Integrating the Healthcare Enterprise

IHE Radiology
Technical Framework Supplement

Encounter-Based Imaging Workflow (EBIW)

Draft FHIR Query for Imaging Context

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Please verify you have the most recent version of this document. See here for Trial Implementation and Final Text versions and here for Public Comment versions.

Foreword

This is a supplement to the IHE Radiology Technical Framework V16.0. Each supplement undergoes a process of public comment and trial implementation before being incorporated into the volumes of the Technical Frameworks.

This supplement is published on June 1, 2018 for trial implementation and may be available for testing at subsequent IHE Connectathons. The supplement may be amended based on the results of testing. Following successful testing it will be incorporated into the Radiology Technical Framework. Comments are invited and may be submitted at http://ihe.net/Radiology_Public_Comments.

This supplement describes changes to the existing technical framework documents.

"Boxed" instructions like the sample below indicate to the Volume Editor how to integrate the relevant section(s) into the relevant Technical Framework volume.

Amend Section X.X by the following:

Where the amendment adds text, make the added text **bold underline**. Where the amendment removes text, make the removed text ~~**bold strikethrough**~~. When entire new sections are added, introduce with editor's instructions to "add new text" or similar, which for readability are not bolded or underlined.

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

Information about the IHE Radiology domain can be found at ihe.net/IHE_Domains.

Information about the organization of IHE Technical Frameworks and Supplements and the process used to create them can be found at http://ihe.net/IHE_Process and http://ihe.net/Profiles.

The current version of the IHE Radiology Technical Framework can be found at http://www.ihe.net/Technical_Frameworks.

CONTENTS

Introduction to this Supplement

This supplement introduces a FHIR-based version of the Get Encounter Imaging Context [RAD-130] query from the Lightweight Modality to the Encounter Manager.

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Add a Security Consideration about following redirects (add weasel words in Expected Actions?)

Open Issues

Q. What protocol should Get Encounter Imaging Context-RS use? A.

Closed Issues

Q. How should the new requirements be added/packaged? A. Option A Option A: "Complete" existing EBIW Profile by adding a Lightweight Modality actor with RESTful transactions to the Encounter Manager and the Image Manager. Option B: Add a RESTful Option and a DIMSE Option to the existing Profile? Option C: Have two EBIW Profiles (EBIW and EBIW-RS?)
Q. Is there a direct link to the FHIR Update to Dynamic Care Team Profile A. No obvious link The search transaction is “sparse”. In X.4.2.1.1.1 for Encounter-focused Care Team, the text does not mention encounter and mentions care team only at the end and describes no relationship to the following diagram.
Q. Should we use a single query or a layered query? A. Layered This was initially written up as a single query against the Service Request endpoint. Patient-level and Encounter-level query parameters would be included using chaining syntax. The return would be a Service Request resource with embedded Patient and Encounter. The premise was that the client would have a single query template and would plug in what it

knew, and a single response pattern from which it would extract what it needed to put in the STOW header. If there are multiple returns, the client interacts with the operator to do one selection.

The alternative is to have the client add business logic to do different layered queries depending on what query parameters it has for this case. If there are patient-level parameters, it will query against a Patient endpoint, and receive one or more references which it can GET and offer as a selection to the operator. Then it queries against the Encounter endpoint with the patient reference and any encounter parameters and receive one or more references which it can GET and offer as a selection to the operator. Finally it queries against the Service Request endpoint, using the Patient and/or Encounter references and any procedure parameters and receive one or more references which it can GET and offer as a selection to the operator. If the query is an Admission ID, then the client starts with an Encounter query, gets the patient reference from that and proceeds to the Service Request.

There was concern that the single query would depend on support of chaining and inclusion by the server. Layering, in principle, makes it simpler for the server by shifting some complexity to the client. But even there, it was felt that the above two approaches are basically the same complexity for the client.

Note that this transaction is essentially an API to get a certain set of metadata. The resources in the model may never actually exist in a persistent form.

Q. Is there an issue with starting a layered search below Patient?

A. We'll assume not.

It is possible some servers refuse to let you query without starting with a Patient. (To prevent wide searches). The Tech Cmte assumes our Admission ID searches and dept searches will go through because we need them.

Q. Should we incorporate the _element parameter to control returned attributes?

A. No, the server will return all possible attributes in every resource.

Note that this may require the server to make up values to populate fields because it doesn't know whether or not the client is really interested in them.

A syntax example to request a specific attribute (http://hl7.org/fhir/R4/search.html#elements) is:

- _element=subject.patient.birthdate

Q. Should we use Compartments in the Queries?

A. No.

That part of FHIR is aspirational so probably shouldn't base a transaction on them.

Based on RESTful concept of compartments. Effectively a Compartment pre-scopes a query without the client having to re-iterate the filtering parameters that limit the scope.

Volume 1 – Profiles

47.1.1 Actor Descriptions and Actor Profile Requirements

Most requirements are documented in transactions (Volume 2 & 3). This section documents any additional requirements on profile's actors.

