Integrating the Healthcare Enterprise

IHE Radiology
White Paper

Code Mapping in IHE Radiology Profiles

Mapping together: RadLex Lexicon and Playbook, IHE Radiology Scheduled Workflow, RSNA Report Templates, HL7 Clinical Document Architecture (CDA), IHE Radiation Exposure Monitoring (REM), IHE Teaching Files and Clinical Trials Export (TCE), and Cross-Enterprise Document Sharing (XDS/XDS-I)

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Foreword

This is a white paper of the IHE Radiology domain.

This white paper is published on March 10, 2022. Comments are invited and can be submitted at Radiology Public Comments.

General information about IHE can be found at IHE.net.

Information about the IHE Radiology domain can be found at IHE Domains.

Information about the organization of IHE Technical Frameworks and Supplements and the process used to create them can be found at Profiles and IHE Process.

The current version of the IHE Radiology Technical Framework can be found at Radiology Technical Framework.

CONTENTS

1 Introduction

This document, the IHE Radiology Code Mapping White Paper, describes how critical codes are mapped consistently throughout a radiology procedure from order entry through reporting.

1.1 Purpose of the Code Mappings in IHE Radiology Profiles White Paper

The purpose of this document is to illustrate how, by using the proper coding schemes correctly and the data mappings defined in IHE Radiology Scheduled Workflow, several standards initiatives can be cohesively linked together. These include:

- RSNA RadLex Lexicon and Playbook
- IHE Radiology Scheduled Workflow Profile
- RSNA Report Templates
- IHE Radiology Radiation Exposure Monitoring (REM) Profile
- IHE Radiology Teaching File and Clinical Export (TCE) Profile
- HL7 v.3 Clinical Document Architecture (CDA)
- IHE IT Infrastructure Cross Enterprise Document Sharing (XDS) Profile
- IHE Radiology Cross Enterprise Document Sharing for Imaging (XDS-I) Profile

The main body of this document focuses specifically on how code sets should flow through an integrated system based on IHE. Consistent use of critical codes, especially the Requested and Performed Procedure Codes, can more fully integrate radiology workflow.

Additional information on other code sets is provided in Appendix A. Additional discussions on radiology standards and quality initiatives are provided in Appendix B. Code mappings in more complex clinical use cases are discussed in Appendix C.

1.2 Intended Audience

The intended audience of the IHE Radiology Code Mapping White Paper includes:

- Those interested in integrating healthcare information systems and workflows
- IT departments of healthcare institutions
- Technical staff of vendors participating in the IHE initiative, especially software developers of modality, radiology information and imaging systems who should verify that the code values in their systems can be mapped correctly

1.3 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.

1.4 Trademark

2 Key Terms

There are several terms in common use that may be confusing.

Orderable: An "orderable" is a procedure that can be ordered (requested). However, the same codes used for "orderables" ("requested procedures") can also be used as codes for "performed procedures".

Billable: It may also seem that an "orderable", once performed, could also be a "billable", and described by the same codes. Typically, however, different coding schemes are used for billing than are used for requested and performed procedures. Billable codes typically represent units of work, rather than specific actions.

3 Clinical Use Case

For the purposes of illustration a "real world clinical use case" is followed throughout the document as an example of the use of codes in the various IHE profiles.

The basic workflow in clinical systems is as follows:

- A new radiology procedure is ordered in the Hospital Information System (HIS) or Computerized Physician Order Entry (CPOE) system (IHE Order Placer (OP)), and communicated to the Radiology Information System (RIS, or IHE Department System Scheduler/Order Filler (DSS/OF).) The order is encoded with a radiology orderable code.
- This radiology department uses the "radiology orderable" code. The "orderable" (i.e., the Requested Procedure Code) will be supplied via the DICOM Modality Worklist (MWL) and will drive the protocol to be performed on the modality, either manually or automatically (Assisted Acquisition Protocol Setting Option).
- The modality, unless the operator alters the procedure, will automatically copy the Requested Procedure Code to the image headers as the (performed) Procedure Code, as well as copy the performed procedure code into the Radiation Exposure Monitoring (REM) Profile Radiation Dose Structured Report (RDSR), as well as the Modality Performed Procedure Step (MPPS). Given the consistent codes, the information can be indexed and analyzed accurately across studies and across the department.
- When the radiologist reviews the images, the Teaching File and Clinical Trial Export (TCE) Profile information may also be sent to a teaching file system or clinical trials registry using the (performed) Procedure Code.
- Based on the (performed) Procedure Code, the correct RSNA structured report template can be selected and displayed to the radiologist to allow them to author a complete and consistent report efficiently and accurately.
- The instance of the RSNA report can be stored as an HL7 CDA document using the correct procedure codes in the header.
- Finally, the HL7 CDA document can be submitted to an IHE XDS Repository with the correct bindings from the CDA document to the XDS metadata.

The clinical use case for this example is a patient with acute pancreatitis:

Our patient's referring physician has ordered a "CT of the Abdomen" in the Order Placer System (OP). The OP sends this "orderable" to the RIS (DSS/OF). Our hospital and radiology department employ the RadLex coding scheme, so an orderable with the description "A computed tomography RADIOLOGY ORDERABLE imaging procedure focused on the PANCREAS in the ABDOMEN WITH IV CONTRAST" is ordered. The long name for this orderable is "CT ABDOMEN PANCREAS WITH IV CONTRAST" and the short name is "CT ABD PANC W IVCON". This orderable has the code value "RPID947".

In this example, "protocoling" is performed at the CT scanner. Hence, there is no "Scheduled Protocol Code" sent by the RIS to the CT modality. See Appendix B for a discussion on protocoling.

For the purposes of discussion, the RadLex coding scheme will be used in the examples, and "RADLEX" will be used as the coding scheme designator throughout, and the codes are drawn from the current version of the RadLex Playbook. It is expected that as the RadLex Playbook-LOINC Harmonization effort proceeds, the codes actually used in deployed HL7 systems, DICOM modality worklists and stored in DICOM images will be LOINC codes (with a coding scheme designator of "LN"), but which will have a 1:1 mapping to the corresponding RadLex Playbook concepts. See Appendix A for a discussion of LOINC and other coding schemes. It is also expected that the cooperative agreement between SNOMED CT and LOINC will eventually result in a mapping of SNOMED-CT procedure code concepts to LOINC and thence to the RadLex Playbook concepts. The UMLS has not yet incorporated RadLex, nor has it unified the LOINC and SNOMED-CT procedure concepts (similar concepts from both schemes are duplicated in UMLS).

There is a cost associated with using non-unified coding systems. When Order Placer, Order Filler, Modalities, Report Creators, billing systems, etc., are using different coding schemes it remains possible to map codes between each system's code set, or to a standard code set. However, there is an effort required to create and maintain code mapping tables and this method is also more error prone and may result in some loss of accuracy.

4 Mapping Procedure Codes in Scheduled Workflow

The Appendices of this whitepaper contain a significant amount of background and useful information. This main body of the white paper assumes this knowledge and delves directly into the code mappings between data elements. It may be useful to review the Appendices prior to reading this section.

4.1 IHE Radiology Scheduled Workflow Data Model

The IHE Radiology Scheduled Workflow Profile integrates ordering, scheduling, imaging acquisition, storage and viewing for Radiology exams. An overview of the IHE Scheduled Workflow Profile can be found at http://wiki.ihe.net/index.php?title=Scheduled_Workflow. The detailed technical specifications for the IHE Radiology Scheduled Workflow Profile are found in the IHE Radiology Technical Framework Volumes 1 and 2 (http://www.ihe.net/Technical_Frameworks/#radiology).

To implement the Radiology Scheduled Workflow Profile, IHE coordinates a data model used by the HL7 version 2 standard and another used by the DICOM standard to perform scheduled workflow (RAD TF-1: 3.4 Data Model for Scheduled Workflow).

A simplistic overview of this IHE data model is that a patient has an order (request) for a radiology procedure. This “orderable” becomes a “requested procedure”. The “orderable” may be refined as part of “protocoling” (see Appendix B). A requested procedure may be made up of several scheduled “procedure steps”, which, in turn, may have one or more “protocol steps”. The “protocol step” is the “smallest” element of “work” described. Performed procedure steps are the smallest element of work actually performed. The result of the acquisition is a set of performed procedure steps that together comprise a “performed procedure”. This “performed procedure” which will result in a report and will also initiate the billing process. An understanding of this data model is important to understand how codes flow through a system.

