. It defines a technical framework for the implementation of established messaging standards to achieve specific clinical goals. It includes a rigorous testing process for the implementation of this framework. And it organizes educational sessions and exhibits at major meetings of medical professionals to demonstrate the benefits of this framework and encourage its adoption by industry and users.

The approach employed in the IHE initiative is not to define new integration standards, but rather to support the use of existing standards, HL7, DICOM, IETF, and others, as appropriate in their respective domains in an integrated manner, defining configuration choices when necessary. When clarifications or extensions to existing standards are necessary, IHE refers recommendations to the relevant standards bodies.

This initiative has numerous sponsors and supporting organizations in different medical specialty domains and geographical regions. In North America the primary sponsors are the American College of Cardiology (ACC), the Healthcare Information and Management Systems Society (HIMSS) and the Radiological Society of North America (RSNA). IHE Canada has also been formed. IHE Europe (IHE-EUR) is supported by a large coalition of organizations including the European Society of Cardiology (ESC), European Association of Radiology (EAR) and European Congress of Radiologists (ECR), the Coordination Committee of the Radiological and Electromedical Industries (COCIR), Deutsche Röntgengesellschaft (DRG), the EuroPACS Association, Groupement pour la Modernisation du Système d'Information Hospitalier (GMSIH), Société Francaise de Radiologie (SFR), and Società Italiana di Radiologia Medica (SIRM). In Japan IHE-J is sponsored by the Ministry of Economy, Trade, and Industry (METI); the Ministry of Health, Labor, and Welfare; and MEDIS-DC; cooperating organizations include the Japan Industries Association of Radiological Systems (JIRA), the Japan Association of Healthcare Information Systems Industry (JAHIS), Japan Radiological Society (JRS), Japan Society of Radiological Technology (JSRT), and the Japan Association of Medical Informatics (JAMI). Other organizations representing healthcare professionals are invited to join in the expansion of the IHE process across disciplinary and geographic boundaries.

The IHE Technical Frameworks for the various domains (IT Infrastructure, Cardiology, Laboratory, Radiology, etc.) defines specific implementations of established standards to achieve integration goals that promote appropriate sharing of medical information to support optimal patient care. It is expanded annually, after a period of public review, and maintained regularly through the identification and correction of errors. The current version for these Technical Frameworks may be found at www.ihe.net.

The IHE Technical Framework identifies a subset of the functional components of the healthcare enterprise, called IHE Actors, and specifies their interactions in terms of a set of coordinated, standards-based transactions. It describes this body of transactions in progressively greater

3

depth. Volume 1 provides a high-level view of IHE functionality, showing the transactions organized into functional units called Integration Profiles that highlight their capacity to address specific clinical needs. This Volume 2 provides detailed technical descriptions of each IHE transaction.

1 Introduction

1.1 Overview of Technical Framework

This document, the IHE Cardiology Technical Framework (IHE CARD-TF), defines specific implementations of established standards to achieve integration goals for cardiology. Such integration promotes appropriate sharing of medical information to support optimal patient care.

The CARD-TF is expanded annually, after a period of public review, and maintained regularly through the identification and correction of errata. The latest version of the document is always available via the Internet at www.ihe.net .

The CARD-TF identifies a subset of the functional components of the healthcare enterprise, called IHE actors, and specifies their interactions in terms of a set of coordinated, standards-based transactions. It describes this body of transactions in progressively greater depth. Volume 1 provides a high-level view of IHE functionality, showing the transactions organized into functional units called Integration Profiles that highlight their capacity to address specific clinical needs. The present Volume 2 provide detailed technical descriptions of each cardiology-specific IHE transaction.

The CARD-TF is part of the larger IHE Technical Framework, which comprises the following domain-specific documents:

- IHE Cardiology Technical Framework
- IHE IT Infrastructure Technical Framework
- IHE Radiology Technical Framework
- IHE Laboratory Technical Framework
- IHE Patient Care Coordination Technical Framework

The IHE Cardiology Integration Profiles rely heavily on, and reference, the transactions defined in those other IHE Technical Framework documents. For the conventions on referencing other frameworks, see Section 1.6.4 in Volume 1.

1.2 Overview of Volume 2

Section 2 presents the conventions used in this volume to define the transactions implemented under IHE.

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 CARD-1 to CARD-6 in detail, specifying the roles for each actor, the standards employed, the information exchanged, and in some cases, implementation options for the transaction.

The appendices following the main body of this volume provide clarification of technical details of the IHE data model and transactions. A glossary of terms and acronyms used in the IHE

Technical Framework, including those from relevant standards (currently HL7 and DICOM), is provided in Volume 1.

1.3 Audience

The intended audience of this document is:

- Clinicians interested in the technical aspects of integrating healthcare information systems
- Technical staff of vendors participating in the IHE initiative
- IT departments of healthcare institutions
- Experts involved in standards development

1.4 Relationship to Standards

The IHE Technical Framework identifies functional components of a distributed healthcare environment (referred to as IHE Actors), solely from the point of view of their interactions in the healthcare enterprise. At its current level of development, it defines a coordinated set of transactions based on the HL7, DICOM, and various Web standards. As the scope of the IHE initiative expands, transactions based on other standards will be included as required.

In some cases, IHE recommends selection of specific options supported by these standards; however, IHE does not introduce technical choices that contradict conformance to these standards. If errors in or extensions to existing standards are identified, IHE's policy is to report them to the appropriate standards bodies for resolution within their conformance and standards evolution strategy.

IHE is therefore an implementation framework, not a standard. Referencing IHE as a standard is inappropriate. Conformance claims by product must still be made in direct reference to specific standards.   In addition, vendors who have implemented IHE integration capabilities shall use an IHE Integration Statement to describe the conformance of their product to the specifications in the IHE Technical Framework. The purpose of an IHE Integration Statement is to communicate to the users of the corresponding product the IHE capabilities it has been designed to support. Vendors publishing IHE Integration Statements accept full responsibility for their content. By comparing the IHE Integration Statements from different implementations, a user familiar with the IHE concepts of Actors and Integration Profiles should be able to determine whether and to what extent communications might be supported between products. IHE encourages implementers to ensure that products implemented in accordance with the IHE Technical Framework also meet the full requirements of the standards underlying IHE, allowing the products to interact, although possibly at a lower level of integration, with products that have been implemented in conformance with those standards, but not in full accordance with the IHE Technical Framework.

1.5 Relationship to Real-world Architectures

The IHE Actors and transactions described in the IHE Technical Framework are abstractions of the real-world healthcare information system environment. While some of the transactions are

traditionally performed by specific product categories (e.g., HIS, Electronic Patient Record, RIS, PACS, Clinical Information Systems or imaging modalities), the IHE Technical Framework intentionally avoids associating functions or actors with such product categories. For each actor, the IHE Technical Framework defines only those functions associated with integrating information systems. The IHE definition of an actor should therefore not be taken as the complete definition of any product that might implement it, nor should the framework itself be taken to comprehensively describe the architecture of a healthcare information system.

The reason for defining actors and transactions is to provide a basis for defining the interactions among functional components of the healthcare information system environment. In situations where a single physical product implements multiple functions, only the interfaces between the product and external functions in the environment are considered to be significant by the IHE initiative. Therefore, the IHE initiative takes no position as to the relative merits of an integrated environment based on a single, all-encompassing information system versus one based on multiple systems that together achieve the same end. To illustrate most dramatically the possibilities of the IHE Technical Framework, however, the IHE demonstrations emphasize the integration of multiple vendors' systems based on the IHE Technical Framework.

1.6 Comments

The ACC welcomes comments on this document and the IHE initiative. They should be directed to the discussion server at http://forums.rsna.org/ or to:

    Katherine Doermann
    American College of Cardiology
    9111 Old Georgetown Rd
    Bethesda, Md 20814-1699
    Email: IHE@acc.org

1.7 Copyright Permission

Health Level Seven, Inc., has granted permission to the IHE to reproduce tables from the HL7 standard. The HL7 tables in this document are copyrighted by Health Level Seven, Inc. All rights reserved.

The National Electrical Manufacturers Association (NEMA) has granted permission to the IHE to incorporate portions of the DICOM standard.

Material drawn from these documents is credited where used.

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.,:
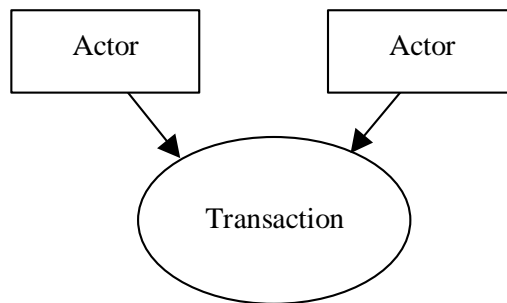
- *Referenced Standards*: the standards (stating the specific parts, chapters or sections thereof) to be used for the transaction.
- *Interaction Diagram*: a graphical depiction of the actors and transactions, with related processing within an actor shown as a rectangle and time progressing downward, similar to:
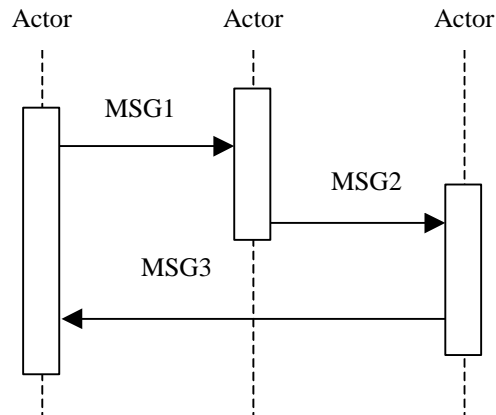
The interaction diagrams used in the IHE Technical Framework are modeled after those described in Grady Booch, James Rumbaugh, and Ivar Jacobson, *The Unified Modeling Language User Guide*, ISBN 0-201-57168-4. Simple acknowledgment messages are omitted from the diagrams for brevity.