47.1.1.1 Encounter Manager

The Encounter Manager manages and provides encounter metadata and marshaled patient demographics (e.g., see Section 47.4.1.4).

The Encounter Manager shall implement both the MWL Semantics and the UPS-RS Semantics in the Get Encounter Imaging Context [RAD-130] transaction.

The Encounter Manager shall be able to generate Study Instance UIDs and Accession Numbers.

The Issuer of Accession Number value shall be configurable on the Encounter Manager. Some sites may find it useful to configure the Encounter Manager to list itself as the issuer as a way to identify encounter-based accession numbers.

The Encounter Manager shall be configurable to assure that the generated accession numbers avoid collisions with those generated by other systems.

Note: This is particularly important on networks where some systems do not observe the Issuer of Accession Number and may include configuring a prefix or suffix string on the Accession Number value.

The Encounter Manager shall not return different accession numbers for the same admission to the same device unless it can determine that there has been an additional encounter. The profile does not constrain how the Encounter Manager achieves this, but it will likely involve keeping a record of the accession numbers that have been provided in recent queries.

The Encounter Manager shall be capable of populating required fields in Get Encounter Imaging Context [RAD-130] with appropriate values for "John Doe" (unidentified) patients. How such behavior is triggered by the query from the modality is up to the Encounter Manager (e.g., querying with a first name of "Unidentified", or a patient id of 0, or using an id from a list of temporary ids) and the modality operators will need to be trained accordingly. See also Section 47.4.1.10 Unidentified Patients.

An Encounter Manager that implements, or is integrated with, systems for encounter appointment scheduling, practice management, or staff scheduling, would likely be able to have more sophisticated business logic and be better able to populate fields of the Get Encounter Imaging Context [RAD-130] transaction. This profile does not require such capabilities beyond being able to populate the required fields.

For the Get Encounter Imaging Context-FHIR [RAD-Y1B] transaction, per IHE Convention (See ITI TF-2x Appendix Z), the Encounter Manager shall publish a

CapabilityStatement on the metadata endpoint as described in FHIR http://hl7.org/fhir/R4/http.html#capabilities

47.1.1.2 Acquisition Modality and Lightweight Modality

For brevity, when the term "Modality" is used by itself in this section, it refers to both the Acquisition Modality and the Lightweight Modality.

The Modality assembles acquired pixels with associated metadata (specifically including metadata obtained via Get Encounter Imaging Context [RAD-130] and perhaps operator input) and then stores the resulting image IODs. The Modality may acquire/construct the pixels itself (e.g., a point of care ultrasound device) or it may import pixels and device metadata from a separate image capture device (e.g., a digital camera). Details of such separate image capture devices and mechanisms for import are the responsibility of the Modality product and are outside the scope of this profile.

For digital photography and video, XC (external-camera photography) is an appropriate value for Modality (0008,0060). VL Photographic Image is an appropriate IOD for photography. Video Photographic Image is an appropriate. DICOM Secondary Capture should only be used for encounter-based images when there is no more appropriate SOP Class.

The Acquisition Modality shall implement the MWL Semantics in the Get Encounter Imaging Context [RAD-130] transaction.

The Lightweight Modality shall implement the UPS-RS Semantics in the Get Encounter Imaging Context [RAD-130] transaction.

A major responsibility of the Modality is to ensure that key metadata for the imaging procedure (such as the body part examined and series description) are included in the stored image. Populating these details may require interacting with the operator. Without this information, encounter images cannot be properly managed, located, and accessed when they are needed. The full requirements for stored images are documented in the Store Encounter Images [RAD-131] transaction. See also Section 47.4.1.6 Recording Encounter and Procedure Metadata.

Note: If the Modality has obtained the metadata encoded in FHIR resources, the values will need to be transcoded into corresponding DICOM values when used in image headers. E.g. the DICOM values for Patient's Sex (0010,0040) are M, F and O, while the FHIR values for Patient.gender are male, female, other, unknown.

The Modality may also store non-image DICOM IODs. Such evidence documents (like accompanying measurements) will share an Accession Number with associated images and be stored in the same DICOM Study. Some Modalities might also store non-DICOM clinical documents, such as HL7 CDA.

The Modality user interface, e.g., where it takes input from the operator or shows the operator the metadata that will be associated with the stored images, is left to product design and is

outside the scope of profile requirements. It is recommended that the Modality be able to show the operator what values are being used and permit adjustment for metadata values like the department, operator, patient, procedure, etc.The Lightweight Modality shall have a method of maintaining the correct time and UTC offset (“timezone”) and ensuring that the time metadata (acquisition time, series time, etc.) are accurate to within seconds. The Acquisition Modality achieves this using the IHE Consistent Time Profile (based on NTP); the Lightweight Modality may choose to use the CT Profile or some other method. Mobile devices on a cellular network are likely time synchronized through that infrastructure, which is acceptable, and the time resulting from synchronization will be reflected in image metadata such as the EXIF tags. See DICOM PS3.17 Annex NNNN for additional details on what EXIF metadata corresponds to which DICOM attributes

47.1.1.3 Image Manager/Archive

The Image Manager/Archive is required to send notifications to the Result Aggregator using Notify of Imaging Results [RAD-132]. Optionally, the Image Manager/Archive may be configurable to also send notifications to the Encounter Manager.