Graphically, this is represented in RAD TF-1: Figure 3.4-1 as:

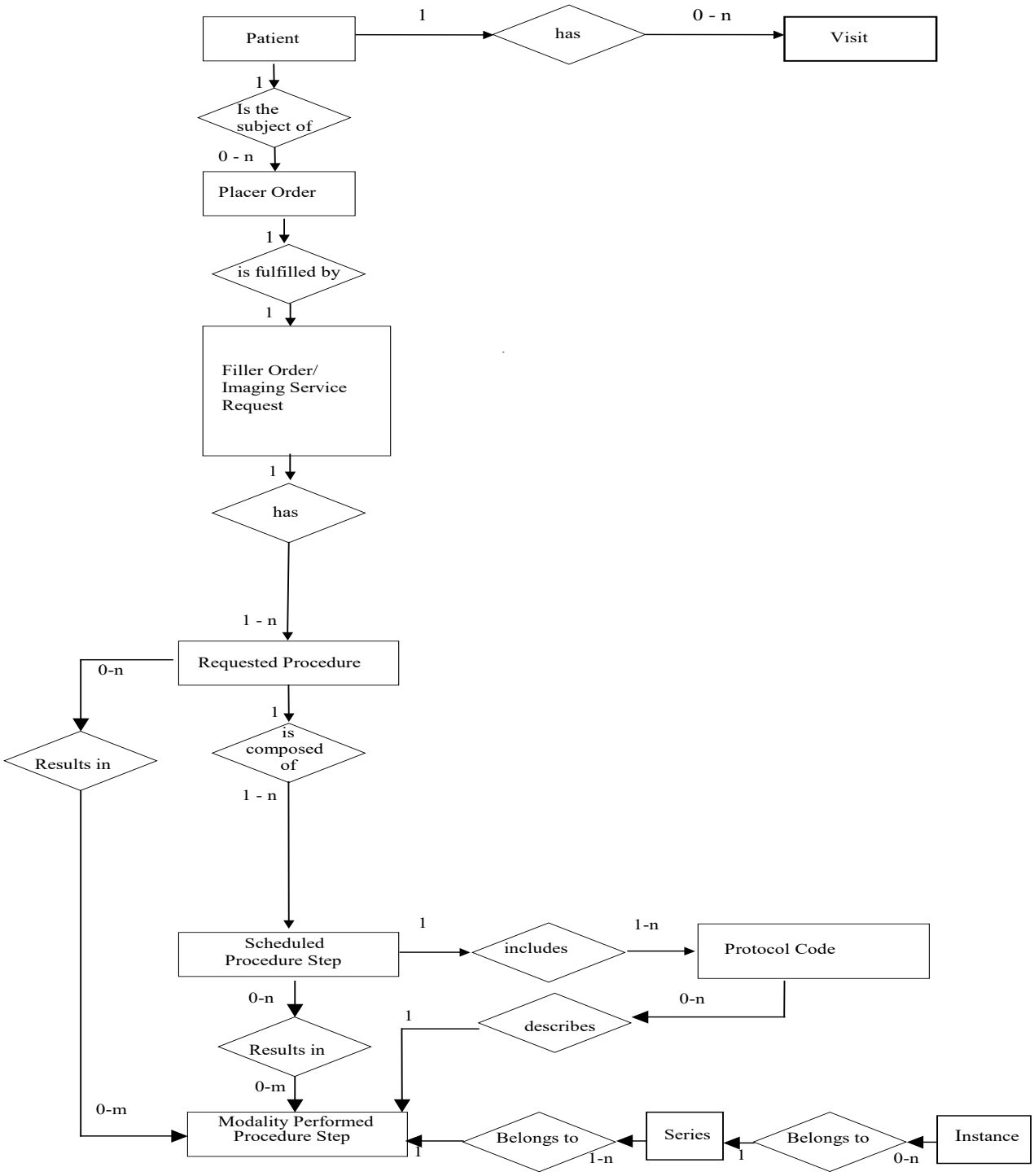

Figure 4.1-1: Real World Model for Scheduled Workflow (from RAD TF-1: Figure 3.4-1)

4.2 Procedure Ordered Code Mappings

Beginning from order entry, it is critical to copy the correct procedure and related codes into the correct attributes so that they flow "downstream". This begins with the IHE Radiology Scheduled Workflow Profile.

When an order is placed in the Order Placer (OP) and received by the Department System Scheduler/Order Filler (DSS/OF), the DSS/OF must notify the Image Manager (IM) and Report Manager (RM) using an IHE Procedure Scheduled [RAD-4] transaction. This transaction specifies an HL7 ORM or OMI message. The differences when using the OMI message are defined in RAD TF-2x: Appendix E.3 for the Procedure Scheduled [RAD-4] / Procedure Update [RAD-13] transactions and are not repeated in this document.

The code mappings for the [RAD-4] transaction are described, originating from RAD TF-2: 4.4.4.1.2.1.5 HL7 OBR Segment. For the sake of simplicity, HL7 OBR elements, which are not relevant to code mappings, are not mentioned here. Specifically, in the [RAD-4] message, the HL7 Message (MSH), Patient ID (PID), Visit (PV1), and Order Control (ORC) remain as specified in the technical framework document.

The key procedure and protocol codes are found in the HL7 OBR segment. RAD TF-2: Table 4.4-5 is copied below with significant reductions/modifications. All rows that are not applicable to coding have been deleted. The Table #, Item #, and Length columns have also been deleted to improve readability.

Table 4.2-1: IHE Profile OBR Segment
(from RAD TF-2: Table 4.4-5, MODIFIED/REDUCED)

SEQ	DT	OPT	ELEMENT NAME	Code Mapping Note
4	CE	R	Universal Service ID	Components 1-3 contain the original orderable (requested procedure code) from the Order Placer. Components 4-6 shall be filled with the Scheduled Protocol Code Sequence (0040, 0008). However, in our example, protocoling is performed at the CT scanner. Because this data element is type "O" (optional), components 4-6 are not included.

<table>
<tr><th>SEQ</th><th>DT</th><th>OPT</th><th>ELEMENT NAME</th><th>Code Mapping Note</th></tr>
<tr><td>5</td><td>ID</td><td>R2</td><td>Priority</td><td>From RAD TF-2x: Table B-1, Note 2:
“Only the suggested values of the HL7 Priority component of Quantity/Timing shall be used for IHE. These values shall be mapped to the DICOM enumerated fields for Priority as:”
<table>
<tr><th>HL7 Status</th><th>DICOM Status</th></tr>
<tr><td>S – STAT (immediate)</td><td>STAT</td></tr>
<tr><td>A – ASAP (lower than stat)</td><td>HIGH</td></tr>
<tr><td>R – Routine; default value</td><td>ROUTINE</td></tr>
<tr><td>P - Pre-op (to be done prior to surgery)</td><td>HIGH</td></tr>
<tr><td>C - Callback</td><td>HIGH</td></tr>
<tr><td>T – Timing Critical(do as near possible to requested time)</td><td>MEDIUM</td></tr>
</table></td></tr>
<tr><td>12</td><td>CE</td><td>R2</td><td>Danger Code</td><td>The “Patient Medical Module” in RAD TF-2x: Appendix B Table B-1 states that Danger Code should be mapped to Patient State (0038,0500), but does not identify a specific code set to use. This value set will most likely be locally defined or agreed upon.</td></tr>
<tr><td>13</td><td>ST</td><td>R2</td><td>Relevant Clinical Info</td><td>The “Patient Medical Module” in RAD TF-2x: Appendix B Table B-1 states that Relevant Clinical Info should be mapped to Medical Alerts (0010,2000), but does not identify a specific code set to use. This value set will most likely be locally defined or agreed upon.</td></tr>
<tr><td>15</td><td>CM</td><td>C</td><td>Specimen Source</td><td>The fifth component, Site Modifier, shall be used for the L/R indicator. The L/R value shall be appended to the Requested Procedure Description (0032,1060).
However, in our example, RadLex is pre-coordinated for laterality and thus this OBR-15 component is not necessary and should not be sent.
For the SWF.b HL7 2.5.1, the use of this field for laterality is deprecated and OBR-46 Placer Supplemental Service Information is used instead.</td></tr>
<tr><td>24</td><td>ID</td><td>R</td><td>Diagnostic Serv Sect ID</td><td>Diagnostic Service Section ID is used to contain the “Modality”. DICOM PS3.16 CID 29 defines the Acquisition Modality in our example as “CT”.</td></tr>
</table>

SEQ	DT	OPT	ELEMENT NAME	Code Mapping Note
31	CE	R2	Reason for Study	This field contains the Reason for Requested Procedure Code Sequence (0040,100A) and the Reason for Requested Procedure (0040, 1002). Component 1 shall contain the Reason for Requested Procedure Code Value (0008,0100), which in this example is "577.0". Component 2 shall contain the Reason for Requested Procedure Code Meaning (0008 0104), which in this example the short name is "Acute pancreatitis". Component 3 shall contain the Reason for Requested Procedure Coding Scheme Designator (0008,0102) which in this example the short name is "I9C", which refers to ICD 9-CM. Component 5 contains the Reason for Requested Procedure Description (0040, 1002), which in this example the long name is "Acute pancreatitis".
44	CE	O	Procedure Code	This field contains the Requested Procedure Code Sequence (0032,1064) (the "orderable") and the Requested Procedure Code Description (0032, 1060). Component 1 shall contain the Requested Procedure Code Value (0008,0100), which in this example is "RPID947". Component 2 shall contain the Requested Procedure Code Meaning (0008 0104), which in this example the short name is "CT ABD PANC W IVCON". (See Note1.) Component 3 shall contain the Requested Procedure Coding Scheme Designator (0008,0102), which in this example is "RADLEX". Component 5 contains the Requested Procedure Description (0032,1060), which in this example the long name is "CT ABDOMEN PANCREAS WITH IV CONTRAST". (See Note 1.) In this example we have chosen to use the RadLex short name for the Code Meaning and the RadLex long name for the Requested Procedure Description. This is an arbitrary decision and either the short or long name could have been used for both attributes. Not all coding schemes have both short and long names.
45	CE	O	Procedure Code Modifier	HL7 V2.5.1 only (see RAD TF-2: Table 4.2-9) - not discussed in this white paper since all RadLex Playbook codes are pre-coordinated without modifiers and IHE SWF does not describe mapping of modifiers.
46	CE	R2	Placer Supplemental Service Information	HL7 V2.5.1 only - instead of Specimen Source for laterality if and only if not implicit in pre-coordinated Procedure Code.