- *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 section 4 and in the appendices.

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 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).

- 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:

9

A key that the Query SCU requests from the Query SCP, receives in the query responses, and displays for the user, if required. 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.

- 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

Table 2.2-1 provides an example table defining matching and return keys.

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)	R+	R	R+*	R	
>Human Performer Code Sequence	(0040,4009)	R+	R	R+*	R	
>>Code Value	(0008,0100)	R+	R	R+*	R	
>>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+	
Referenced Study Component Sequence	(0008,1111)	O	O	O	O	

10

>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)	O	O	R+*	R	

2.3 HL7 Profiling Conventions

The HL7 tables included in this document have been modified from the HL7 2.3.1 standard document. Such a modification is called a profile. Refer to the HL7 2.3.1 standard for the meanings of specific columns in the table.

The profiling tables in this document leverage the ongoing HL7 profile definition. To maintain this specification at a generic level, the following differences have been introduced:

- Message specifications do not indicate the cardinality of segments within a message.
- For fields composed of multiple components, there is no indication of the size of each component.
- Where a table containing enumerated values is referenced from within a segment profile table, the enumerated values table is not always present.
- The number of times a repeating field can repeat is not indicated.
- The conditions that would require inclusion of conditional fields are not defined when they depend on functional characteristics of the system implementing the transaction and they do not affect data consistency.

The following terms refer to the OPT column, which has been profiled:

R   Required

R2   This is an IHE extension. If the sending application has data for the field, it is required to populate the field. If the value is not known, the field may not be sent.

O   Optional

C   Conditional

IHE requires that Z-segments be present in HL7 transactions only when defined by the IHE Technical Framework.

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.

Table 2.3-1 provides a sample profile for an imaginary HL7 segment. Tables for real segments are copied from the HL7 2.3.1 standard with modifications made only to the OPT 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

2.4 HL7 Implementation Notes

2.4.1 Network Guidelines

The HL7 2.x standard does not define a network communications protocol. The HL7 2.1 standard defines lower layer protocols in an appendix. 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.

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.

2.4.2 Message Control

According to the HL7 standard, each message shall begin with the MSH (message header) segment. Table 2.4-1 identifies all required fields in this message. This table shall be interpreted according to the HL7 Standard unless otherwise noted in section 2.3.

Table 2.4-1. 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
7	26	TS	O		00007	Date/Time Of Message
8	40	ST	O		00008	Security

12

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
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
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	2	ID	O		00017	Country Code
18	6	ID	C	0211	00692	Character Set
19	60	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

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

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.

2.4.3 Acknowledgment Modes

Applications that receive HL7 messages shall send acknowledgments using the HL7 Original Mode (versus Enhanced Acknowledgment Mode).

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 tables 2.4-1, 2.4-2 and corresponding notes. The ERR segment is optional and may be included if the *MSA-1 Acknowledgement Code* field identifies an error condition.

ACK	Acknowledgement Message	Chapter in HL7 2.3.1
MSH	Message Header	2
MSA	Message Acknowledgement	2
[ERR]	Error Comments	2

13

Table 2.4-2. 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-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.

Table 2.4-3. 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

2.5 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.

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

IHE does not produce, maintain or otherwise specify a coding scheme or other resource for controlled terminology (coded entities). Where applicable, coding schemes required by the HL7 and DICOM standards take precedence. In the cases where such resources are not explicitly

identified by the standards, implementations may utilize any resource (including proprietary or local) provided any licensing/copyright requirements are satisfied.

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 (see CARD-TF 1).

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 Modality Procedure Step In Progress [CARD-1]

This transaction is identical to Modality Procedure Step In Progress [RAD-6] (see **RAD-TF 2: 4.6**), with the addition of one option.

Also please see Appendix A: Clarification of MPPS for Intermittently Connected Modality

4.1.1 Multi-Modality Procedure Update Option

It is essential in the multi-modality environment for all modalities to have the same patient and Request Procedure identifiers. However, due to the frequent emergency nature of cath procedures, it is often impossible for the DSS/OF to prepare Scheduled Procedure Steps in advance of the start of the procedure. See CARD-TF-1: Appendix B.

When a DSS/OF supports the MULTI-MODALITY PROCEDURE UPDATE option, it shall use the first Modality Procedure Step In Progress that it receives for each Study Instance UID from designated modalities to create Scheduled Procedure Steps for all the modalities that may participate in that lab. This may also involve the automatic creation of a Requested Procedure for an unscheduled Procedure Step.

The DSS/OF shall support configuration of the set of modality stations associated with a lab (room), and the designation of one or more of them as a selector (or triggering) modality. It shall also support configuration of a default Procedure type (code and/or description) for that lab.

Note: The default Procedure type is not constrained to a single value for each lab (e.g., it may be selected from a set based on attributes such as protocol in the MPPS).

4.1.1.1 Expected Actions

If the Modality Procedure Step In Progress identifies a Requested Procedure, the DSS/OF shall create the associated Scheduled Procedure Steps for the modality devices present in that lab (if such SPSs do not already exist for the Requested Procedure).

If the Modality Procedure Step In Progress is unscheduled, the DSS/Order Filler shall automatically create a Requested Procedure (with the configured default Procedure type for that lab) based on the Patient ID and the Study Instance UID provided in the MPPS. The DSS/OF shall create the associated Scheduled Procedure Steps for all the modalities in that lab.

Note: In the Modality Procedure Step In Progress transaction, the Requested Procedure is identified in the Referenced Study Sequence in the Scheduled Step Attributes Sequence. If the Referenced Study Sequence is zero length, the Performed Procedure Step is unscheduled. See **RAD-TF-2: 4.6.4.1.3 and RAD-TF-2: Appendix A**.

When the Requested Procedure is automatically created in the unscheduled case, and there is an existing ADT record for the patient, the DSS/OF shall generate and submit a new order to the Order Placer, as specified in the Filler Order Management (New Order) transaction, and shall then send a Procedure Scheduled transaction to the Image Manager. If there is no existing patient ADT record (i.e., the modality provided a temporary patient ID), the DSS/OF does not send the Filler Order Management (New Order) transaction to the Order Placer when the Requested Procedure is created, since the temporary Patient ID is out of the ADT domain scope of the Order Placer.

4.2 Modality Images/Evidence Stored [CARD-2]

This transaction is identical to Modality Images Stored [RAD-8] and Evidence Documents Stored [RAD-43] (see RAD-TF 2: 4.8 and RAD-TF 3: 4.43), with the addition of several options.

4.2.1 Cardiac Cath Option

Image Archives supporting the CARDIAC CATH option are required to support all of the SOP classes listed in Table 4.2-1 below.

Table 4.2-1. Cardiac Cath 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
1.2.840.10008.5.1.4.1.1.7.3	Multi-Frame Grayscale Word Secondary Capture
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
1.2.840.10008.5.1.4.1.1.9.1.2	General ECG Waveform Storage
1.2.840.10008.5.1.4.1.1.9.2.1	Hemodynamic Waveform Storage
1.2.840.10008.5.1.4.1.1.12.1	X-Ray Angiographic Image Storage
1.2.840.10008.5.1.4.1.1.88.11	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
1.2.840.10008.5.1.4.1.1.88.40	Procedure Log Storage

Image Archives supporting the CARDIAC CATH option shall be able to negotiate and accept the JPEG Baseline (Process 1): Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression for Ultrasound Multi-frame images, and shall support the YBR_FULL_422 photometric interpretation.

4.2.2 Echocardiography Option

Image Archives supporting the ECHOCARDIOGRAPHY option shall be able to negotiate and accept the JPEG Baseline (Process 1): Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression for Ultrasound Multi-frame images, and shall support the YBR_FULL_422 photometric interpretation.

Image Archives supporting the ECHOCARDIOGRAPHY option are required to support all of the SOP classes listed in Table 4.2-5. Acquisition Modalities supporting the ECHOCARDIOGRAPHY option are required to support Ultrasound Multi-frame Image Storage.

19

Table 4.2-5. Echocardiography SOP Classes

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.7	Secondary Capture Image Storage
1.2.840.10008.5.1.4.1.1.6.1	Ultrasound Image Storage
1.2.840.10008.5.1.4.1.1.3.1	Ultrasound Multi-frame Image Storage
1.2.840.10008.5.1.4.1.1.88.59	Key Object Selection
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

4.2.3 Stress Echo Option

Two mechanisms are required by IHE for conveying Stage and View identification in stress echo image SOP Instances:

- *Numbers*: Stage Number (0008,2122) and View Number (0008,2128) number Stages and Views, starting with 1.

- *Code Sequences*: Stage Code Sequence (0040,000A) and View Code Sequence (0054,0220) provide standard coded identifiers for Stages and Views.

A Stage is a phase in the stress echo exam protocol. A View is a particular combination of the transducer position and orientation at the time of image acquisition.

An additional option mechanism is defined in the DICOM Standard, but not required in IHE:

- *Names*: Stage Name (0008,2120) and View Name (0008,2127) specify non-standardized textual names for Stages and Views.

While View Name (0008,2127) and Stage Name (0008,2120) enable correlating and labeling the images for display, their value sets are undefined. Therefore, IHE requires the use of coded identifiers to unambiguously describe the stage and view in the Stage Code Sequence and View Code Sequence.

Acquisition Modality actors supporting the STRESS ECHO option are required to support a number of attributes in Multiframe Ultrasound Images created for a stress echo procedure as described in the following Table 4.2-2. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+).