Consistent with the IHE Web Image Capture (WIC) Profile, the Image Manager/Archive is required to populate Image Pixel Macro fields that the Lightweight Modality may leave empty. See RAD TF-3 4.108.4.1.3

47.1.1.4 Result Aggregator

The Result Aggregator receives notifications about newly acquired and stored images from encounter-based procedures. Typically this actor will be a component of, or a proxy for, an electronic medical record (EMR) system.

Volume 3 – Transactions

4.130 Get Encounter Imaging Context [RAD-130]

Table 4.130.4.1.2-1: Return and Matching Keys for Encounter Metadata

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
Patient Metadata					
Patient Identification					
Patient's Name	(0010,0010)	R+	R	R+	R
Patient ID	(0010,0020)	R+	R	R+	R
Issuer of Patient ID	(0010,0021)	O	R+	R+	R+

Other Patient IDs Sequence	(0010,1002)	O	O	O	R+
Patient Demographic					
Patients Birth Date	(0010,0030)	O	O	R+	R+
Patient's Sex	(0010,0040)	O	O	R+	R+
Confidentiality constraint on patient data	(0040,3001)	O	O	O	O
Encounter Metadata					
Visit Identification					
Institution Name	(0008,0080)	O	R+	R+	R+
Institution Code Sequence	(0008,0082)	O	O	R+	R+
Institution Address	(0008,0081)	O	O	R+	R+
Institutional Department Name	(0008,1040)	R+	R+	R+	R+
Institutional Department Type Code Sequence	(0008,1041)	R+	R+	R+	R+
Admission ID	(0038,0010)	R+	R+	R+	R+
Issuer of Admission ID Sequence	(0038,0014)	R+	R+	R+	R+
Visit Admission					
Admitting Date	(0038,0020)	O	O	O	R+
Admitting Time	(0038,0021)	O	O	O	R+
Admitting Diagnoses Description	(0008,1080)	O	O	O	O
Admitting Diagnoses Code Sequence	(0008,1084)	O	O	O	O
Reason for Visit	(0032,1066)	O	O	O	R+
Reason for Visit Code Sequence	(0032,1067)	O	O	O	R+
Referring Physician's Name	(0008,0090)	O	O	O	O
Referring Physician Identification Sequence	(0008,0096)	O	O	O	O
Referring Physician's Telephone Numbers	(0008,0094)	O	O	O	O
Visit Status					
Current Patient Location	(0038,0300)	O	O	O	O
Procedure Metadata					
Imaging Service Request					
Accession Number	(0008,0050)	O [IHE-4]	O [IHE-4]	R+	R+ [IHE-3]
Issuer of Accession Number Sequence	(0008,0051)	O	O	R+	R+
Requesting Service	(0032,1033)	O	O	O	O
Requesting Service Code Sequence	(0032,1034)	O	O	O	O
Requested Procedure					
Requested Procedure Description	(0032,1060)	O	O	O	R [IHE-5]
Requested Procedure Code Sequence	(0032,1064)	O	O	O	R [IHE-5]
Reason for the Requested Procedure	(0040,1002)	O	O	O	O
Reason for Requested Procedure Code Sequence	(0040,100A)	O	O	O	O
Study Instance UID	(0020,000D)	O	O	R+*	R
Scheduled Procedure Step					
Scheduled Procedure Step Sequence	(0040,0100)			[IHE-1]	[IHE-2]

>Scheduled Station AE Title	(0040,0001)	R+	R	R+	R
>Scheduled Procedure Step Start Date	(0040,0002)	O	R	O	R
>Scheduled Procedure Step Start Time	(0040,0003)	O	R	O	R
>Scheduled Procedure Step Location	(0040,0011)	O	O	O	O
>Modality	(0008,0060)	R+	R	R+	R
>Scheduled Performing Physician's Name	(0040,0006)	O	R	O	O
>Scheduled Protocol Code Sequence	(0040,0008)	O	O	O	O
>Scheduled Procedure Step Description	(0040,0007)	O	O	O	R

[IHE-1]: To obtain attribute values in the Scheduled Procedure Step Sequence, SCUs request a universal attribute match by including selected attributes in the Scheduled Procedure Step Sequence (0040,0100) in the Matching Key list.

[IHE-2]: SCP implementations shall support, per the DICOM Standard, the method described in IHE-1. The SCP will return managed attributes that were selected.

[IHE-3]: A value (non-empty field) shall be returned in the Accession Number attribute.

[IHE-4]: The matching performed by the SCP for the Accession Number attribute shall be single value (SV) matching.

[IHE-5]: Requested Procedure Description (0032,1060) and Requested Procedure Code Sequence (0032,1064) are type 1C return keys with the condition that one or the other or both shall be supported by the SCP.