Note 1: For the purposes of illustration, we have chosen to use the RadLex Short Name as the Requested Procedure Code Meaning (0008,0104), which in this example is "CT ABD PANC W IVCON". Similarly, we have chosen to use the RadLex Long Name as the Requested Procedure Description (0032,1060), which in this example is "CT ABDOMEN PANCREAS WITH IV CONTRAST". This selection is not a strict requirement.

It is strongly recommended that readers review RAD TF-2x: Appendices A and B for full data mapping requirements.

4.3 Patient Arrival at Modality Code Mappings

When the patient arrives at the modality at the time of the imaging procedure, the modality will request the scheduled procedure information from the DSS/OF using a Query Modality Worklist [RAD-5] transaction as discussed in this section.

Prior to the modality querying for the worklist [RAD-5], an admission message (ADT) should have been sent [RAD-1] to the Department System Scheduler/Order Filler (DSS/OF). The DSS/OF should retain the value sent for item 3 which "Admitting Diagnosis" in the DG1 segment. This data is necessary to be able to fulfill the Admitting Diagnoses Description attribute (0008,1080) in the DICOM Modality Worklist response. (Note: Admitting Diagnoses Code Sequence (0008,1084) may be better suited here as a coded value, but though this sequence is defined in DICOM, it is not mentioned in the IHE RAD TF.) Admitting Diagnoses is typically supplied as an ICD-9-CM or ICD-10-CM code, but for our clinical example we will use the uncoded string value, "Acute Pancreatitis".

The table given below is from RAD TF-2: Table 4.5-3 and from RAD TF-2x: Appendix B, Table B-1.

Table 4.3-1: Return and Matching Keys For Modality Worklist (from RAD TF-2: Table 4.5-3, REDUCED/MODIFIED)

Attribute Name	Tag	Matching Keys		Return Keys		Whitepaper Note
		SCU	SCP	SCU	SCP	
Scheduled Procedure						
>Scheduled Protocol Code Sequence	(0040,0008)					In our example protocoling is performed at the modality, so this sequence is copied from the values from OBR-44 used to populated Requested Procedure Code Sequence (0032,1064), since it is not permitted to be absent or empty. See Note 1.
>>Code Value	(0008,0100)	O	O	R+*	R	From OBR-44 Component 1: "RPID947"
>>Coding Scheme Version	(0008,0103)	O	O	O	O	From OBR-44 Component 3: "RADLEX"

Attribute Name	Tag	Matching Keys		Return Keys		Whitepaper Note
>>Coding Scheme Designator	(0008,0102)	O	O	R+*	R	Not sent since RADLEX does not reuse codes with different meanings
>>Code Meaning	(0008,0104)	O	O	R+	R+	From OBR-44 Component 2: "CT ABD PANC W IVCON"
>Scheduled Procedure Step Description	(0040,0007)	O	O	R+	R	In our example protocoling is performed at the modality, so this value is copied from Requested Procedure Description. In our example this would be "CT ABDOMEN PANCREAS WITH IV CONTRAST". See Note 2.
Requested Procedure						
Requested Procedure Comments	(0040,1400)	O	O	O	O	In our example, left zero length.
Requested Procedure Description	(0032,1060)	O	O	R+	R	From OBR-44 Component 5: "CT ABDOMEN PANCREAS WITH IV CONTRAST". See Note 2.
Requested Procedure Code Sequence	(0032,1064)					
>Code Value	(0008,0100)	O	O	R+*	R	From OBR-44 Component 1: "RPID947"
>Coding Scheme Designator	(0008,0102)	O	O	R+*	R	From OBR-44 Component 3: "RADLEX"
>Coding Scheme Version	(0008,0103)	O	O	O	O	Not sent since RADLEX does not reuse codes with different meanings
>Code Meaning	(0008,0104)	O	O	R+	R+	From OBR-44 Component 2: "CT ABD PANC W IVCON"
Reason for Requested Procedure	(0040,1002)					From OBR-31 Component 5: "Acute pancreatitis".

Attribute Name	Tag	Matching Keys		Return Keys		Whitepaper Note
Reason for Requested Procedure Code Sequence	(0040,100A)					
>Code Value	(0008,0100)					From OBR-31 Component 1: "577.0"
>Coding Scheme Designator	(0008,0102)					From OBR-31 Component 3: "I9C"
>Coding Scheme Version	(0008,0103)					Not sent since ICD-9-CM does not reuse codes with different meanings
>Code Meaning	(0008,0104)					From OBR-31 Component 2: "Acute pancreatitis".
Admitting Diagnosis Description	(0008,1080) Note: Admitting Diagnoses Code Sequence (0008,1084) could also be used.	O	O	O	O	From ADT DG-1 Component 3: "Acute pancreatitis".

Note 1: Scheduled Procedure Code Sequence cannot be omitted or sent with no items (zero length). Though DICOM PS3.4 Table K.6-1 specifies that:

"*Either the Scheduled Procedure Step Description (0040,0007) or the Scheduled Protocol Code Sequence (0040,0008) or both shall be supported by the SCP. The Scheduled Protocol Code Sequence contains one or more Items.*"

The [RAD-5] message semantics (RAD TF 2: 4.5.4.2.2) specify that:

"*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.*"

Note 2: It is not required that the code meanings be copied into Scheduled Procedure Step Description or Requested Procedure Description. The [RAD-5] message semantics (RAD TF 2: 4.5.4.2.2) specify that:

"*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 Patient Medical module also contains elements (e.g., "Pregnancy Status"), which may be coded using HL7, SNOMED CT, or other codes. Please refer to the appropriate standards and coding schemes for those values.

It is strongly recommended that readers review RAD TF-2x: Appendices A and B for full data mapping requirements.

4.4 Images Generated at Modality Code Mappings

In this clinical scenario, after the patient has arrived for the imaging procedure and the modality has queried for the worklist, the images are generated at the modality using the worklist information. Some of the information from the worklist is used to accurately populate the DICOM image attributes and modality performed procedure step information.

Specifically, RAD TF-2x: Appendix A provides a table (RAD TF-2x: Table A.1-1) describing the mapping of all data elements from the DICOM Modality Worklist to the Image Object and the Modality Performed Procedure Step (MPPS) message.

This table is reproduced below (modified and reduced to the code mapping elements), with values provided for the data elements relevant to our example:

Table 4.4-1: Simple Case - Required Mapping of Corresponding Attributes

(from RAD TF-2x: Table A.1-1, MODIFIED AND REDUCED)

DICOM attribute	Modality Worklist	Filling values for:	
	(return attribute values)	Image/ Standalone IOD	MPPS IOD
Requested Procedure Description (0032,1060)	Source "CT ABDOMEN PANCREAS WITH IV CONTRAST"	Copy	Copy
Scheduled Procedure Step Description (0040,0007)	Source "CT ABDOMEN PANCREAS WITH IV CONTRAST"	Copy	Copy
Scheduled Protocol Code Sequence (0040,0008)	Source (RPID947, RADLEX, "CT ABD PANC W IVCON")	Copy	Copy
Performed Protocol Code Sequence (0040,0260)	n.a.	Equal (internally generated). Recommendation: Absent if the value is not known. Is non-empty if Assisted Acquisition Protocol Setting Option is	Equal (internally generated). Shall be zero length if the value is not known, e.g., Assisted Acquisition Protocol Setting not supported.