Table 4.2-2. Multiframe Ultrasound Image Attributes That Convey Staged Protocol Related Information

Attribute Name	Tag	Requirement
Performed Procedure Step Description	(0040,0254)	R+
Protocol Name	(0018,1030)	R+
Performed Protocol Code Sequence	(0040,0260)	R+

Attribute Name	Tag	Requirement
Number of Stages	(0008,2124)	R+
Number of Views in Stage	(0008,212A)	R+
Stage Code Sequence	(0040,000A)	R+ (note 2)
Stage Number	(0008,2122)	R+
View Number	(0008,2128)	R+ (note 1)
View Code Sequence	(0054,0220)	R+ (note 2)

Note: Extra-protocol images (i.e., images not associated with the stress echo exam protocol) shall have the View Number empty or omitted.

The Performed Protocol Code Sequence for stress test procedures shall use codes drawn from the subset of DICOM Context Group 12001 shown in Table 4.2-3.

Table 4.2-3. Ultrasound Stress Protocol Codes

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT	P5-B3050	Exercise stress echocardiography
SRT	P2-7131C	Balke protocol
SRT	P2-7131A	Bruce protocol
SRT	P2-7131D	Ellestad protocol
SRT	P2-7131B	Modified Bruce protocol
SRT	P2-713A1	Modified Naughton protocol
SRT	P2-713A0	Naughton protocol
SRT	P2-7131F	Pepper protocol
SRT	P2-7131E	Ramp protocol
SRT	P2-31102	Stress test using Bicycle Ergometer
SRT	P2-31107	Pharmacologic Stress protocol
SRT	P2-3110A	Dipyridamole Stress protocol
SRT	P2-31109	Adenosine Stress protocol
SRT	P2-31108	Dobutamine Stress protocol
SRT	P2-31011	Pharmacologic and exercise stress test
SRT	P2-3110B	Stress test using cardiac pacing

Adapted from DICOM PS3.16-2009

The Stage Code Sequence shall use codes drawn from the subset of DICOM Context Group 12002 shown in Table 4.2-4, supplemented by additional codes as necessary for the performed stress echo protocol.

Table 4.2-4. Ultrasound Staged Protocol Stage Codes

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT	F-01604	Resting State
SRT	F-05019	Cardiac stress state
SRT	F-05028	Peak cardiac stress state
SRT	F-05018	Cardiac stress recovery state
SRT	F-25040	Hyperventilation

Adapted from DICOM PS3.16-2009

The View Code Sequence shall use the codes of DICOM Context Group 12226 (see Table 4.2-5).

Table 4.2-5. DICOM Context Group 12226 Echocardiography Image View

Coding Scheme Designator	Code Value	Code Meaning
SRT	G-A19B	Apical two chamber
SRT	G-A19C	Apical four chamber
SRT	G-0395	Apical long axis
SRT	G-0396	Parasternal long axis
SRT	G-0397	Parasternal short axis
SRT	G-0398	Parasternal short axis at the aortic valve level
SRT	G-0399	Parasternal short axis at the level of the mitral chords
SRT	G-039A	Parasternal short axis at the Mitral Valve level
SRT	G-039B	Parasternal short axis at the Papillary Muscle level
SRT	G-039C	Right Ventricular Inflow Tract View
SRT	G-039D	Right Ventricular Outflow Tract View
SRT	G-039E	Subcostal long axis
SRT	G-039F	Subcostal short axis
SRT	G-03A0	Suprasternal long axis
SRT	G-03A1	Suprasternal short axis

Adapted from DICOM PS3.16-2009

4.2.4 Cath Evidence Option

Acquisition Modality and Evidence Creator actors supporting the CATH EVIDENCE option are required to support one or more of the SOP classes listed in Table 4.2-6 below.

Table 4.2-6. Cath Evidence SOP Classes

SOP Class UID	SOP Class Name
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
1.2.840.10008.5.1.4.1.1.88.40	Procedure Log

IHE defines the following criteria for setting the value of the Completion Flag (0040,A491) in SR evidence documents:

Completeness of an SR evidence document is defined in relation to the scope of the Requested Procedure and the scope of the Root Concept Name. I.e., a Completion Flag (0040,A491) value of "COMPLETE" indicates that the document content includes all significant observations within the topic of the root Concept Name (as restricted by any Concept Modifiers) that are related to the Requested Procedure identified in the Referenced Request Sequence (0040,A370). A Requested Procedure may thus have multiple Complete SR Documents on different topics.

A document shall have Completion Flag value of "COMPLETE" only when the content has been attested to be complete by an authorized user as meeting these completion criteria, and the user is identified in the SR Document Instance. All other documents shall have Completion Flag value of "PARTIAL".

Notes: 1.See DICOM PS3.3-2009, Section C.17.2.5, for discussion of attestation and verification.

2. Implementations are encouraged to use or reference this definition of Completeness in their DICOM Conformance Statements.

The Acquisition Modality or Evidence Creator actor shall use one or more of the Templates listed in Table 4.2-7 below.

Table 4.2-7. Cath Evidence Templates

Cath Evidence Templates
3001 Procedure Log
3202 Ventricular Analysis
3213 Quantitative Arterial Analysis
3250 Intravascular Ultrasound
3500 Hemodynamics

These templates use subsidiary Template 300 for the formatting of individual measurements. Template 300 provides for the encoding of a "Normality" flag (for abnormal values) through subsidiary Template 310, and for the encoding of the specific image source of the measurement

23

through subsidiary Template 320. IHE strongly recommends the use of these attributes where appropriate.

4.2.5 Echo Evidence Option

Acquisition Modality and Evidence Creator actors supporting the ECHO EVIDENCE option are required to support one or more of the SOP classes listed in Table 4.2-8 below.

Table 4.2-8. Echo Evidence SOP Classes

SOP Class UID	SOP Class Name
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

The Acquisition Modality or Evidence Creator actor shall use one or more of the Templates listed in Table 4.2-9 below.

Table 4.2-9. Echo Evidence Templates

Echo Evidence Templates
5100 Vascular Ultrasound
5200 Echocardiography

These templates use subsidiary Template 300 for the formatting of individual measurements. Template 300 provides for the encoding of a "Normality" flag (for abnormal values) through subsidiary Template 310, and for the encoding of the specific image source of the measurement through subsidiary Template 320. IHE strongly recommends the use of these attributes where appropriate.

See Section 4.2.4 for the IHE criteria for setting the value of the Completion Flag (0040,A491) in SR evidence documents.

4.3 Storage Commitment [CARD-3]

This transaction is identical to Storage Commitment [RAD-10] (see RAD-TF 2: 4.10), with the addition of one option.

4.3.1 Intermittently Connected Modality Option

An INTERMITTENTLY CONNECTED MODALITY option is specified for the Image Manager, under which the Image Manager must queue N-Event Report messages if the modality is not connected. The modality opening an Association (message channel) for Storage Commitment shall serve as a trigger for the Image Manager to open a separate Association to the Modality to send the queued N-Event Report messages. This option is required for the Cath Workflow and Echo Workflow Profiles.

The purpose of this option is to alleviate the mobile devices from filling up their local storage with images that are awaiting Storage Commitment response (indicating that the Image Manager has successfully taken responsibility for the associated set of images) prior to deletion. The Storage Commitment response cannot be received if the mobile device is not connected at the time in which the Image Manager attempts to send the N-Event Report.

This option requires the Image Manager to send the N-Event Report message to the mobile modality at the time that it reconnects to the Image Manager.

4.3.1.1 Trigger Events

The following event shall trigger queued N-Event Reports for the mobile device:

- The acquisition modality makes a successful Association Negotiation with the Image Manager that has N-Event Reports pending

  Note: The need to handle intermittently connected modalities applies equally to the Image Manager under the RAD-TF Scheduled Workflow Profile, but the RAD-10 transaction is silent on the manner. There are several possible approaches to meeting this requirement, some of which require functionality on the Image Manager side of the transaction, some on Modality side. Without a clear specification, there will be significant interoperability problems.

  The IHE Cardiology Technical Committee has specified this Image Manager side approach to minimize the complexity of implementation for the Modalities, and to minimize the differences in the overall data flow between the intermittently and the full-time connected environments. The IHE Cardiology Technical Committee recognizes the impact this may have on radiology, but determined that a definitive resolution was critical for the Echocardiography Workflow Profile in the Cardiology Technical Framework. The IHE Cardiology and Radiology Technical Committees will work towards resolution of a common approach.

4.4 Retrieve Images/Evidence [CARD-4]

This transaction is identical to Retrieve Images [RAD-16] and Retrieve Evidence Documents [RAD-45] (see RAD-TF 2: 4.16 and RAD-TF 3: 4.45), with the addition of several options.

4.4.1 Stress Echo Option

Image Display actors supporting the STRESS ECHO option shall be able to negotiate and accept the JPEG Baseline (Process 1): Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression for Ultrasound Multi-frame images, and shall support the YBR_FULL_422 photometric interpretation.

Image Display actors supporting the STRESS ECHO option are required to support all of the SOP classes listed in Table 4.4-1 below.

Table 4.4-1. Stress Echo Image SOP Classes

SOP Class UID	SOP Class Name
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

Image Display actors supporting the STRESS ECHO option are required to support all of the attributes listed in Table 4.4-2 below in ultrasound images.