Table 4.130.4.1.2-2: Encounter Metadata Mapping from Table 4.130.4.1.2-1 to UPS-RS

Attribute Name	Tag	UPS Mapping
Patient Metadata		
Patient Identification		
Patient's Name	(0010,0010)	Same
Patient ID	(0010,0020)	Same
Issuer of Patient ID	(0010,0021)	Same
Other Patient IDs Sequence	(0010,1002)	Same
Patient Demographic		
Patients Birth Date	(0010,0030)	Same
Patient's Sex	(0010,0040)	Same
Confidentiality constraint on patient data	(0040,3001)	Same
Encounter Metadata		
Visit Identification		
Institution Name	(0008,0080)	Same
Institution Code Sequence	(0008,0082)	Same
Institution Address	(0008,0081)	Same

Institutional Department Name	(0008,1040)	Same
Institutional Department Type Code Sequence	(0008,1041)	Same
Admission ID	(0038,0010)	Same
Issuer of Admission ID Sequence	(0038,0014)	Same
Visit Admission		
Admitting Date	(0038,0020)	Same
Admitting Time	(0038,0021)	Same
Admitting Diagnoses Description	(0008,1080)	Same
Admitting Diagnoses Code Sequence	(0008,1084)	Same
Reason for Visit	(0032,1066)	Same
Reason for Visit Code Sequence	(0032,1067)	Same
Referring Physician's Name	(0008,0090)	Same. (in Referenced Request Sequence (0040,A370))
Referring Physician Identification Sequence	(0008,0096)	Same
Referring Physician's Telephone Numbers	(0008,0094)	Same
Visit Status		
Current Patient Location	(0038,0300)	Same
Procedure Metadata		
Imaging Service Request		
Accession Number	(0008,0050)	Same. (in Referenced Request Sequence (0040,A370))
Issuer of Accession Number Sequence	(0008,0051)	Same. (in Referenced Request Sequence (0040,A370))
Requesting Service	(0032,1033)	Same. (in Referenced Request Sequence (0040,A370))
Requesting Service Code Sequence	(0032,1034)	Same. (in Referenced Request Sequence (0040,A370))
Requested Procedure		
Requested Procedure Description	(0032,1060)	Same. (in Referenced Request Sequence (0040,A370))
Requested Procedure Code Sequence	(0032,1064)	Same. (in Referenced Request Sequence (0040,A370))
Reason for the Requested Procedure	(0040,1002)	Same. (in Referenced Request Sequence (0040,A370))
Reason for Requested Procedure Code Sequence	(0040,100A)	Same. (in Referenced Request Sequence (0040,A370))
Study Instance UID	(0020,000D)	Same.
Scheduled Procedure Step		
Scheduled Procedure Step Sequence	(0040,0100)	Some of the following attributes not nested in UPS
>Scheduled Station AE Title	(0040,0001)	Station Name Code Sequence (0040,4025) meaning
>Scheduled Procedure Step Start Date	(0040,0002)	Scheduled Procedure Step Start Date and Time (0040,4005)
>Scheduled Procedure Step Start Time	(0040,0003)	
>Scheduled Procedure Step Location	(0040,0011)	Scheduled Station Geographic Location Code Sequence (0040,4027)
>Modality	(0008,0060)	Scheduled Station Class Code Sequence (0040,4026) using CID 29 Acquisition Modality
>Scheduled Performing Physician's Name	(0040,0006)	Human Performer's Name (0040,4037) in Scheduled Human Performers Sequence (0040,4034)
>Scheduled Protocol Code Sequence	(0040,0008)	Scheduled Workitem Code Sequence (0040,4018)
>Scheduled Procedure Step Description	(0040,0007)	Procedure Step Label (0074,1204)

4.131 Store Encounter Images [RAD-131]

Table 4.131.4.1.2-1: Required Attributes

Attribute	Tag	Type	Notes
Patient's Name	(0010,0010)	R+	Important for organizing/finding images
Patient ID	(0010,0020)	R+	Important for organizing/finding images
Issuer of Patient ID	(0010,0021)	R+	Important for organizing/finding images
Issuer of Patient ID Qualifiers Sequence	(0010,0024)	O	Important for organizing/finding images
Other Patient IDs Sequence	(0010,1002)	O	Important for organizing/finding images
Patients Birth Date	(0010,0030)	R+	Important for organizing/finding images
Patient's Sex	(0010,0040)	R+	Important for organizing/finding images
Ethnic Group	(0010,2160)	O	
Patient's Weight	(0010,1030)	O	
Patient's Size	(0010,1020)	O	
Patient State	(0038,0500)	O	
Pregnancy Status	(0010,21C0)	O	
Medical Alerts	(0010,2000)	O	
Contrast Allergies	(0010,2110)	O	
Institution Name	(0008,0080)	R+	Important for organizing/finding images
Institution Address	(0008,0081)	R+	Important for organizing/finding images
Institution Code Sequence	(0008,0082)	R+	Important for organizing/finding images
Institutional Department Name	(0008,1040)	R+	Important for organizing/finding images
Institutional Department Code Sequence [IHE-1]	(xxxx,yyyy)	R+	Important for organizing/finding images
Admission ID	(0038,0010)	R+	Important for organizing/finding images
Issuer of Admission ID	(0038,0011)	R+	Important for organizing/finding images
Consulting Physician's Name	(0008,009C)	O	
Consulting Physician Identification Sequence	(0008,009D)	O	
Referring Physician's Name	(0008,0090)	O	
Referring Physician's Address	(0008,0092)	O	
Referring Physician's Telephone Numbers	(0008,0094)	O	
Referring Physician Identification Sequence	(0008,0096)	O	
Admitting Diagnoses Description	(0008,1080)	O	
Admitting Diagnoses Code Sequence	(0008,1084)	O	
Reason(s) for Visit [IHE-1]	(xxxx,yyyy)	O	
Reason(s) for Visit Code Sequence [IHE-1]	(xxxx,yyyy)	O	