DICOM attribute	Modality Worklist (return attribute values)	Filling values for: Image/ Standalone IOD	Filling values for: MPPS IOD
		supported (see RAD TF-2: 4.6.4.1.2.4). In our example, a Scheduled Protocol Code Sequence to copy was provided, but the modality was not able to confirm that the specified protocol was executed, or to provide its own code(s), so does not send this sequence.	In our example, a Scheduled Protocol Code Sequence to copy was provided, but the modality was not able to confirm that the specified protocol was executed, or to provide its own code(s), so does not send this sequence.
Performed Procedure Step Description (0040,0254)	n.a.	Equal (internally generated). Recommendation: use the same value for Study Description. (i.e., also copy this TO the Study Description if the value is the same all series.) In our example, the value is "CT ABDOMEN PANCREAS WITH IV CONTRAST". (See Note 1.)	Equal (internally generated). In our example, the value is "CT ABDOMEN PANCREAS WITH IV CONTRAST".
Requested Procedure Code Sequence (0032,1064)	Value shall be used for Procedure Code Sequence as specified below.	In our example, the value is (RPID947, RADLEX, "CT ABD PANC W IVCON").	
(performed) Procedure Code Sequence (0008,1032)	n.a.	Copy from: Requested Procedure Code Sequence (0032,1064). Recommendation: absent, if empty in MWL or performed acquisition is different to what was scheduled. In our example, the (performed) Procedure Code Sequence was not changed from the Requested Procedure Code Sequence: (RPID947, RADLEX, "CT ABD PANC W IVCON").	Copy from: Requested Procedure Code Sequence (0032,1064). Recommendation: empty, if empty in MWL or performed acquisition is different to what was scheduled. In our example, the (performed) Procedure Code Sequence was not changed from the Requested Procedure Code Sequence: (RPID947, RADLEX, "CT ABD PANC W IVCON").
Protocol Name (0018,1030)	n.a.	Recommendation: equal (internally generated) The series level attribute Protocol Name is defined or selected on the CT acquisition modality, it is rarely used outside MR studies; if present, it may vary between each series. In our CT example, it is not sent. (See Note 2.)	**Performed Series Sequence** (0040,0340) Equal (internally generated) In our CT example, it is not sent. (See Note 2.)

Note 1: Study Description (0008,1030) is not explicitly mapped or copied from a DMWL response attribute. Today, typically, Study Description is manually entered at the scanner as free text and often is not a coded value. Often the Study Description text is copied into each Performed Procedure Step Description (0040,0254) for the entire study. Performed Procedure Step Description (0040,0254) could also be implemented as a coded value to be able to convey more precise and accurate information.

Note 2: Protocol Name (0018,1030) is a modality specific technique. DICOM defines Protocol Name as a "User-defined description of the conditions under which the Series was performed. This attribute conveys series-specific protocol identification and may or may not be identical to the one presented in the Performed Protocol Code Sequence (0040,0260)." Ideally, Protocol Name would also be the code meaning from a code or standard value set.

4.5 Radiation Exposure Monitoring Code Mappings

The IHE Radiation Exposure Monitoring (REM) Profile specifies how radiation exposure information from imaging procedures is created, exchanged and used.

An example of a real-world implementation using both REM and RadLex Playbook "orderable" codes is the American College of Radiology (ACR) Dose Index Registry (DIR). The DIR is a data registry that allows facilities to compare their CT dose indices to regional and national values. Information related to dose indices for all CT exams is collected, anonymized, transmitted to the ACR, and stored in a database. Institutions are then provided with periodic reports that compare their results by body part and procedure. Data collected from the registry will be used to establish national benchmarks for CT dose indices. More information can be found at: https://nrdr.acr.org/Portal/DIR/Main/AboutDIR/page.aspx.

An early challenge in the DIR project was that every facility was using a local code set for the orderables, and no consistent values for Study Description, making it difficult to compare and analyze radiation dosage for similar procedures. As a result, the ACR DIR project also provides a code mapping utility, which maps local codes, and/or local Study Description values, to RadLex codes.

The IHE Radiology Radiation Exposure Monitoring (REM) Profile uses the Radiology Store Dose Information [RAD-62] transaction. [RAD-62] specifies that a DICOM Radiation Dose Structured Report (RDSR) be created, which contains information about the procedure that was performed. RAD TF-2: Table 4.62-2 of this transaction, shown modified below, demonstrates the use of the RadLex codes from our example.

Table 4.5-1: Dose Context Attributes

(from RAD TF-2: Table 4.62-2, REDUCED/MODIFIED)

Attribute Name	Tag	Requirement	Whitepaper Notes
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.	The same value as used for Procedure Code Sequence (0008, 1032) in the image objects should be copied into this sequence. In our example, this would be (RPID947, RADLEX, "CT ABD PANC W IVCON").
Requested Procedure Description	(0032,1060)	Shall be copied from the relevant acquisition SPS (Modality Worklist entry)	In our example, this value would be "CT ABDOMEN PANCREAS WITH IV CONTRAST".
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.	In our example this value would be "Acute pancreatitis" from the ADT DG1:3 as described in Section 4.3 of this paper.
Admitting Diagnoses Code Sequence	(0008,1084)		In our example, this would be (577.0, I9C, "Acute pancreatitis")
Reason for the Requested Procedure	(0040,1002)		In our example this value is the long name "Acute pancreatitis".
Reason for Requested Procedure Code Sequence	(0040,100A)		In our example, this would be (577.0, I9C, "Acute pancreatitis")

Group cases and other workflow changes are addressed in the IHE Radiology REM Profile Store Dose Information [RAD-62] transaction.

4.6 Teaching File and Clinical Trials Code Mappings

The IHE Teaching File and Clinical Trial Export (TCE) Profile lets users flag images and related information for automatic routing to teaching file authoring or clinical trials management systems.

As a real-world example, the MIRC Teaching File System (TFS) (http://www.rsna.org/MIRC.aspx) is openly available software that gives users the ability to author, manage, store and share radiology teaching files through any web browser, either locally or across institutions. The ARRS GoldMiner project (http://goldminer.arrs.org/) is an image library drawing from seven core journals and over 250 other peer-reviewed journals. Because both MIRC and GoldMiner use a consistent coding scheme (RadLex), the RSNA GoldMiner project automatically incorporates relevant images in the MIRC display.

The MIRC Clinical Trials Processor (CTP) is a powerful image set anonymizer that does not need to remove procedure or diagnosis codes. Also employed by the National Cancer Institute, the CTP can anonymize all DICOM objects and send data across institutions, dramatically minimizing errors and saving time. Preservation of the procedure and diagnosis codes is important for analysis of the image data. Consistent use of codes between sites in multi-center trials is helpful.

TCE uses the Store Export Selection [RAD-51] transaction. [RAD-51] specifies that a Key Object Selection document acting as a manifest is created containing information about the study which was performed. Table 4.51.4-1 of this transaction, shown modified below, demonstrates the use of the RadLex codes from our example.

[RAD-51] specifies the de-identification and pseudonymization of the image and other objects for clinical trial or teaching file submission. However, it is recommended that the following DICOM procedure code attributes are not changed or altered. Some clinical trials have pre-defined requested and/or performed procedure codes to identify the studies participating in the clinical trial. These special procedure codes may be used for routing or other indications.

DICOM attribute	Whitepaper Notes
Requested Procedure Description (0032,1060)	In our example: “CT ABDOMEN PANCREAS WITH IV CONTRAST”
Scheduled Procedure Step Description (0040,0007)	In our example: “CT ABDOMEN PANCREAS WITH IV CONTRAST”
Scheduled Protocol Code Sequence (0040,0008)	In our example: (RPID947, RADLEX, “CT ABD PANC W IVCON”)
Performed Protocol Code Sequence (0040,0260)	In our example, not populated by CT scanner.
Performed Procedure Step Description (0040,0254)	In our example: CT ABDOMEN PANCREAS WITH IV CONTRAST
Requested Procedure Code Sequence (0032,1064)	In our example: (RPID947, RADLEX, “CT ABD PANC W IVCON”)
Procedure Code Sequence (0008,1032)	In our example, the (performed) Procedure Code Sequence is not changed from the Requested Procedure Code Sequence: (RPID947, RADLEX, “CT ABD PANC W IVCON”)
Protocol Name (0018,1030)	In our CT example, it is not sent, since this Attribute is used mostly by MR acquisition modalities.

4.7 Report Templates Code Mappings

The RSNA has developed a library of more than 200 reporting templates contributed by radiology societies, institutions, and individuals. This effort was undertaken in response to consensus at the 2007 ACR Intersociety Conference that the radiology report is a key area for practice improvement. The open, online library (http://www.radreport.org/) offers the templates both in text format, resembling dictation systems' "speech macros," and in extensible markup language (XML) for interoperability with information systems. DICOM Supplement 155, incorporated into DICOM Standard 2015a, seeks to define a standardized structure for radiology reporting templates and how reports based on such templates will be transmitted to EHR systems. The templates are free of charge and not subject to license restrictions on their reuse.

The RSNA structured report templates are currently indexed using RadLex codes, which have not yet been mapped to diagnosis codes like ICD-9-CM, or RadLex Playbook codes for procedures. In our example, the "CT Pancreatitis" RSNA report template is (currently) indexed by:

- abdomen (RID56)
- computed tomography (RID10321)
- pancreas (RID170)
- pancreatitis (RID3529)

If the report selection mechanism "knows" that a (RPID947, RADLEX, "CT ABD PANC W IVCON") corresponds to (RID10321, RADLEX, "Computed Tomography") and (RID170, RADLEX, "Pancreas"), and/or that (577.0, I9C, "Acute pancreatitis") corresponds to (RID3529, RADLEX, "Pancreatitis"), then the correct report template could be automatically selected. This can be achieved through the use of an "ontology" that understands the relationship of these concepts, or recognizes different coded representations of the same concept in different standard coding schemes. A downloadable version of the RadLex Playbook codes each with a list of the component RadLex concepts is available.

Alternatively, each report can be "indexed" with a long list of such codes (e.g., report template 0000078 "CT Pancreatitis" could have (RPID947, RADLEX, "CT ABD PANC W IVCON") and (577.0, I9C, "Acute pancreatitis") added to the list of terms for which it is appropriate.