Table 4.4-2. Stress Echo Display Attributes

Attribute Name	Tag	Requirement
Performed Protocol Code Sequence	(0040,0260)	R+*
>Code Meaning	(0008,0104)	R+ (see note)
Protocol Name	(0018,1030)	R+ (see note)
Number of Stages	(0008,2124)	R+
Number of Views in Stage	(0008,212A)	R+
Stage Code Sequence	(0040,000A)	R+*
>Code meaning	(0008,0102)	R+
Stage Number	(0008,2122)	R+
View Code Sequence	(0054,0220)	R+*
>Code Meaning	(0008,0104)	R+
View Number	(0008,2128)	R+

Note: The Performed Protocol Code Sequence Code Meaning attribute and the Protocol Name attribute should contain similar information. If both are present in the image, Protocol Name (rather than Performed Protocol Code Sequence Code Meaning) shall be displayed.

4.4.1.1 Expected Actions

The Image Display actor may organize and present multiple images based on Stage and View for clinical comparison. Stage Number (0008,2122), View Number (0008,2128), Stage Code Sequence (0040,000A), and View Code Sequence (0008,2240) are mandated for the stress echo Modality (see section 4.2.3), and may be used by the Image Display Actor to determine the Stage and View of each image unambiguously.

4.4.2 Cath Evidence Option

Image Display actors supporting the CATH EVIDENCE option are required to support all of the SOP classes listed in Table 4.4-5 below.

Table 4.4-5. Cath Evidence SOP Classes

SOP Class UID	SOP Class Name
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
1.2.840.10008.5.1.4.1.1.88.40	Procedure Log

4.4.2.1 Expected Actions

The Image Display actor may optimize display for the Templates listed in Table 4.2-7 above.

> Note: An Image Display that supports a DICOM SR SOP Class is required (by the DICOM Standard) to unambiguously render all legal SOP Instances within that SOP Class, regardless of the Template used to create it. See DICOM PS3.4 Annex O.

Any measurements that have a subsidiary "HAS PROPERTIES" Content Item with Concept Name (121402, DCM, "Normality") and a Value from Table 4.4-6 shall be rendered with a readily visible emphasis (e.g., font, bold, text or background color, specialized window area, etc.).

Table 4.4-6. DICOM Context Group 222 Abnormal Value Flag codes

Coding Scheme	Code Value	Code Meaning
SRT	R-42037	Abnormal
SRT	R-002C4	Abnormally High
SRT	R-002C5	Abnormally Low

Adapted from DICOM PS3.16-2009

4.4.3 Echo Evidence Option

Image Display actors supporting the ECHO EVIDENCE option are required to support all of the SOP classes listed in Table 4.2-7 below.

Table 4.4-7. Echo Evidence SOP Classes

SOP Class UID	SOP Class Name
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

4.4.3.1 Expected Actions

The Image Display actor may optimize display for the Templates listed in Table 4.2-9 above.

> Note: An Image Display that supports a DICOM SR SOP Class is required (by the DICOM Standard) to unambiguously render all legal SOP Instances within that SOP Class, regardless of the Template used to create it. See DICOM PS3.4 Annex O.

Any measurements that have a subsidiary "HAS PROPERTIES" Content Item with Concept Name (121402, DCM, "Normality") and a Value from Table 4.4-6 shall be rendered with a readily visible emphasis (e.g., font, bold, text or background color, specialized window area, etc.).

4.5 Retrieve ECG List [CARD-5]

This transaction is derived from Retrieve Specific Information for Display [ITI-11] (see ITI-TF-2: 3.11), but is an independent transaction.

4.5.1 Scope

This transaction involves the query for a list of ECG documents, primarily for presentation purposes. This may occur when a user attempts to lookup ECGs associated with a certain patient that are stored on a different system. Note that the retrieved list is always related to a well-identified patient (Patient ID), but its content is generally dynamic (i.e., retrieving the same List at a different point in time is likely to result in different content); for example, a new ECG may have been recorded between two requests.

To support a wide range of display capabilities, the information provided is formatted as XML with a reference to a default style sheet. The XML format shall be done according to the schema specified in Appendix C, and is explicitly harmonized with the HL7 v3 Reference Information Model.

4.5.2 Use Case Roles
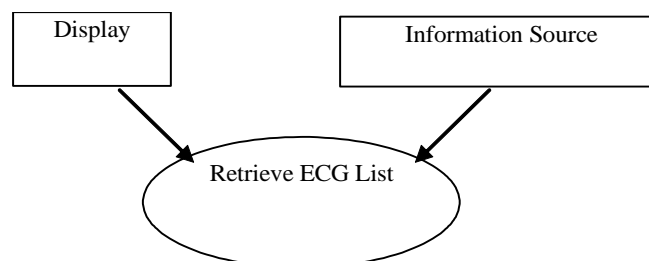
Actor: Display

Role: A system that requests an ECG list, and displays it.

Actor: Information Source

Role: A system that provides ECG lists in response to the request from the Display Actor, in a presentation-ready format.

4.5.3 Referenced Standard

Please refer to ITI-TF-2: 3.11.3, Referenced Standards
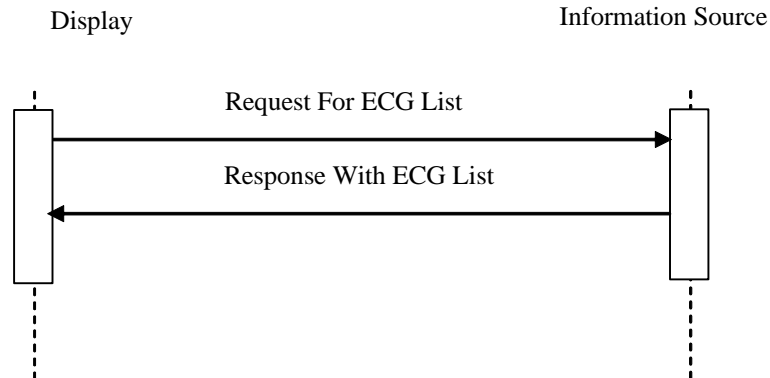
4.5.4 Interaction Diagram

Display   Information Source

Figure 4.5-1 Request for ECG List

4.5.4.1 Request For ECG List

4.5.4.1.1 Trigger Events

The following event will trigger a Request for ECG List:

- User of the Display Actor needs to review a list of ECGs that are part of a patient's clinical history with the intent of selecting a specific ECG off the list for subsequent retrieval as a persistent object via the Retrieve ECG for Display Transaction

4.5.4.1.2 Message Semantics

Please refer to ITI-TF-2: 3.11.4.1.2, Message Semantics for Request for Specific Information – Summary message.

ITI-TF-2: 3.11.4.1.2 Table 3.11.4-2 lists the web service request types for ITI-11. This transaction shall support the request type listed in Table 4.5.4-1.

Table 4.5.4-1 Web Service Request Types

requestType value	Description
SUMMARY-CARDIOLOGY-ECG	List of ECG documents

4.5.4.1.3 Expected Actions

Please refer to ITI-TF-2: 3.11.4.1.3, Expected Actions for Request For Specific Information – Summary message.

30

4.5.4.2 Response with ECG List

4.5.4.2.1 Trigger Events

This message is sent by the Information Source Actor in response to the Request For ECG List web service request.

4.5.4.2.2 Message Semantics

The Information Source Actor shall support the requestType parameters specified in section 4.5.4.1.2.

> Note: The Retrieve ECG for Display Profile requires the Information Source Actor to also support the SUMMARY and SUMMARY-CARDIOLOGY options of the Retrieve Specific Information [ITI-11] transaction. If the Information Source Actor only manages ECGs, its response to SUMMARY, SUMMARY-CARDIOLOGY, and SUMMARY-CARDIOLOGY-ECG will have the same content (but different formats). However, if it manages other types of documents, it responds with only a list of ECG documents in response to a SUMMARY-CARDIOLOGY-ECG request. It always includes ECG documents it manages when responding to SUMMARY and SUMMARY-CARDIOLOGY requests.

The Information Source shall set an expiration of zero to ensure no caching. The message shall be formatted according the XML schema defined in Appendix C. The XML shall reference a default server-side style sheet so the Display Actor can display the list without further processing. Appendix C includes an example style sheet, but that particular one is not required. Appendix C also includes a sample XML instance to help illustrate how the list shall be formated.

The Display Actor may request the Information Source Actor to provide a list of documents of different types pertaining to a particular patient. The exact content of the list is determined by the Information Source Actor and may be regulated by the institution policy. It shall contain the hyperlink to a persistent object so that it can be retrieved by using the Retrieve ECG For Display Transaction. The link shall be formatted as a web service request in accordance with the requirements in Section 4.6. It may also contain other hyperlinks representing the invocation of other services.

4.5.4.2.3 Expected Actions

The Display Actor shall render the received response for the user. Note that the contents of the list may be parsed for specific data to enable more advanced display applications.

4.6 Retrieve ECG Document for Display [CARD-6]

This transaction is derived from Retrieve Document for Display [ITI-12] (see ITI-TF-2: 3.12).

4.6.1 Scope

This transaction involves the retrieval of an ECG document (persistent object) for presentation purposes. The uniquely identifiable persistent object means that retrieving the same document instance at a different point in time will provide the same semantics for its presented content. The information content of the document is immutable even if the presentation of such content is provided with the use of different formats, stylesheets, etc.

4.6.2 Use Case Roles

Please refer to ITI-TF-2: 3.12.2, Use Case Roles for Retrieve Document for Display transaction.

4.6.3 Referenced Standard

Please refer to ITI-TF-2: 3.12.3, Referenced Standards for Retrieve Document for Display transaction.

4.6.4 Interaction Diagram

Please refer to ITI-TF-2: 3.12.4, Interaction Diagram for Retrieve Document for Display transaction.

4.6.4.1 Request For ECG Document

4.6.4.1.1 Trigger Events

The request for a document is triggered when a user of the Display Actor needs to review a particular document that is stored by the Information Source Actor.