Route of Admissions	(0038,0016)	O	
Study Instance UID	(0020,000D)	R	Important for organizing/finding images
Accession Number	(0008,0050)	R+	Important for organizing/finding images
Issuer of Accession Number Sequence	(0008,0051)	R+	Important for organizing/finding images. Can also be an indicator to differentiate encounter-based imaging from unscheduled radiology.
Study Date	(0008,0020)	R+	Important for organizing/finding images
Study Time	(0008,0030)	R+	Important for organizing/finding images
Study Description	(0008,1030)	R+	Important for organizing/finding images. Many hanging protocols and data browsing interfaces use this prominently.
Study ID	(0020,0010)	O	
Procedure Code Sequence	(0008,1032)	O	
Reason for Performed Procedure Code Sequence	(0040,1012)	O	This is strongly recommended since it is important for organizing/finding images, however since some modalities might lack a user interface to select this, it is optional in this transaction. See RAD TF-3: Appendix Z for potential codes.
Name of Physician(s) Reading Study	(0008,1060)	O	
Physician(s) Reading Study Identification Sequence	(0008,1062)	O	
Physician(s) of Record	(0008,1048)	O	May contain Admitting Physician
Physician(s) of Record Identification Sequence	(0008,1049)	O	
Series Date	(0008,0021)	R+	Important for organizing/finding images
Series Time	(0008,0031)	R+	Important for organizing/finding images
Series Description	(0008,103E)	R+	Important for organizing/finding images
Series Description Code Sequence	(0008,103F)	O	
Modality	(0008,0060)	R	Important for organizing/finding images
Performing Physician's Name	(0008,1050)	O	Important for organizing/finding images
Performing Physician Identification Sequence	(0008,1052)	O	Important for organizing/finding images
Operators' Name	(0008,1070)	R+	Important for organizing/finding images. Also important for attributing the images to a specific person for quality purposes. The Operator may also be the Performing Physician.
Operator Identification Sequence	(0008,1072)	R+	Important for organizing/finding images
Body Part Examined	(0018,0015)	R+	Important for organizing/finding images
Laterality	(0020,0060)	O	Note that laterality is handled in several ways

Anatomic Region Sequence	(0008,2218)	O	The Anatomic Region describes the anatomy visible in the imaging, which is often more than the Body Part Examined. This is strongly recommended since it is important for organizing/finding images, especially for use as priors, however since some modalities might lack a user interface to select this, it is optional in this transaction. See DICOM PS3.16. CID 4 Anatomic Region for potential codes.
Anatomic Region Modifier Sequence	(0008,2220)	O	Important for organizing/finding images
Primary Anatomic Structure Sequence	(0008,2228)	O	The Primary Anatomic Structure describes the focus of the imaging procedure. This typically corresponds to the text value in Body Part Examined (0018,0015). See DICOM PS3.16. CID 4 Anatomic Region for potential codes.
Primary Anatomic Structure Modifier Sequence	(0008,2230)	O	

4.Y1B Get Encounter Imaging Context-FHIR [RAD-Y1b]

4.Y1B.1 Scope

This transaction is used to get the contextual metadata that will be associated with encounter-based imaging acquisitions. This may include metadata about the patient demographics, admission status, details of the encounter/visit and possibly the procedure(s) being performed.

This transaction is analogous to the Query Modality Worklist [RAD-5] transaction that is used in the context of order-based imaging procedures.

This transaction is a FHIR-based equivalent to Get Encounter Imaging Context [RAD-130].

4.Y1B.2 Actor Roles

The roles in this transaction are defined in the following table and may be played by the actors shown here:

Table 4.Y1B.2-1: Actor Roles

Role:	Requester: Requests contextual metadata for an encounter-based imaging acquisition.

Actor(s):	The following actors may play the role of Requester: Lightweight Modality
Role:	Responder: Processes a request and returns metadata results that matches the requested filter (if any).
Actor(s):	The following actors may play the role of Responder: Encounter Manager

Transaction text specifies behavior for each role. The behavior of specific actors may also be specified when it goes beyond that of the general role.