It should be noted that a single RadLex code could map to multiple applicable RSNA report templates. A reporting system could either automatically propose a single RSNA report template or provide a selection list of templates. At this point, the radiologist is free to complete the report using voice dictation, editing, or any other means.

The "CT Pancreatitis" RSNA report template (template number 0000078) is shown below as an example. In the example below, square brackets "[ ]" indicate data entry requirements, angle brackets "< >" provide guidance on the expected values, and curly brackets "{ }" provide general guidance. The RSNA report templates will be converted to the IHE MRRT template format in the future, but are still presented here in Relax NG format until that conversion is completed.

==========

* CT Pancreatitis
* http://www.radreport.org/template/0000078

Type: Reporting template
Language: English (en)
Modified date: 2012-07-16
Creator: Heilbrun ME, et al.
Contributor: Hong Y [coder]
Contributor: Kahn CE Jr [editor]
Contributor: Society for Computed Body Tomography and Magnetic Resonance (SCBTMR)

This file is part of the "RSNA Radiology Reporting Templates."

==========

CT ABDOMEN [AND PELVIS] WITHOUT AND WITH CONTRAST: PANCREATITIS PROTOCOL
CLINICAL INDICATION: [Pancreatitis]. {If available, describe the time from onset of disease, e.g., <1 week, > 4 weeks, etc.)
COMPARISON: [<date> | None*].
TECHNIQUE: {Institution specific, with verbiage regarding post-processing per institution protocol as necessary for billing and coding purposes.}
Unenhanced and multi-phasic contrast enhanced imaging of the abdomen [and pelvis]. Scan phases: []
{Post-processing description}
IV contrast: [# ml] [<Contrast agent and concentration>]
Oral contrast: [None | xxx Volumen]
CT radiation dose: {Dose CTDLP: xxx mGy*cm, for example.}

OBSERVATIONS:
Pancreatitis: [Present*|Absent]
{If pancreatitis is absent insert phrase to indicate that no CT evidence of pancreatitis or its complications is identified, and revert to normal CT template. If pancreatitis is present, continue with this template for documentation of the extent of disease}
Extent of disease: [Diffuse enlargement* |Focal enlargement]
{If focal describe site of involvement: [Uncinate process| Head| Neck| Body| Tail]]
Parenchymal enhancement: [Homogeneous*| Non-homogeneous]
Necrosis: [Absent*| Present with [<30% | 30-50%| >50%] involvement| Indeterminate]
{If necrosis present, describe site of involvement: [Uncinate process| Head| Neck| Body| Tail]]
Pancreatic/Peripancreatic fluid collections: [Present*|Absent]
Location:
Intrapancreatic: [Yes| No] {if yes, use features below to characterize}
Extrapancreatic: [Yes| No] {if yes, use features below to characterize}
Characteristics: [Homogeneous| Non-homogeneous] {if non-homogeneous comment on the attenuation, fat, soft tissue, fluid, etc.}
Well demarcated wall: [Yes| No] {describe thickness, completeness, septations, etc.}
Extraluminal gas or Air/fluid level: [None*| Yes {describe}] {presence of gas implies infected collection, may be necessary to confirm with FNA, for Gram stain/culture.}
Size & Location; [# x # cm] {free text}

Related extrapancreatic findings:
Gallstones: [No*|Yes]
Extrahepatic biliary dilatation: [No*|Yes]
Venous thrombosis [No*| Yes] {if yes describe the specific vessels involved: [Portal vein |Superior mesenteric vein | Splenic vein]}
Varices: [No*|Yes] {if yes, describe}
Arterial (pseudo)aneurysm: [No*|Yes] {free text location, size}
Pleural effusions: [No*|Yes]
Ascites: [No*|Yes]
Inflammatory involvement of [stomach| duodenum| jejunum| colon {where} | right kidney| left kidney]

IMPRESSION:
Acute pancreatitis.
[Interstitial edematous pancreatitis* | Necrotizing pancreatitis]
{if necrotizing pancreatitis, describe location [Pancreatic necrosis with peripancreatic necrosis*| Pancreatic necrosis alone| Peripancreatic necrosis alone]}
Fluid collections: [None*| Pancreatic and peripancreatic| Pancreatic alone| Peripancreatic alone]. {If gas bubbles/air-fluid levels noted comment specifically, as this indicates infected fluid collections}
**
{alternative verbiage in centers using most current Atlanta Classification to characterize the peripancreatic fluid collections:}
< 4 weeks after onset of pancreatitis: [Acute necrotic collection (ANC)| Acute peripancreatic fluid collection (APFC)]
> 4 weeks after onset of pancreatitis: [Pancreatic pseudocyst| Walled off necrosis (WON)]
ritis

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4.8 Radiology Report CDA Document Code Mappings

Once the RSNA radiology report template has been completed, the signed instance of the report can be made available for storage and access by converting it to an HL7 CDA document. At the time of this writing, an IHE Radiology "report content module" profile has not yet been developed so this section consists of recommendations. However, there are several references that are very closely related.

Radiology Report CDA Reference material:

- Implementation Guide for CDA Release 2: Imaging Integration - Basic Imaging Reports in CDA and DICOM Diagnostic Imaging Reports (DIR), Release 1.0, March 2009: http://www.hl7.org/implement/standards/product_brief.cfm?product_id=13
- Consolidate CDA Implementation Guide (US Realm only) Release 1.1, July 2012: http://www.hl7.org/implement/standards/product_brief.cfm?product_id=258
- Digital Imaging and Communications in Medicine (DICOM) Part 20: Transformation of DICOM to and from HL7 Standards, 2011: http://medical.nema.org/Dicom/2011/11_20pu.pdf (Codes are found in Table A.5.1.1-20.)

Additionally, the countries of Denmark and Canada have published Implementation Guides that specify the header and body elements of radiology report CDA documents. These are not currently available as Internet references, however.

For the purpose of this white paper, besides the patient identity and author information defined in the references above, there are several CDA header elements specific to procedure and related coded values that are worth additional discussion. Given that IHE Radiology has not developed a report content module as of this writing, it is recommended to make the mapping to these CDA header elements configurable. The following recommendations are made:

- The CDA header ClinicalDocument/text element should contain the Code Meaning (0008,0104) of Procedure Code Sequence (0008,1032). If this value is not present, then Study Description (0008,1030) should be copied.

  Note that the Requested Procedure Code Description and the code meaning from Requested Procedure Code Sequence are not listed here because the IHE Radiology Scheduled Workflow Profile instructs Modality actors to copy the Requested Procedure Code Sequence into the (Performed) Procedure Code Sequence unless it was changed. If the procedure code was not copied, then the Requested Procedure Code Description and Requested Procedure Code Sequence may be inaccurate and should not be used as a data source (see RAD TF-2x: Appendix A).

  In our clinical example, "CT ABD PANC W IVCON", is the code meaning of the Performed Procedure Code Sequence.

- The CDA header infulfillmentOf/code element should contain the Requested Procedure Code Sequence (0032,1064).

In our clinical example, (RPID947, RADLEX, “CT ABD PANC W IVCON”) would be copied from the DICOM image.

- The CDA header documentationOf/serviceEvent/code element should contain the (performed) Procedure Code Sequence (0008,1032).

  In our clinical example, (RPID947, RADLEX, “CT ABD PANC W IVCON”) would be copied from the DICOM image.

- The CDA header documentationOf/serviceEvent/ element should contain information that reflects the full scope of the acquisition. This is a multi-valued field and several data elements can be included. Anatomic Region and Body Part Examined are not usually “copied” data fields previously provided from a DICOM Modality Worklist. That is, these two attributes are often input, uncoded, at the modality, or are populated by the modality from the manual or assisted protocol selection. Although the possible data elements should be limited to defined elements, the attributes may also be free format. It may also be possible to derive the general anatomic region from the Requested Procedure Code or (Performed) Procedure Code. Alternately, the Report Creator Actor may also request input from the radiologist to select a general anatomic region rather than attempting to copy the value from existing data. In any case, laterality should also be considered. Nonetheless, there may be several DICOM image attributes which should be considered for this element:

  - Anatomic Region Sequence (0008,2218) is defined in DICOM Part 3:10.5 as “the general region of the body (e.g., the anatomic region, organ, or body cavity being examined). These Attributes allow the specification of the information encoded by the Body Part Examined (0018,0015) in the General Series Module in a more robust, consistent way.” The defined terms for this attribute are defined in DICOM PS3.16 CID 4 Anatomic Region, including subsequent CID tables. CID 4 is an extensive list, which includes “coarse grained” anatomic regions, e.g., “Abdomen”, “fine grained” anatomic regions, e.g., “Adrenal gland”, as well as “combined” anatomic regions, such as “Chest, Abdomen and Pelvis”.

  - Body Part Examined (0018,0015) is defined in DICOM PS3.3 Section 7.3 as “text description of the part of the body examined.” It is the uncoded predecessor of Anatomic Region Sequence and if both are present should represent the same concept and level of granularity. The defined terms for Body Part Examined (0018,0015) are specified in DICOM PS3.16 Annex L, together with mapping to the corresponding codes that would be used for Anatomic Region Sequence.