4.6.4.1.2 Message Semantics

The Retrieve ECG Document for Display transaction is performed by the invocation of a web service. The Display Actor shall generate the web service request whenever a user needs to review the document stored as part of a patient's clinical history on the Information Source Actor.

Note: For comparison, please refer to ITI-TF-2: 3.12.4.1.2, Message Semantics for Request for Persistent Document message. With repect to that transaction, this transaction has the following differences in sematics:

1. In addition to accepting OIDs as the value for a documentUID, this transaction allows persistent ECG documents to be referenced by UUID.

2. Instead of the content types listed in ITI-TF-2 Tables 3.12.4-1 and 3.12.4-3, this transaction allows only the content types "Application/pdf" and "Image/svg+xml".

The web service request shall include the following parameters (keys) to identify the document to be returned and its format. See Table 4.6.4-1.

Table 4.6.4-1 Query Keys

Parameter Name	REQ	Description	Values
requestType	R	This parameter is required to have a value of "DOCUMENT".	"DOCUMENT"
documentUID	R	Identifies document'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, or a Universal Unique identifier (UUID) as specified in DCE 1.1 RPC (see note).
preferredContentType	R	This parameter is required to identify the preferred format in which the document is to be provided (as MIME content type).	Display may specify one of the following formats: Application/pdf (see note) Image/svg+xml

Note: See IANA registry for details about PDF, such as version. Applications creating PDF may use this MIME type for other versions of PDF up to 1.3. Receivers shall support documents encoded in this version and previous versions.

The UUID is specified in Open Group, DCE 1.1 Remote Procedure Call specification, Appendix A (http://www.opengroup.org/onlinepubs/9629399/apdxa.htm).

Formal definition of the web service in WSDL is provided in Appendix B.

The only binding required for both the Display Actor and Information Source Actor is the binding to the HTTP-GET. In this binding the sample message will be formatted as follows:

http://<location>/<IHERetrieveDocument>?requestType=DOCUMENT&documentUID=1.2.3&preferredContentType=application%2fpdf

where <location> is the address of the service specified in the <service> tag of WSDL definition. IHERetrieveDocument is the operation location specified in the <operation> tag of the WSDL definition. This location shall be implementation-independent.

In addition, the Display Actor shall support the following fields of the HTTP protocol for request and response:

Table 4.6.4-2 HTTP Request and Response Fields

HTTP Field	REQ	Description	Values
Accept	O	This field is used to specify certain media types which are acceptable for the response	At least one of the following values: Application/pdf Image/svg+xml */* Other values may be included as well
Accept-Language	O	This field is similar to Accept, but restricts the set of natural languages that are preferred as a response to the request.	Any valid value according to RFC2616
Expires	R	This field gives the date/time after which the response is considered stale	Any valid value not to exceed one week

The Display Actor shall provide list of content types it supports in the HTTP Accept field. If the HTTP Accept Field is absent, it means that any content type is acceptable by the Display Actor.

The preferredContentType parameter shall specify the content type desired by the Display Actor. The value of the preferredContentType parameter of the request shall be one of the values from the Table 4.6.4-1 and shall not contradict values specified in the HTTP Accept field.

The Information Source shall provide info in preferredContentType if capable, otherwise it shall only use a type specified in the Accept Field as appropriate given the information to be returned.

If necessary, the Display Actor may perform the request to the web service utilizing HTTPS protocol.

4.6.4.1.3 Expected Actions

Please refer to ITI-TF-2:3.12.4.1.3, Expected Actions for Request for Persistent Document message.

The Information Source may provide an HTTP Redirect response of 301 - Moved Permanently, 302 – Found, 303 – See Other, or 307 – Temporary Redirect. The Display Actor shall issue an HTTP GET to the redirect target URI, but if a loop is detected, it may report an error..

4.6.4.2 Delivery of ECG Document

4.6.4.2.1 Trigger Events

Please refer to ITI-TF-2: 3.12.4.2.1, Trigger Events for Delivery of Persistent Document message.

4.6.4.2.2 Message Semantics

Please refer to ITI-TF-2: 3.12.4.2.2, Message Semantics for Delivery of Persistent Document message.

ECG documents retrieved using this transaction must meet the following minimum requirements:

4.6.4.2.2.1 Minimum Demographics

The ECG document shall include at the least the patient's name and patient's ID. The Cardiology Technical Framework does not support the delivery of anonymous ECG documents in this transaction.

4.6.4.2.2.2 Minimum Recording Context

The ECG document shall state when the ECG waveforms were recorded from the patient. The document shall include the date and time (to the resolution recorded by the device) of the recording. It is assumed the date/time is local to wherever the recording was made, unless specific timezone information is provided.

4.6.4.2.2.3 Minimum Waveform Fidelity

ECG documents that include waveforms shall encode those waveforms at diagnostic quality.

> Note: There is no standard for diagnostic quality of softcopy ECG display. The ANSI/AAMI EC-11-1991 standard specifies diagnostic quality for hardcopy recording of ECGs. It is the responsibility of the document source to provide equivalent quality, presuming typical personal computer display capabilities.

4.6.4.2.2.4 Minimum Waveform Information

ECG waveforms shall include an indication of voltage and time scale by usage of standard calibration pulse (1 mV high, 200 ms wide), and a nominal 1 mm grid. Statements about mm/time and mm/mV, e.g., "25 mm/s 10 mm/mV" are recommended, but are optional. If different leads have different gains (e.g., precordial chest leads at half gain), sufficient information must be given to determine the gain of each lead.

The actual size of the displayed ECG document is under control of the user at the display client. Thus, the information source cannot control that the nominal 1 mm squares on the background grid are always displayed as a 1 mm square on the screen of the display device. The aspect ratio shall be fixed, so that the grid squares will always be displayed as squares, not rectangles; a change in aspect ratio may make the ECG interpretation difficult for those accustomed to reading ECGs at the standard 1 mm x 1 mm fixed aspect ratio. There should be major axes every 5 mm in both dimensions drawn with darker or thicker lines, corresponding to 200 ms and 500 uV when the report scaling is 25mm/s and 10 mm/mV. The minor axes at 1 mm intervals (at 40 ms and 100 uV when the report scaling is 25 mm/s and 10 mm/mV) may be drawn using fainter or thinner lines, or by using small "dots".

ECG waveforms shall include lead labels. The rendered waveform shall include an indication denoting the transition from one lead to the next in a waveform "line".

ECG waveforms shall include statement of frequency content, e.g., "0.05 – 150 Hz".

4.6.4.2.2.5 Minimum Interpretation Information

If the interpretation statements are included, the ECG document shall also include a statement if interpretation is confirmed or unconfirmed, e.g., "Unconfirmed Report", "Confirmed Report".

4.6.4.2.2.6 Required Request Types

Information Source must support the **Application/pdf** format.

To meet the waveform quality requirements, the Information Source shall use vector graphics to minimize aliasing effects. This means the Information Source shall generate PDF "content" (i.e., vector drawing commands) to be rendered on the display device, versus generating a PDF "image" (i.e., a rasterized bitmap). To do this, the Information Source needs to generate the PDF content using PDF vector drawing commands.

Note: There exist a number of tools available for this purpose, including the Adobe PDF Library SDK, and libraries from other vendors such as PDFLIB (www.pdflib.com). Many common PDF tools (e.g., current versions of Adobe Acrobat Distiller) do not create vector drawing commands.

The Information Source may additionally support the **Image/svg+xml** MIME type format.

Note: Scalable Vector Graphics (SVG) is well suited to this application, but requires an SVG browser plugin (such as the Adobe SVG plugin for Internet Explorer). An XML document using SVG has the capability for embedding JavaScript commands, which could be used for local reformatting of the ECG image (such as changing the format from 3x4 1R to 6x2, etc.).

Note that applications that serve ECGs using raster formats do not conform to this transaction, but may conform to the Retrieve Information for Display Profile.

4.6.4.2.3 Expected Actions

Please refer to ITI-TF-2: 3.12.4.2.3, Expected Actions for Delivery of Persistent Document message.

4.7 Encapsulated Report Submission [CARD-7]

This section reserved.

4.8 Report Reference Submission [CARD-8]

This section reserved.

4.9 Encapsulated Report Storage [CARD-9]

This section reserved.

4.10 Encapsulated Report Query [CARD-10]

This section reserved.

4.11 Encapsulated Report Retrieve [CARD-11]

This section reserved.

Appendix A: Clarification on MPPS for Intermittently Connected Modality

When an Acquisition Modality is only intermittently connected to the network, in particular when it is not connected during the performance of a procedure, it may not be able to send Modality Procedure Step In Progress [CARD-1 and RAD-6] and Modality Procedure Step Completed [RAD-7] transactions in real time.

The trigger events for these transactions (user begins or completes a procedure step) remain the same as specified in those transaction definitions, but the message remains queued for transmission until the modality reconnects to the network.

The Acquisition Modality shall send both an MPPS N-CREATE (with status IN PROGRESS) and an MPPS N-SET (with status COMPLETED or DISCONTINUED) message. The Acquisition Modality shall not send the MPPS N-SET until it receives a response from the Performed Procedure Step Manager for the MPPS N-CREATE.

The expected actions of the Performed Procedure Step Manager, DSS/OF, and Image Manager are the same as specified in the Modality Procedure Step In Progress and Modality Procedure Step Completed transaction definitions.