4.Y1B.3 Referenced Standards

HL7 FHIR R4 http://hl7.org/fhir/R4/index.html

4.Y1B.4 Messages

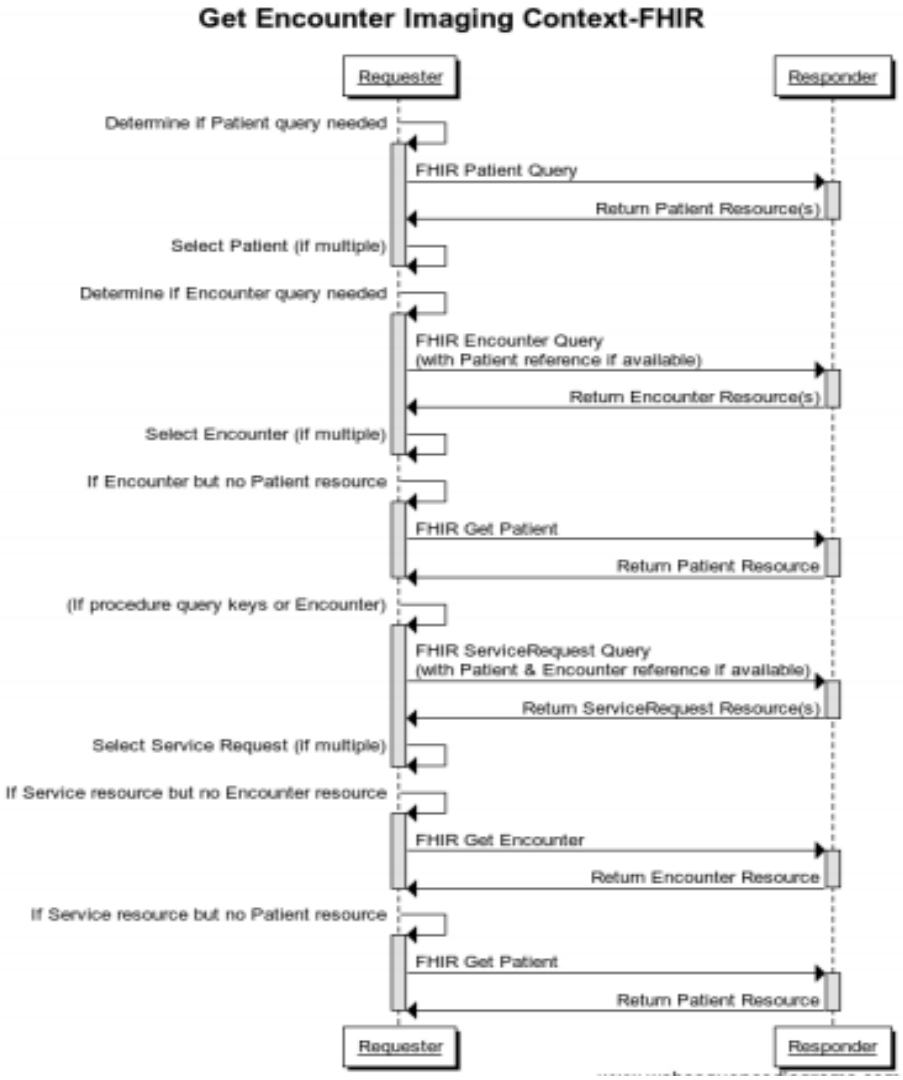

Figure 4.Y1B.4-1: Interaction Diagram

The text in Figure 4.Y1B.4-2 was used to generate the diagram in Figure 4.Y1B.4-1. Readers will generally find the diagram more informative. The text is included here to facilitate editing.


```
title Get Encounter Imaging Context-FHIR

participant Requester

Requester->+Requester: Determine if Patient query needed
Requester->+Responder: FHIR Patient Query
Responder->-Requester: Return Patient Resource(s)
Requester->-Requester: Select Patient (if multiple)

Requester->+Requester: Determine if Encounter query needed
Requester->+Responder: FHIR Encounter Query\n(with Patient reference if available)
Responder->-Requester: Return Encounter Resource(s)
Requester->-Requester: Select Encounter (if multiple)

Requester->+Requester: If Encounter but no Patient resource
Requester->+Responder: FHIR Get Patient
Responder->-Requester: Return Patient Resource
deactivate Requester

Requester->+Requester: (If procedure query keys or Encounter)
Requester->+Responder: FHIR ServiceRequest Query\n(with Patient & Encounter reference if available)
Responder->-Requester: Return ServiceRequest Resource(s)
Requester->-Requester: Select Service Request (if multiple)

Requester->+Requester: If Service resource but no Encounter resource
Requester->+Responder: FHIR Get Encounter
Responder->-Requester: Return Encounter Resource
deactivate Requester

Requester->+Requester: If Service resource but no Patient resource
Requester->+Responder: FHIR Get Patient
Responder->-Requester: Return Patient Resource
deactivate Requester
```

Figure 4.Y1B.4-2: Diagram Pseudocode for Interaction Diagram

Example Query Patterns

Due to the variety of encounter contexts, there are a variety of query patterns using the matching keys. Due to the layering of the resource queries, different patterns of matching keys will result in different combinations of query message types. The following examples use few query parameters, however cases with combinations and additional query parameters (within the requirements stated below) should be expected.The Responder shall support all of the following cases.