  - It is also possible for an affinity domain to define a shorter list of values that could be used as a “coarse anatomy” list.

    In our clinical example, either the word “Pancreas” or “Abdomen”, or both, could be included in this element, depending on how the affinity domain intends to use this value.

- The CDA header documentationOf/serviceEvent/ element should also contain the acquisition modality as defined in DICOM PS3.3 Section C.7.3.1.1.1 Modality (which also map to coded values defined in DICOM PS3.16 CID 29).

  In our clinical example, this is copied from DICOM image attribute (0008,0060) and is "CT".

4.9 Cross-Enterprise Document and Image Sharing Code Mappings

When diagnostic radiology reports and images are to be shared between institutions, the IHE Cross-Enterprise Document Sharing (XDS.b) and the IHE Cross-Enterprise Document Sharing for Imaging (XDS-I.b) Profiles are used. The IHE XDS.b/XDS-I.b Profiles define metadata of documents and images to enable indexing. Refer to ITI TF-1:10 and RAD TF-1:18 for the use cases for XDS.b and XDS-I.b, respectively.

At this point, in addition to the patient demographics, author information, practice setting codes, etc., defined by the XDS.b Document Sharing metadata (ITI TF-3: 4.1.3 and Table 4.2.3.2-1), and the XDS-I.b Metadata (RAD TF-2: 4.68 and Table 4.68.4.1.2.3-1), the key pieces of coded data to be mapped are:

- The XDS metadata eventCodeList, and corresponding eventCodeListDisplayName, are multi-valued fields used to convey the coded values for acquisition modality and body part examined. No order within the multi-valued field is specified. The eventCodeList is required to contain:
  - Acquisition Modality as defined in DICOM PS3.16 CID 29: This element should be mapped from the CDA header documentationOf/serviceEvent/ or from the DICOM image attribute (0008,0060).

    In our clinical example, this is mapped from either source as "CT" and converted to the code (CT, 1.2.840.10008.2.16.4, "Computed Tomography").
  - Anatomic Region: Some clinical use cases may include enabling selection from a queried list of procedures from an XDS Registry, pre-fetching of relevant prior exams across an affinity domain, or searching for comparable cases for a clinical trial. The clinical use cases of this field and the value set should be agreed to and defined by the affinity domain. See the discussion on these topics in the CDA Report section of this document, Section 4.8.

    In our clinical example, this is obtained from the CDA document header documentationOf/serviceEvent/ element or DICOM image Body Part Examined (0018,0015) text value of "Pancreas", which is then mapped to the corresponding code of (15776009, 2.16.840.1.113883.6.96, "Pancreas"), or directly obtained from the Anatomic Region Sequence (0008,2218), or in the absence of the foregoing, mapped from knowledge of the anatomic focus concept component of the Procedure Code Sequence value (RPID947, RADLEX, "CT ABD PANC W IVCON").
- The XDS metadata referenceIdList is a multi-valued field, which is used in XDS-I to convey the Accession Number and Issuer of Accession Number. If the Issuer of

Accession Number is not contained in the image headers, it may be obtained from a pre-configured source. Order within the multi-valued field is not specified. The referenceIdList is encoded as a CXi datatype and is required to contain:

- Accession Number (0008,0050)
- Issuer of Accession Number Sequence (0008,0051)

  In our clinical example these attributes have not been previously identified, but the Accession Number (0008,0050) should be copied and, at a minimum, the Local Namespace Entity ID (0040,0031) of the Issuer of Accession Number Sequence (0008,0051).

- The XDS-I.b metadata typeCode and typeCodeDisplayName elements should contain the coded value and text name, respectively, Procedure Code Sequence (0008,1032) from the DICOM image objects, or from the CDA header documentationOf/serviceEvent/code element.

  In our clinical example, (RPID947, RADLEX, “CT ABD PANC W IVCON”) would be copied from either source.

Finally, it should be noted that the IHE ITI Cross Community Access (XCA/XCA-I) Profiles are the next step in integration across XDS affinity domains. When XCA is implemented, code mappings and definitions defined by an XDS affinity domain may not be consistent with the other XDS affinity domains grouped by the XCA Profile.

Appendix A – An Overview of Code Schemes

A brief overview of several coding schemes is given here. A description of the intended use of the coding scheme is also included. There is some overlap of both intended use and duplication of codes between several of these coding schemes. In some cases, mapping tables exist between the various code schemes, but discussion of that is outside the scope of this white paper.

A.1 RadLex Lexicon and Playbook

Radiology Lexicon and Playbook (RadLex) is a radiology centric code system with two main components: lexicon (radiology and other terminology) and playbook (orderable radiology procedure codes).

RadLex codes were originally created to address deficits in sufficiently descriptive radiology terms and a lack of specificity in orderable procedures in other existing code schemes.

The original component of RadLex is a comprehensive lexicon of radiology terms used to standardize terminology in radiology reports and other applications for indexing and retrieving information, as well as to specify relationships among terms and to provide attributes on terms such as synonyms. The RadLex lexicon is accessible in several forms, including a browsable tree (http://www.radlex.org/) as well as programmers' interfaces (APIs) and file downloads (http://radlexwiki.rsna.org/).

In relation to our clinical example, the RadLex code for "Pancreas" is "RID170" as can be seen here:

Visualize

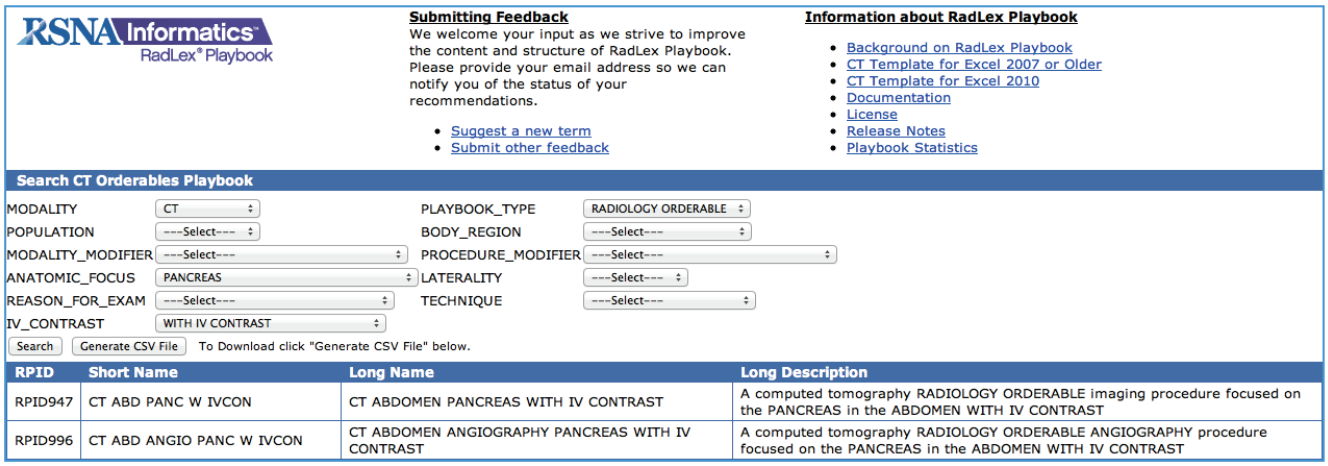
Preferred Name:	Pancreas
RadLex ID:	RID170
PURL:	http://www.radlex.org/RID/RID170
Definition:	Lobular organ the parenchyma of which consists of glandular acini which communicate via a duct system with the duodenum. [FMA]
Source:	Playbook
UMLS_ID:	C0030274
UMLS_TERM:	pancreas
Comment:	[alt def] A nodular organ in the abdomen that contains a mixture of endocrine glands and exocrine glands. The small endocrine portion consists of the islets of langerhans secreting a number of hormones into the blood stream. The large exocrine portion (exocrine pancreas) is a compound acinar gland that secretes several digestive enzymes into the pancreatic ductal system that empties into the duodenum. [MeSH]
FMAID:	7198
Part Of:	pancreaticobiliary system

The second main component of the RadLex project is the Playbook (http://playbook.radlex.org/), which provides standard names for radiology procedures ("orderables"). An "orderable" is any procedure which can be ordered by a physician. In this context, orders can be very specific, such as an order for a "CT Pancreas" requested by an internal medicine physician or surgeon or can be more general such as a "CT Abdomen" requested by a primary care physician. Given the expertise of the radiologist, the orderable may be changed to be more specific. Furthermore, although the term "orderable" is used, this term may be mapped downstream and also be used as a "performed procedure" code.

Each Playbook entry includes:

- A unique identifier (RPID) used in information systems to identify the Playbook name.
- A long version of the name, which is composed according to the Playbook grammar.
- A short version of the name, which is used in DICOM header information
- A human-readable definition.
- Mappings to RadLex concepts that provide components of the Playbook name, such as modality, body region, reason for exam, etc. These mappings are useful in query and data analysis applications.