Appendix B: Web Service Definition for Retrieve ECG for Display Transaction

The following is the WSDL definition of web services used in the Transactions CARD-5 and CARD-6. Note that there are portions of this definition that need to be replaced during implementation, such as the service location, which is here bound to http://localhost/. Also, the definitions of summaryRequestType, listRequestType and contentType shall correspond to the capabilities of the Information Source Actor.

```xml
<?xml version="1.0" encoding="utf8"?>

<definitions xmlns:http="http://schemas.xmlsoap.org/wsdl/http/"
    xmlns:s="http://www.w3.org/2001/XMLSchema"
    xmlns:s0="http://rsna.org/ihe/IHERetrieveForDisplay"
    xmlns:tm="http://microsoft.com/wsdl/mime/textMatching/"
    xmlns:mime="http://schemas.xmlsoap.org/wsdl/mime/"
    targetNamespace="http://rsna.org/ihe/IHERetrieveForDisplay"
    xmlns="http://schemas.xmlsoap.org/wsdl/">

  <!-- Defines the types available for the parameters -->
  <!-- May also include the return type defintiions -->
  <types>
    <s:schema elementFormDefault="qualified"
targetNamespace="http://rsna.org/ihe/IHERetrieveForDisplay">
      <!-- Add any items that control the returned values list or type here -->
      <!-- Add or remove items in the actual supplied WSDL to show the available types. -->
      <s:simpleType name="summaryRequestType">
        <s:restriction base="s:string">
          <s:enumeration value="SUMMARY" />
          <s:enumeration value="SUMMARY-CARDIOLOGY" />
          <s:enumeration value="SUMMARY-CARDIOLOGY-ECG" />
        </s:restriction>
      </s:simpleType>

      <!-- Please list all content types available, and remove those not available. -->
      <s:simpleType name="contentType">
        <s:restriction base="s:string">
          <s:enumeration value="text/html" />
        </s:restriction>
      </s:simpleType>

      <!-- Indicates that this item is a returned rows restriction -->
      <s:simpleType name="ReturnedResultCount" type="s:positiveInteger" />

      <!-- Please use the string "Search" as a prefix for all search criteria, and list below -->
      <!-- Indicates that this item is a search string -->
      <s:simpleType name="SearchString" type="s:string" />

    </s:schema>
  </types>

  <message name="RetrieveSummaryInfoHttpGetIn">
    <!-- Add other parameters here if they are available, using types defined above. -->
    <part name="requestType" type="summaryRequestType" />
    <part name="patientID" type="SearchString" />
    <part name="lowerDateTime" type="s:dateTime" />
    <part name="upperDateTime" type="s:dateTime" />
    <part name="mostRecentResults" type="ReturnedResultCount" />
  </message>
```

```
  <message name="RetrieveSummaryInfoHttpGetOut">
    <!-- If a complex type is defined for the return value, then it is suggested that -->
    <!-- it be used here instead of s0:string. If a complex type is allowed as one -->
    <!-- of the options, but an arbitrarily formatted string is also allowed, then create -->
    <!-- a union type here that allows either option. -->
    <part name="Body" element="s0:string" />
  </message>

  <message name="RetrieveDocumentHttpGetIn">
    <!-- Add other parameters here if they are available, using types defined above. -->
    <!-- It is recommended that one of the sub-types of SearchUID is chosen here -->
    <!-- Especially if SearchStudyUID is allowed, then the display client can know that -->
    <!-- it is permissable to use a dicom uid here -->
    <part name="documentUID" type="SearchString" />
    <part name="contentType" type="contentType" />
  </message>

  <message name="RetrieveDocumentHttpGetOut">
    <!-- If a complex type is defined for the return value, then it is suggested that -->
    <!-- it be used here instead of s:string. If a complex type is allowed as one -->
    <!-- of the options, but an arbitrarily formatted string is also allowed, then create -->
    <!-- a union type here that allows either option. -->
    <part name="Body" element="s:string" />
  </message>

  <portType name="IHERetrieveForDisplayHttpGet">
    <operation name="RetrieveSummaryInfo">
      <input message="s0:RetrieveSummaryInfoHttpGetIn" />
      <output message="s0:RetrieveSummaryInfoHttpGetOut" />
    </operation>
    <operation name="RetrieveDocument">
      <input message="s0:RetrieveDocumentHttpGetIn" />
      <output message="s0:RetrieveDocumentHttpGetOut" />
    </operation>
  </portType>

  <binding name="IHERetrieveForDisplayHttpGet" type="s0:IHERetrieveForDisplayHttpGet">
    <http:binding verb="GET" />
    <operation name="RetrieveSummaryInfo">
      <http:operation location="/IHERetrieveSummaryInfo" />
      <input>
        <http:urlEncoded />
      </input>

      <output>
        <mime:content type="text/html" />
      </output>
    </operation>

    <operation name="RetrieveDocument">
      <http:operation location="/IHERetrieveDocument" />
      <input>
        <http:urlEncoded />
      </input>

      <!-- The type of the output should be restricted on a per-server basis to the types -->
      <!-- actually provided. -->
      <output>
        <mime:content type="application/pdf" />
        <mime:content type="image/svg+xml" />
      </output>
    </operation>
  </binding>

  <!-- Bind the actual service here -->
  <service name="IHERetrieveForDisplay">
    <port name="IHERetrieveForDisplayHttpGet" binding="s0:IHERetrieveForDisplayHttpGet">
```

```
        <http:address location="http://localhost/" />
    </port>
</service>
```

Appendix C: ECG List XML Specification

When the list of ECG documents is requested, the list shall be returned as XML. The XML schema is based on the HL7 V3 Reference Information Model (RIM).

Notes: 1. The following schema and example are available as a zipped file at www.ihe.net and www.acc.org.