- Wristband-driven Query

  Patients often have an identification wristband with a barcode or RFID that could be scanned by a reader connected to the Requester. Typically the value returned is either a value for Patient ID (0010,0020) or Admission ID (0038,0010) that could be matched. The Requester shall be configurable to know which attribute is coded on the wristbands

at its institution and shall be configurable with the value for the local Issuer of Patient ID (0010,0021) or Issuer of Admission ID (0038,0014) since those might not be encoded in the barcode or RFID.
Wristbands often also have the Patient Name printed in text, although that would have to be entered on the modality console by the operator.

- Query by Department
  Using Institutional Department Name (0008,1040) or the Institutional Department Code Sequence (xxxx,yyyy), the Requester can query for all patient encounters planned for this clinical unit. Ideally, the department value reflects the context of the acquisition, rather than ownership of the device. The Requester may be configured with the department to which it belongs or a short list of departments in which it is typically used. An additional range match against the Scheduled Procedure Step Start Date (0040,0002) and Scheduled Procedure Step Start Time (0040,0003) could allow the Requester to request planned encounters for a particular day or shift. An intermittently connected Acquisition Modality might also query and cache the returned list for use while disconnected from the network.
- Query by Operator/Physician
  By including Scheduled Performing Physician's Name (0040,0006) in the query, the Requester can request that the Responder return procedures relevant to the named person. Note that the name may be a performing operator that is not strictly a physician. The modality may be able to use the identity of the currently logged-in account to populate or map this field, or the operator may scan their own badge when activating the modality to perform the procedure.
- Query by Room/Location

  Using Scheduled Procedure Step Location (0040,0011), the Requester can query against a more fine grained location such as a room.

4.Y1B.4.1 FHIR Patient Query

The Requester sends a filter to the Responder in a request for matching Patient metadata.

The Responder shall support handling such messages from more than one Requester. The Requester shall support making requests to more than one Responder.

4.Y1B.4.1.1 Trigger Events

A user or an automated function on the Requester needs to obtain information (including metadata about the Patient) about an encounter being managed by the Responder.

Typically, the Requester intends to perform image acquisition in the context of the encounter and associate the acquisition results with the medical record of the patient.

This transaction supports the use of various matching query keys to find the appropriate patient encounter. In some implementations, the Requester may scan a barcode or RFID, such as those found on patient wristbands, to automatically populate such matching query keys. It should be noted that some wristbands encode the Admission ID rather than the Patient ID, and the patient name might only be in printed text on the wristband. Requesters shall be configurable to support such variations in automatic queries.

Note: Admission ID may be referred to elsewhere as Visit Number, PV1-19 or Account Number (that is unique to the admission).

If the matching query keys available to the Requester include any in Table 4.Y1B.4.1.2-1, the Requester will send a FHIR Patient Query message; otherwise, the Requester will not do a FHIR Patient Query and will proceed to Section 4.Y1B.4.3.1 (Trigger Events for the FHIR Encounter Query).

4.Y1B.4.1.2 Message Semantics

The message is an HTTP GET executed by the Requester against the FHIR Patient endpoint of the Responder.

The syntax of the message shall be:

```
GET [base]/Patient?<query><result>
```

The `[base]` address is determined by the Responder. The Requester shall support configuration of the `[base]` address(es) to which it sends such requests.

Note: The `[base]` address is not necessarily the "main" organizational endpoint for accessing patient resources and might only be used for this encounter-based imaging metadata retrieval service.

The message shall conform to the FHIR specification for search operations. See http://hl7.org/fhir/R4/http.html#search

The `<query>` and `<result>` parameters shall conform to the FHIR specification for parameterized queries. See http://hl7.org/fhir/R4/search.html.

Some semantics and expected actions in this message are stated in terms of DICOM MWL Attributes and DIMSE Services. For FHIR semantics, the same requirements apply with the mappings between DICOM attributes to FHIR elements described here.

4.Y1B.4.1.2.1 Query Search Parameters

The `<query>` represents a series of encoded name-value pairs representing the filter for the query, as well as control parameters to modify the matching behavior of the Responder such as exact matching.

Note: This message uses the "basic" parameters of the search operation but does not make use of the FHIR _filter alternate syntax to encode the search parameters.

The Requester shall be capable of providing all query parameters indicated in the Query Keys Matching column as required for the SCU in the Patient Metadata section of Table 4.130.4.1.2-1 using the corresponding FHIR parameter as mapped in Table 4.Y1B.4.1.2-1.