Examples of RadLex Playbook orderables related to our example are given below:



RSNA Informatics RadLex® Playbook

Submitting Feedback
We welcome your input as we strive to improve the content and structure of RadLex Playbook. Please provide your email address so we can notify you of the status of your recommendations.
- Suggest a new term
- Submit other feedback

Information about RadLex Playbook
- Background on RadLex Playbook
- CT Template for Excel 2007 or Older
- CT Template for Excel 2010
- Documentation
- License
- Release Notes
- Playbook Statistics

Search CT Orderables Playbook

MODALITY	CT	PLAYBOOK_TYPE	RADIOLOGY ORDERABLE
POPULATION	---Select---	BODY_REGION	---Select---
MODALITY_MODIFIER	---Select---	PROCEDURE_MODIFIER	---Select---
ANATOMIC_FOCUS	PANCREAS	LATERALITY	---Select---
REASON_FOR_EXAM	---Select---	TECHNIQUE	---Select---
IV_CONTRAST	WITH IV CONTRAST		

Search | Generate CSV File | To Download click "Generate CSV File" below.

RPID	Short Name	Long Name	Long Description
RPID947	CT ABD PANC W IVCON	CT ABDOMEN PANCREAS WITH IV CONTRAST	A computed tomography RADIOLOGY ORDERABLE imaging procedure focused on the PANCREAS in the ABDOMEN WITH IV CONTRAST
RPID996	CT ABD ANGIO PANC W IVCON	CT ABDOMEN ANGIOGRAPHY PANCREAS WITH IV CONTRAST	A computed tomography RADIOLOGY ORDERABLE ANGIOGRAPHY procedure focused on the PANCREAS in the ABDOMEN WITH IV CONTRAST

Note that in RadLex, laterality is pre-coordinated in procedure codes when it will affect the procedure protocol that is completed.

RadLex is made freely available for private, research, and commercial use internationally.

The RadLex Playbook will likely be harmonized with the Logical Observation Identifier Names and Codes (LOINC) coding system in the near future. In the harmonization process with LOINC, it is intended that the code mapping will extend to additional coding schemes (e.g., SNOMED CT) as well.

A.2 Logical Observation Identifier Names and Codes (LOINC)

Logical Observation Identifier Names and Codes (LOINC) is a universal code system with two main components: laboratory observations and clinical observations.

LOINC codes were originally created to observations (measurements), but have since been extended to include other coded values.

The laboratory portion of the LOINC database contains the usual categories of chemistry, hematology, serology, microbiology, toxicology; as well as categories for drugs and the cell

counts, antibiotic susceptibilities, and more. The clinical portion of the LOINC database includes entries for vital signs, hemodynamics, intake/output, EKG, obstetric ultrasound, cardiac echo, urologic imaging, gastroendoscopic procedures, pulmonary ventilator management, selected survey instruments (e.g., Glascow Coma Score, PHQ-9 depression scale, CMS-required patient assessment instruments), and other clinical observations.

The example of the LOINC Clinical Observation codes for the CT Pancreas used in our example is:

LOINC_NUM	COMPONENT	PROPERTY	TIME_ASPCT	SYSTEM	SCALE_TYP	METHOD_TYP	CLASS	SHORTNAME	LONG_COMMON_NAME
24858-3	Multisection^W contrast IV	Find	Pt	Pancreas	Nar	CT	RAD	Pancreas CT W contr IV	Pancreas CT W contrast IV

The Regenstrief Institute at Indiana University distributes at no cost both LOINC and the RELMA mapping program (which helps link local codes to LOINC terms).

A.3 Systematized Nomenclature Of Medicine Clinical Term (SNOMED-CT)

Systematized Nomenclature Of Medicine Clinical Terms, or SNOMED-CT, is a systematically organized computer processable collection of medical terms providing codes, terms, synonyms and definitions covering diseases, findings, procedures, microorganisms, substances, etc. SNOMED-CT covers areas such as diseases, symptoms, operations, treatments, devices and drugs.

SNOMED was originally developed by the College of American Pathologists (CAP), merged with the UK Read Codes to form SNOMED CT. Currently, SNOMED CT is maintained and distributed by the IHTSDO, an international non-profit standards development organization, located in Copenhagen, Denmark. The use of SNOMED CT in production systems requires a license, though in many regions (e.g., US) there are national licenses allowing the codes to be used freely, and in addition organizations like DICOM have special arrangements.

SNOMED-RT preceded SNOMED-CT before the incorporation of the UK Read codes. SNOMED-RT codes are used extensively in DICOM objects, both images and structured reports, particularly for anatomic concepts, views, contrast agents and general concepts. To date, they have not been widely used for procedure codes or reasons for procedures.

In Canada, Ontario eHealth and the Canada Health Infoway Standards Collaborative Working Groups on Terminology and Diagnostic Imaging (SCWGs 9 and 10) are in the process of developing a Diagnostic Imaging Terminology (ON DI) based on SNOMED CT procedure codes, extending the SNOMED CT code set as necessary. The UK NHS is in the process of

converting from using its National Interim Clinical Imaging Procedure (NICIP) codes to using SNOMED CT codes, also extending the SNOMED CT code set as necessary.

SNOMED CT is expressed in "concepts". There are over 300,000 concepts defined. As an example, the concept ID 15776009 uniquely identifies the "Pancreas" body structure; in DICOM, the SNOMED-RT code is always used, "T-65000" in this case.

SNOMED also defines codes for procedures. For example, there is a SNOMED concept for the procedure of "Computed tomography of pancreas" ("241551006", "P5-08029").

SNOMED concepts range from the very general to the very specific, and in the latter case, many can be used in a pre-coordinated manner; this includes, for example, the SNOMED procedure codes (with the exception, perhaps of laterality, which may need to be post-coordinated (supplied as a modifier)). For example, there is a SNOMED concept for the procedure of "Computed tomography of kidney with contrast" ("429931008", "P5-6001F"), but there is no specific procedure for the right kidney, though there is a general qualifier of Right ("24028007", "G-A100").

A.4 International Classification of Diseases (ICD-9/ICD-10)

The International Classification of Diseases, or ICD-9 and ICD-10, is, according to its publisher, the United Nations-sponsored World Health Organization, "the standard diagnostic tool for epidemiology, health management and clinical purposes." [1] It is known as a health care classification system that provides codes to classify diseases and a wide variety of signs, symptoms, abnormal findings, complaints, social circumstances, and external causes of injury or disease. Under this system, every health condition can be assigned to a unique category and given a code, up to six characters long.

In the United States, modifications of ICD-9 and ICD-10 codes, referred to as "clinical modifications" (ICD-9-CM and ICD-10-CM) are primarily used in medical billing to describe diseases, injuries, symptoms and conditions, and mortality. Other countries have their own nationally specific modifications for clinical use (e.g., ICD-10-AM in Australia).

Examples of ICD-9 diagnostic code sets are available at http://www.findacode.com/code-set.php?set=ICD9.

A.5 Current Procedural Terminology (CPT-4)

The Current Procedural Terminology, or CPT code set, is maintained by the American Medical Association through the CPT Editorial Panel. The CPT code set describes medical, surgical, and diagnostic services and is designed to communicate uniform information about medical services and procedures for administrative, financial, and analytical purposes.

CPT codes identify the services rendered rather than the diagnosis on the claim, for which they are used in conjunction with ICD-9-CM or ICD-10-CM codes in the US. As a result, CPT-4 codes are often used for "billables". CPT codes focus primarily, but not exclusively, on ambulatory procedures.

CPT codes are used primarily for billing, and are unsuitable for ordering, since their granularity and specificity are focused on amount of work to be reimbursed and the relationship to the diagnosis, and not what needs to be done. For example, there is a generic code for billing for a CT of the Abdomen (74170), but nothing specific enough to order a CT of the Abdomen specific to the pancreas (e.g., for pancreatitis), or even to specify a three-phase liver study.

Further, a single orderable (e.g., of a CT chest, abdomen and pelvis) may map to multiple billing codes (one for each of the three anatomic regions), depending on the vagaries of what the payer permits to be used to maximize the revenue for the procedure, and how aggressive they are about "bundling" these for reduced payment for "combined" procedures.

A.6 International Classification of Diseases Procedure Code Set (ICD-10-PCS)

Not to be confused with ICD-10 or ICD-10-CM, ICD-10-PCS is a set of procedure codes created by 3M under contract to the US Centers for Medicare and Medicaid Services (CMS) for the purpose of replacing CPT and ICD-9-CM Volume 3 codes for billing; it is planned for adoption at the same time as ICD-10-CM.

Though still oriented towards billing rather than ordering, they are a considerable improvement over CPT in terms of being constructed concepts using various attributes ("multi-axial") of a procedure not dissimilar to RadLex, though without the granularity or clinically oriented (as opposed to effort and resource consumption oriented) modifiers.