2. The specific codes to be used for document types and statuses are in discussion. Implementers are advised make these configurable within the applications.
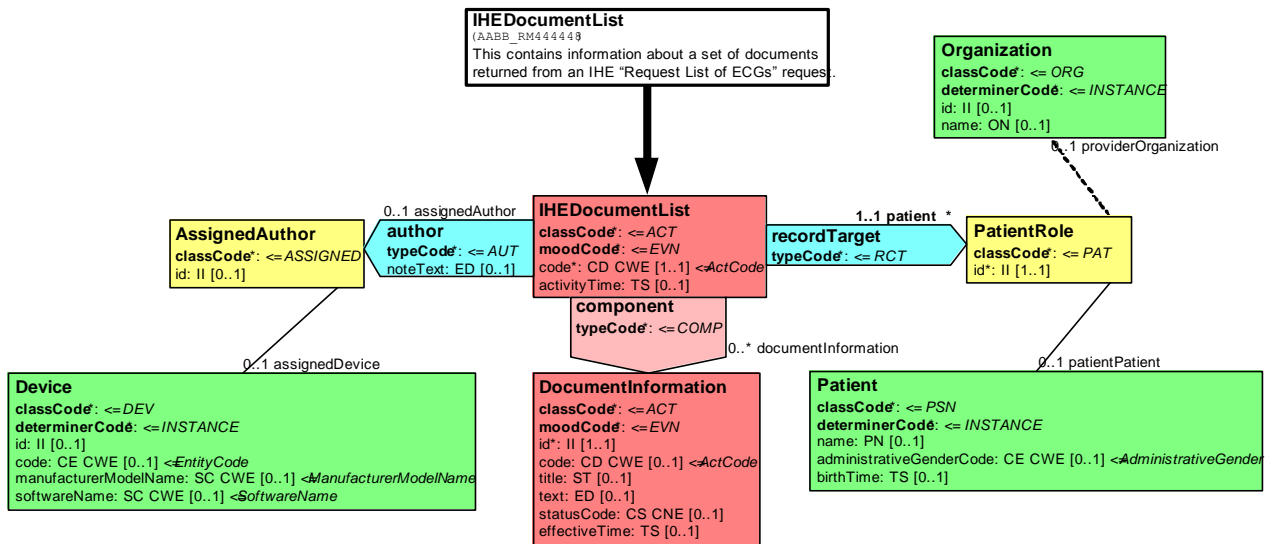
C.1 Schema

```
<?xml version="1.0" encoding="UTF-8" standalone="no"?>
<xs:schema targetNamespace="urn:hl7-org:v3" xmlns:fo="http://www.w3.org/1999/XSL/Format" xmlns:msg="urn:hl7-org:v3/mif"
xmlns:hl7="urn:hl7-org:v3" xmlns:voc="urn:hl7-org:v3/voc" xmlns="urn:hl7-org:v3" xmlns:xs="http://www.w3.org/2001/XMLSchema"
elementFormDefault="qualified">
    <xs:include schemaLocation="../dt/datatypes.xsd"/>
    <xs:include schemaLocation="../voc/voc.xsd"/>
    <!--
*********************************************************************************************************************
* XML schema for message type .
* Generated by XMLITS version 1.1, Copyright (C) 2002, 2003 by Health Level 7, Inc.
*
* Copyright (c) 2002, 2003, Health Level Seven. All rights reserved.
*  Redistribution and use in source and binary forms, with or without
*  modification, are permitted provided that the following conditions
*  are met:
*  1. Redistributions of source code must retain the above copyright
```

```
    <xs:group name="AABB_MT444448">
        <xs:sequence>
            <xs:element name="IHEDocumentList" type="AABB_MT444448.IHEDocumentList"/>
        </xs:sequence>
    </xs:group>
    <xs:element name="IHEDocumentList" type="AABB_MT444448.IHEDocumentList"/>
    <xs:complexType name="AABB_MT444448.IHEDocumentList">
        <xs:sequence>
            <xs:element name="code" type="CD"/>
            <xs:element name="activityTime" type="TS" minOccurs="0"/>
            <xs:element name="recordTarget" type="AABB_MT444448.RecordTarget"/>
            <xs:element name="author" type="AABB_MT444448.Author" minOccurs="0"/>
            <xs:element name="component" type="AABB_MT444448.Component" minOccurs="0" maxOccurs="unbounded"/>
        </xs:sequence>
        <xs:attribute name="type" type="Classes" default="ActHeir"/>
        <xs:attribute name="classCode" type="ActClass"/>
        <xs:attribute name="moodCode" type="ActMood"/>
        <xs:attribute name="templateId" use="optional">
            <xs:simpleType>
                <xs:list itemType="oid"/>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="typeID" use="optional">
            <xs:simpleType>
                <xs:list itemType="oid"/>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="realmCode" use="optional">
            <xs:simpleType>
                <xs:list itemType="cs"/>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="nullFlavor" type="cs" use="optional"/>
    </xs:complexType>
    <xs:complexType name="AABB_MT444448.RecordTarget">
        <xs:sequence>
            <xs:element name="patient" type="AABB_MT444448.PatientRole"/>
        </xs:sequence>
        <xs:attribute name="type" type="Classes" default="Participation"/>
        <xs:attribute name="typeCode" type="ParticipationType"/>
        <xs:attribute name="templateId" use="optional">
            <xs:simpleType>
                <xs:list itemType="oid"/>
            </xs:simpleType>
        </xs:attribute>
```

```xml
            <xs:attribute name="typeID" use="optional">
                <xs:simpleType>
                    <xs:list itemType="oid"/>
                </xs:simpleType>
            </xs:attribute>
            <xs:attribute name="realmCode" use="optional">
                <xs:simpleType>
                    <xs:list itemType="cs"/>
                </xs:simpleType>
            </xs:attribute>
            <xs:attribute name="nullFlavor" type="cs" use="optional"/>
    </xs:complexType>
    <xs:complexType name="AABB_MT444448.PatientRole">
        <xs:sequence>
            <xs:element name="id" type="II"/>
            <xs:element name="patientPatient" type="AABB_MT444448.Patient" minOccurs="0"/>
            <xs:element name="providerOrganization" type="AABB_MT444448.Organization" minOccurs="0"/>
        </xs:sequence>
        <xs:attribute name="type" type="Classes" default="Patient"/>
        <xs:attribute name="classCode" type="RoleClass"/>
        <xs:attribute name="templateId" use="optional">
            <xs:simpleType>
                <xs:list itemType="oid"/>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="typeID" use="optional">
            <xs:simpleType>
                <xs:list itemType="oid"/>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="realmCode" use="optional">
            <xs:simpleType>
                <xs:list itemType="cs"/>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="nullFlavor" type="cs" use="optional"/>
    </xs:complexType>
    <xs:complexType name="AABB_MT444448.Patient">
        <xs:sequence>
            <xs:element name="name" type="PN" minOccurs="0"/>
            <xs:element name="administrativeGenderCode" type="CE" minOccurs="0"/>
            <xs:element name="birthTime" type="TS" minOccurs="0"/>
        </xs:sequence>
        <xs:attribute name="type" type="Classes" default="Person"/>
        <xs:attribute name="classCode" type="EntityClass"/>
        <xs:attribute name="determinerCode" type="EntityDeterminer"/>
        <xs:attribute name="templateId" use="optional">
            <xs:simpleType>
                <xs:list itemType="oid"/>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="typeID" use="optional">
            <xs:simpleType>
                <xs:list itemType="oid"/>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="realmCode" use="optional">
            <xs:simpleType>
                <xs:list itemType="cs"/>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="nullFlavor" type="cs" use="optional"/>
    </xs:complexType>
    <xs:complexType name="AABB_MT444448.Organization">
        <xs:sequence>
            <xs:element name="id" type="II" minOccurs="0"/>
```

```
                    <xs:element name="name" type="ON" minOccurs="0"/>
            </xs:sequence>
            <xs:attribute name="type" type="Classes" default="Organization"/>
            <xs:attribute name="classCode" type="EntityClass"/>
            <xs:attribute name="determinerCode" type="EntityDeterminer"/>
            <xs:attribute name="templateId" use="optional">
                    <xs:simpleType>
                            <xs:list itemType="oid"/>
                    </xs:simpleType>
            </xs:attribute>
            <xs:attribute name="typeID" use="optional">
                    <xs:simpleType>
                            <xs:list itemType="oid"/>
                    </xs:simpleType>
            </xs:attribute>
            <xs:attribute name="realmCode" use="optional">
                    <xs:simpleType>
                            <xs:list itemType="cs"/>
                    </xs:simpleType>
            </xs:attribute>
            <xs:attribute name="nullFlavor" type="cs" use="optional"/>
    </xs:complexType>
    <xs:complexType name="AABB_MT444448.Author">
            <xs:sequence>
                    <xs:element name="noteText" type="ED" minOccurs="0"/>
                    <xs:element name="assignedAuthor" type="AABB_MT444448.AssignedAuthor"/>
            </xs:sequence>
            <xs:attribute name="type" type="Classes" default="Participation"/>
            <xs:attribute name="typeCode" type="ParticipationType"/>
            <xs:attribute name="templateId" use="optional">
                    <xs:simpleType>
                            <xs:list itemType="oid"/>
                    </xs:simpleType>
            </xs:attribute>
            <xs:attribute name="typeID" use="optional">
                    <xs:simpleType>
                            <xs:list itemType="oid"/>
                    </xs:simpleType>
            </xs:attribute>
            <xs:attribute name="realmCode" use="optional">
                    <xs:simpleType>
                            <xs:list itemType="cs"/>
                    </xs:simpleType>
            </xs:attribute>
            <xs:attribute name="nullFlavor" type="cs" use="optional"/>
    </xs:complexType>
    <xs:complexType name="AABB_MT444448.AssignedAuthor">
            <xs:sequence>
                    <xs:element name="id" type="II" minOccurs="0"/>
                    <xs:element name="assignedDevice" type="AABB_MT444448.Device" minOccurs="0"/>
            </xs:sequence>
            <xs:attribute name="type" type="Classes" default="RoleHeir"/>
            <xs:attribute name="classCode" type="RoleClass"/>
            <xs:attribute name="templateId" use="optional">
                    <xs:simpleType>
                            <xs:list itemType="oid"/>
                    </xs:simpleType>
            </xs:attribute>
            <xs:attribute name="typeID" use="optional">
                    <xs:simpleType>
                            <xs:list itemType="oid"/>
                    </xs:simpleType>
            </xs:attribute>
            <xs:attribute name="realmCode" use="optional">
                    <xs:simpleType>
                            <xs:list itemType="cs"/>
```

49

```xml
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="nullFlavor" type="cs" use="optional"/>
    </xs:complexType>
    <xs:complexType name="AABB_MT444448.Device">
        <xs:sequence>
            <xs:element name="id" type="II" minOccurs="0"/>
            <xs:element name="code" type="CE" minOccurs="0"/>
            <xs:element name="manufacturerModelName" type="SC" minOccurs="0"/>
            <xs:element name="softwareName" type="SC" minOccurs="0"/>
        </xs:sequence>
        <xs:attribute name="type" type="Classes" default="Device"/>
        <xs:attribute name="classCode" type="EntityClass"/>
        <xs:attribute name="determinerCode" type="EntityDeterminer"/>
        <xs:attribute name="templateId" use="optional">
            <xs:simpleType>
                <xs:list itemType="oid"/>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="typeID" use="optional">
            <xs:simpleType>
                <xs:list itemType="oid"/>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="realmCode" use="optional">
            <xs:simpleType>
                <xs:list itemType="cs"/>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="nullFlavor" type="cs" use="optional"/>
    </xs:complexType>
    <xs:complexType name="AABB_MT444448.Component">
        <xs:sequence>
            <xs:element name="documentInformation" type="AABB_MT444448.DocumentInformation"/>
        </xs:sequence>
        <xs:attribute name="type" type="Classes" default="ActRelationship"/>
        <xs:attribute name="typeCode" type="ActRelationshipType"/>
        <xs:attribute name="templateId" use="optional">
            <xs:simpleType>
                <xs:list itemType="oid"/>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="typeID" use="optional">
            <xs:simpleType>
                <xs:list itemType="oid"/>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="realmCode" use="optional">
            <xs:simpleType>
                <xs:list itemType="cs"/>
            </xs:simpleType>
        </xs:attribute>
        <xs:attribute name="nullFlavor" type="cs" use="optional"/>
    </xs:complexType>
    <xs:complexType name="AABB_MT444448.DocumentInformation">
        <xs:sequence>
            <xs:element name="id" type="II"/>
            <xs:element name="code" type="CD" minOccurs="0"/>
            <xs:element name="title" type="ST" minOccurs="0"/>
            <xs:element name="text" type="ED" minOccurs="0"/>
            <xs:element name="statusCode" type="CS" minOccurs="0"/>
            <xs:element name="effectiveTime" type="TS" minOccurs="0"/>
        </xs:sequence>
        <xs:attribute name="type" type="Classes" default="ActHeir"/>
        <xs:attribute name="classCode" type="ActClass"/>
        <xs:attribute name="moodCode" type="ActMood"/>
```

50

```
                <xs:attribute name="templateId" use="optional">
                    <xs:simpleType>
                        <xs:list itemType="oid"/>
                    </xs:simpleType>
                </xs:attribute>
                <xs:attribute name="typeID" use="optional">
                    <xs:simpleType>
                        <xs:list itemType="oid"/>
                    </xs:simpleType>
                </xs:attribute>
                <xs:attribute name="realmCode" use="optional">
                    <xs:simpleType>
                        <xs:list itemType="cs"/>
                    </xs:simpleType>
                </xs:attribute>
                <xs:attribute name="nullFlavor" type="cs" use="optional"/>
        </xs:complexType>
</xs:schema>
```