For our example, the "CT Pancreas with (low osmolar) contrast" would be coded as "BF271ZZ", as defined in the following table:

Section	**B** Imaging		
Body System	**F** Hepatobiliary System and Pancreas		
Type	**2** Computerized Tomography (CT Scan): Computer reformatted digital display of multiplanar images developed from the capture of multiple exposures of external ionizing radiation		
Body Part	*Contrast*	*Qualifier*	*Qualifier*
5 Liver **6** Liver and Spleen **7** Pancreas **C** Hepatobiliary System, All	**0** High Osmolar **1** Low Osmolar **Y** Other Contrast	**0** Unenhanced and Enhanced **Z** None	**Z** None
5 Liver **6** Liver and Spleen **7** Pancreas **C** Hepatobiliary System, All	**Z** None	**Z** None	**Z** None

A mapping of RadLex Playbook codes to ICD-10-PCS should be straightforward, though the reverse may not be the case, except to the extent that RadLex Playbook contains fairly generic concepts in addition to specific ones (i.e., a round-trip from RadLex to ICD-10-PCS back to RadLex would likely result in generalization of the concept).

Appendix B – Other Topics Related to Code Mapping

B.1 Coding Scheme Anomalies – Laterality

Laterality (left or right) is a unique issue in coding medical procedures.

Laterality can either be pre- or post-coordinated with the procedure code. Pre-coordinating the laterality results in the need for more codes to be defined.

In post-coordinated coding schemes, a code may have multiple meanings (left and right) for a single concept. To understand a post-coordinated value, a modifier is necessary; however, fewer concept code values will need to be defined.

For example, the RadLex code RPID9 specifies the laterality at the highest possible level, that is, the "orderable" or "requested procedure code" level, as shown below:

RPID:	SHORT NAME:	LONG NAME:	LONG DESCRIPTION: A computed tomography RADIOLOGY ORDERABLE ANGIOGRAPHY procedure focused on the LEFT LOWER EXTREMITY WITHOUT THEN WITH IV CONTRAST
RPID9	CT LE ANGIO LT WO & W IVCON	CT LOWER EXTREMITY ANGIOGRAPHY LEFT WITHOUT THEN WITH IV CONTRAST	

Other coding schemes, such as SNOMED CT, post-coordinate laterality in their procedure codes. This results in fewer coded terms, but requires additional logic to understand the full meaning of the code and additional modifiers for the post-coordinated expression.

B.2 Appropriateness Criteria

"Appropriateness Criteria" are evidence-based guidelines created to assist referring physicians and other providers in making the most appropriate imaging or treatment decision for a specific clinical condition. The intent of guidelines for radiology is to eliminate inappropriate utilization of radiologic services.

The American College of Radiology (ACR) has defined a set of Appropriateness Criteria for radiology procedures, which can be found at http://www.acr.org/Quality-Safety/Appropriateness-Criteria.

An example of a guideline is given below:
(http://www.acr.org/~/media/ACR/Documents/AppCriteria/Diagnostic/AcutePancreatitis.pdf)

Date of origin: 1998
Last review date: 2010

American College of Radiology
ACR Appropriateness Criteria®

Clinical Condition: **Acute Pancreatitis**

Variant 1: **Etiology unknown, first episode of pancreatitis; abdominal pain, elevated amylase lipase; no fever or evidence of fluid loss at admission; clinical score pending.**

Radiologic Procedure	Rating	Comments	RRL*
US abdomen	8	Primarily to assess for gallstones.	O
CT abdomen with contrast	8	Best test to assess pancreatic parenchyma.	☢☢☢
CT abdomen without contrast	6		☢☢☢
CT abdomen without and with contrast	6	"Without" should be performed with low dose technique. To detect presence of pancreatic calcifications and/or calcified stones within pancreatic duct.	☢☢☢☢
MRI abdomen without contrast with MRCP	6		O
MRI abdomen without (including MRCP) and with contrast	6	Can also demonstrate pancreatic parenchyma as well as ducts and gallstones. May be somewhat limited in acutely ill patients related to procedure time. See statement regarding contrast in text under "Anticipated Exceptions."	O
US abdomen endoscopic	4		O
Rating Scale: 1,2,3 Usually not appropriate; 4,5,6 May be appropriate; 7,8,9 Usually appropriate			***Relative Radiation Level**

It is possible that a computerized implementation of the Appropriateness Criteria could recommend a selection list of requested procedure codes ("orderables") from the RadLex or SNOMED CT code sets. For example, a commercial implementation of decision support for ordering based on the ACR Appropriateness Criteria is available as ACR Select. See "http://www.acrselect.org/".

B.3 Protocoling

"Protocoling" is a term, which generally means the process of taking an "orderable" or requested procedure code and describing it in more detail, such that it could be carried out on a modality. For example, for a CT scan, protocoling may be the process of taking the fairly generic RadLex requested procedure code of "CT ABDOMEN" (RPID188), possibly ordered by a non-radiologist, and converting it to a more specific RadLex requested procedure code such as "CT ABDOMEN PANCREAS WITH IV CONTRAST" (RPID947). Or, for protocoling a radiologist or technologist may convert the requested procedure code of "CT ABDOMEN" to a specific anatomical coverage, use of contrast, number of phases, slice thickness, and other parameters to necessary to actually acquire the images.

The output of the "protocoling" step may either be a more refined requested procedure code or description, or the inclusion of protocol information as Scheduled Protocol Code Sequence items

or Scheduled Protocol Description, or both. “Protocoling” is a cognitive activity, and is distinct from, though may be executed in combination with, setting the protocol parameters on the Acquisition Modality, which may be performed either manually by the operator or automatically by the device (IHE SWF Assisted Acquisition Protocol Setting Option) in response to the output of the “protocoling” step (see Appendix C).

However, “protocoling” can be refined at several points in the process, on different systems, and may vary by ordering provider, clinical trial specifications, or even by particular scanner.

A radiologist, physicist, or technologist on the DSS/OF prior to the start of the study may perform “protocoling”. At this stage, this is typically done at the highest level by changing the actual orderable or requested procedure code prior to the start of the study, as given in the “CT ABDOMEN” example above. If other devices (e.g., the Image Manager or Report Manager) have already been notified of the study, update messages may be sent.

The radiologist or technologist also often performs “Protocoling” as the patient presents at the modality. Examples of this could include an order for the use of IV contrast, but then the patient identifies an allergy to the contrast agent. The technologist, with the radiologist's guidance, may perform the procedure without the contrast injection, but may or may not update the requested procedure code at the DSS/OF prior to starting the study (and may not re-request the modality worklist to get the new code onto the modality.) In this case, the requested procedure code in the image set is now inconsistent with what was actually performed.

“Protocoling” may also change mid-study. In a cardiology procedure, a cardiologist may order a diagnostic procedure (e.g., 33367005, SCT, “Coronary angiography”), but mid-procedure, upon seeing significant stenosis, may immediately convert the procedure to an interventional procedure, which might have been a requested procedure of (429809004, SCT, “Percutaneous transluminal angioplasty of coronary artery using fluoroscopic guidance with contrast”). At best, the performed procedure code may be changed after the completion of the procedure (typically for billing purposes).

Finally, it is important to note that there is no comprehensive coding scheme for Protocol Codes to be used in Scheduled Protocol Code Sequence and Performed Protocol Code Sequence. Although, for example, RadLex Playbook may define a requested procedure, it does not define the actual acquisition protocol, which may vary by radiologist, clinical trials, scanner, manufacturer, and for other reasons. AAPM is attempting to standardize common patterns of protocols for particular procedures (for dose optimization reasons). The elements of such protocols or protocol components have no standard coding scheme defined for them yet. DICOM Supplement 121 may eventually provide exchange and identification methods for protocols.

Appendix C – Complex Workflows Code Mappings

C.1 Scheduled Workflow Complex Cases

This white paper illustrates the "simple case" of 1:1:1 (One Requested Procedure: One Performed Procedure Step: One report). In the real world it is possible to complete two or three orders in a single acquisition scan. In IHE, this is referred to as the "Group Case".

There are other real-world clinical use cases that are significantly more complex, including unidentified patients ("John Doe"), updated procedures, discontinued studies, multi-part studies (e.g., nuclear medicine studies), and several more. For discussions on these variations in radiology workflow, refer to RAD TF-1:3 Scheduled Workflow. Also pay special attention to the attribute mapping tables in RAD TF-2x: Appendices A and B.

C.2 Scheduled Workflow Assisted Acquisition Protocol Setting Option

There is an option within the IHE Radiology Scheduled Workflow Profile called the "Assisted Acquisition Protocol Setting Option". It is defined in RAD TF-2: 4.6.4.1.2.4.2.

The purpose of the Assisted Acquisition Protocol Setting Option is to simplify the operator's work on the modality and enable a better management of the protocols used in an imaging department. Using this option, it is possible for protocols to be defined prior to the patient arrival or start of the procedure.

Using this option, the protocol codes are provided to the scanner as part of the DICOM Modality Worklist query response. In this case, a Scheduled Procedure Step will contain a requested Procedure Code Sequence and one or more items in Scheduled Protocol Code Sequence. The operator does not need to manually enter the attributes of the acquisition protocol as in the Manual Modality Setting, since the modality can automatically use the information provided in the worklist to select a matching protocol, or narrow the choice offered to the operator. The operator may still choose a different protocol or edit the parameters of a selected protocol. The Performed Protocol Codes of the protocols actually used may be included in the DICOM image objects and the MPPS messages.

IHE does not define a specific set of codes for acquisition protocols to be used with the Assisted Acquisition Protocol Setting Option. Protocol codes are often defined locally.