C.2   Example

Example XML instance returned from a query for SUMMARY-CARDIOLOGY-ECG:

```
<?xml version="1.0" encoding="UTF-8"?>
<?xml-stylesheet href = 'IHEDocumentList.xsl' type = 'text/xsl'?>
<IHEDocumentList xmlns="urn:hl7-org:v3" xmlns:voc="urn:hl7-org:v3/voc" xmlns:xsi="http://www.w3.org/2001/XMLSchema-
instance" xsi:schemaLocation="urn:hl7-org:v3 ../schema/AABB_MT444448.xsd" type="Observation" classCode="ACT">
    <code code="SUMMARY-CARDIOLOGY-ECG" codeSystem="1.2.3.4.5" displayName="Summary of ECG Documents"/>
    <!-- When this document was created by Information Source Actor -->
    <activityTime value="20040608215104"/>
    <recordTarget>
        <patient>
            <!-- Patient Identifier (a.k.a. Medical Record Number)
        "root" is UID scoping the local ID, usually identifying the Organization that assigned it
        "extension" is ID assigned by the Organization -->
                <id root="1.3.6.1.4.1.20029.10.2332.23" extension="324414"/>
                <patientPatient>
                    <name>
                        <family>Smith</family>
                        <given>John</given>
                    </name>
                    <administrativeGenderCode code="M" codeSystem="2.16.840.1.113883.5.1"/>
                    <birthTime value="19650423"/>
                </patientPatient>
                <providerOrganization>
                    <id root="1.3.6.1.4.1.20029.10.2332.23"/>
                    <name>XYZ Memorial Hospital</name>
                </providerOrganization>
        </patient>
    </recordTarget>
    <author>
        <noteText>
            <!-- URL of the list author -->
            <reference value="http://192.168.100.146/IHERetrieveSummaryInfo?requestType='SUMMARY-CARDIOLOGY-
ECG'&amp;patientID='12345'"/>
        </noteText>
        <assignedAuthor>
            <!-- Optional role-specific ID of authoring device, e.g. hospital-assigned tracking ID -->
            <id root="1.2.3.4.5" extension="123"/>
            <assignedDevice>
                <!-- Optional role-independent ID of authoring device, e.g. serial number -->
```

51

```xml
                    <id root="1.2.3.4.5" extension="123"/>
                    <!-- Optional code specifying the type of device -->
                    <code code="ECG_MANAGER" codeSystem="1.2.3.4.5" displayName="ECG Manager"/>
                    <manufacturerModelName>ABC ECG Management System</manufacturerModelName>
                    <softwareName>Standard Edition, V2.12</softwareName>
                </assignedDevice>
            </assignedAuthor>
        </author>
        <component>
            <documentInformation>
                <!-- Unique Identifier of document, and be OID or UUID -->
                <id root="61d1a24f-b47e-41aa-ae95-f8ac302f4eeb"/>
                <!-- Type of document -->
                <code code="28010-7" codeSystem="2.16.840.1.113883.5.22" displayName="EKG Report"/>
                <!-- Optional title of the document -->
                <title>Resting 12-Lead ECG</title>
                <text>
                    <!-- URL of the document -->
                    <reference
value="http://192.168.100.146/IHERetrieveDocument?requestType='DOCUMENT'&amp;documentUID='61d1a24f-b47e-41aa-ae95-
f8ac302f4eeb'&amp;preferredContentType='application/pdf'"/>
                </text>
                <!-- Status of the document, need a vocabulary to define these codes -->
                <statusCode code="CONFIRMED" codeSystem="1.2.3.4.5"/>
                <!-- Acquisition time of the data used to make the report, e.g. device time of cardiograph when it recorded the ECG -->
                <effectiveTime value="20040423134502"/>
            </documentInformation>
        </component>
        <component>
            <documentInformation>
                <id root="61d1a24f-b47e-41aa-ae95-f8ac302f4eec"/>
                <code code="28010-7" codeSystem="2.16.840.1.113883.5.22" displayName="Resting 12-Lead ECG"/>
                <title>Resting 12-Lead ECG</title>
                <text>
                    <reference
value="http://192.168.100.146/IHERetrieveDocument?requestType='DOCUMENT'&amp;documentUID='61d1a24f-b47e-41aa-ae95-
f8ac302f4eec'&amp;preferredContentType='application/pdf'"/>
                </text>
                <statusCode code="CONFIRMED" codeSystem="1.2.3.4.5"/>
                <effectiveTime value="20040423134745"/>
            </documentInformation>
        </component>
</IHEDocumentList>
```

Example style sheet:

```xml
<?xml version='1.0'?>
<xsl:stylesheet xmlns:xsl="http://www.w3.org/TR/WD-xsl">

<xsl:template match="/">
<html>
   <head>
      <title> <xsl:value-of select="IHEDocumentList/recordTarget/patient/patientPatient/name/family"/>,
      <xsl:value-of select="IHEDocumentList/recordTarget/patient/patientPatient/name/given"/>
      </title>
   </head>
   <body>
      <h2>List of ECG's for <xsl:value-of select="IHEDocumentList/recordTarget/patient/patientPatient/name/family"/>,
      <xsl:value-of select="IHEDocumentList/recordTarget/patient/patientPatient/name/given"/>
      </h2>
```
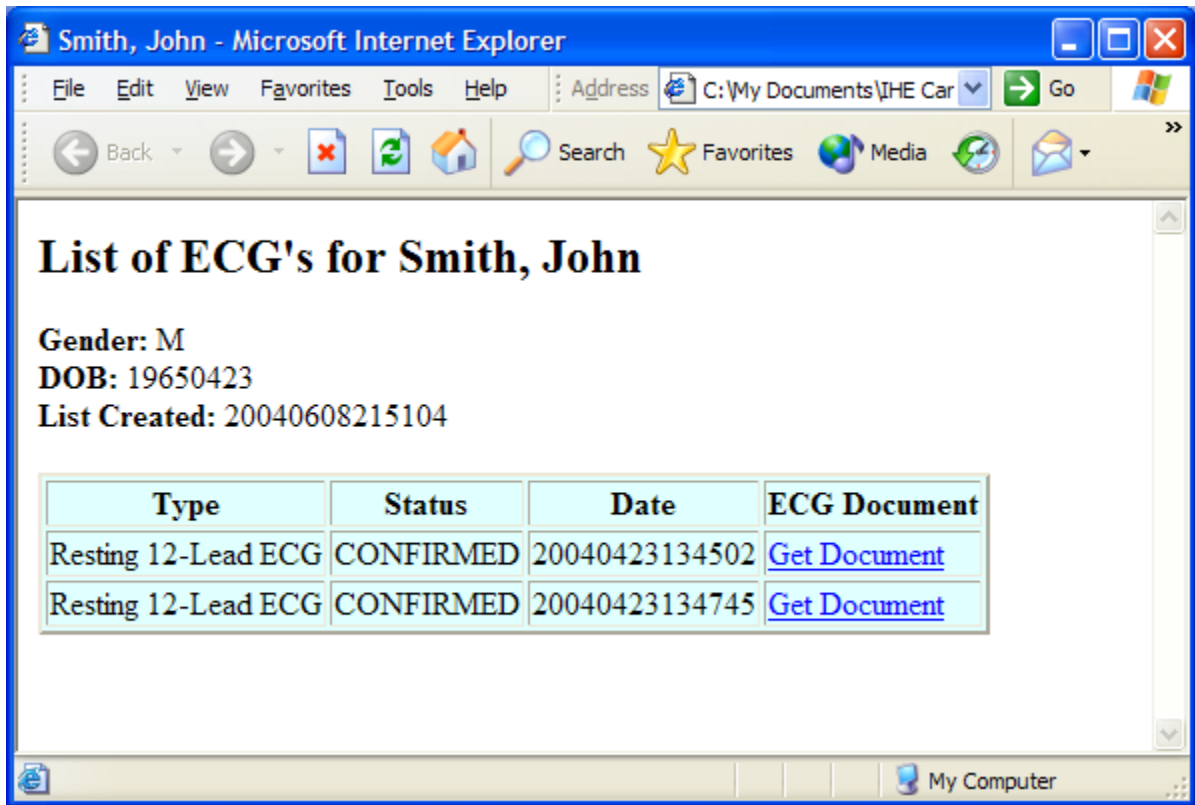
```
      <b> Gender:</b> <xsl:value-of
select="IHEDocumentList/recordTarget/patient/patientPatient/administrativeGenderCode/@code"/><br/>
      <b> DOB:</b> <xsl:value-of select="IHEDocumentList/recordTarget/patient/patientPatient/birthTime/@value"/><br/>
      <b> List Created:</b> <xsl:value-of select="IHEDocumentList/activityTime/@value"/><br/><br/>
    <table border="2" bgcolor="lightcyan">
     <tr>
        <th>Type</th>
        <th>Status</th>
        <th>Date</th>
        <th>ECG Document</th>
     </tr>
     <xsl:for-each select="/IHEDocumentList/component/documentInformation">
     <tr>
        <td><xsl:value-of select="code/@displayName"/></td>
        <td><xsl:value-of select="statusCode/@code"/></td>
        <td><xsl:value-of select="effectiveTime/@value"/></td>
        <td>
         <a> <xsl:attribute name = "HREF"> <xsl:value-of select="text/reference/@value"/>
         </xsl:attribute> Get Document</a>
        </td>
        </tr>
     </xsl:for-each>
    </table>
  </body>
</html>
</xsl:template>
</xsl:stylesheet>
```

Display based on example instance and style sheet:

Appendix D: Coded Report Titles

This section reserved.