Table 4.Y1B.4.1.2-1: Patient Metadata Mapping from Table 4.130.4.1.2-1 to FHIR

Notes:

1) A patient may have multiple names. Patient.name.use, if populated, may provide sense of which to use.

2) In FHIR, the Issuer of Patient ID is included in the token together with the identifier value, and Other Patient IDs are included in Patient.identifier since it can be multivalued.

All query parameter values shall be encoded per RFC3986 "percent" encoding rules, which restrict the character set to a subset of ASCII characters.

The Requester may supply the "`:exact`" parameter modifier on query parameters of type `string` to request exact matching. The Responder shall support the "`:exact`" parameter modifier on all query parameters of type `string`.

Note: As mandated by FHIR, the Responder will return, in the response bundle, the parameters AS PERFORMED so the Requester can know if they were modified.

4.Y1B.4.1.2.2 Result Search Parameters

The `<result>` parameters are used to control behavior related to the returned results, such as encoding, number-of-result limits, pagination, sort order, and included referenced resources.

The Requester shall indicate its preferred response encoding as described in ITI TF-2x: Appendix Z.6 (Populating the Expected Response Format). The Requester shall support at least one of XML and JSON.

The Requester is recommended to make use of the `_count` parameter (as described in http://hl7.org/fhir/R4/search.html#return) to avoid responses the Requester may consider unmanageably large. The Requester may use other parameters but should not depend on the Responder supporting them.

Although FHIR has result parameters for the Requester to indicate specific elements it wants returned, those are not incorporated here since the Responder will be required to include all available elements in the returned Resource(s).

4.Y1B.4.1.3 Expected Actions

The Responder shall accept and process the request. This involves parsing the matching key values provided by the Requester and using those to determine matching patients for return to the Requester in the Return Patient Resources message.

Whether the Responder maintains a persistent set of Patient Resources that it searches locally, or whether the Responder marshals the required content on-demand from one or more sources, or whether it searches, obtains, and returns Patient Resources managed by another system is not specified by this transaction.

The Responder shall be capable of processing all query parameters indicated in the Query Keys Matching column as required for the SCP in the Patient Metadata section of Table 4.130.4.1.2-1 using the corresponding FHIR parameter as mapped in Table 4.Y1B.4.1.2-1.

If search parameters other than those defined in Section 4.Y1B.4.1.2 are specified in the FHIR Patient Query message, the Responder shall ignore parameters it does not support.

4.Y1B.4.2 Return Patient Resource(s)

The Responder sends matching Patient Resources back to the Requester.

4.Y1B.4.2.1 Trigger Events

The Responder receives a FHIR Patient Query Message.

4.Y1B.4.2.2 Message Semantics

The message is a FHIR search response message from the Responder to the Requester.

The message shall conform to the FHIR specification for search responses. See http://hl7.org/fhir/R4/http.html#search.

Per ITI TF-2x: Appendix Z.6 (Populating the Expected Response Format), the Responder is required to support both XML and JSON encodings for the response. The Responder shall comply with the format indicated by the Requester in the FHIR Patient Query message.

The Responder may return an HTTP redirect response.

Per FHIR, (http://hl7.org/fhir/R4/bundle.html), the Responder will encode the matching Patient Resource or Resources into a bundle. If there are no results, the bundle will be empty. Per FHIR, the Responder will not return more than `_count` Patient resources in a given bundle (but may return fewer). The Responder shall support FHIR Paging. (See http://hl7.org/fhir/R4/search.html#return and http://hl7.org/fhir/R4/http.html#paging).

The Responder shall include in the returned resources all elements indicated as required Matching or Return Keys for the SCP in the Patient Metadata section of Table 4.130.4.1.2-1 using the corresponding FHIR Element as mapped in Table 4.Y1B.4.1.2-1.

Note that the codeset used for the meta.security element is locally managed. Some guidance is provided here: https://www.hl7.org/fhir/v3/ConfidentialityClassification/vs.html

The primary purpose of this message is to convey context metadata to the point of care where it can be properly associated with acquired data. The Responder is not necessarily the original source of the context metadata but may have obtained them via other transactions.

It is the responsibility of the Responder to ensure that the patient information is current in the Return Patient message. For a list of some potential methods to obtain such information, see RAD TF-1: 47.4.1.4 and 47.4.1.5.

4.Y1B.4.2.3 Expected Actions

The Requester shall accept the returned bundle.

If the Responder returns an HTTP redirect response (HTTP status codes 301, 302, 303, or 307), the Requester shall follow the redirect, but may stop processing if it detects a loop. See RFC7231 Section 6.4 Redirection.

The Requester shall be prepared to process incremental responses returned from the Responder as specified FHIR Paging http://hl7.org/fhir/R4/http.html#paging.

RAD TF-2:2.2 specifies that the Query SCU (in this case the Requester) shall display for the user the returned value of all attributes specified as R or R+ in the normal user interface. While this transaction uses the notation of RAD TF-2:2.2, the Requester is not specifically required to display all these attributes; the most effective method of presenting response entries to the operator for selection is left to the product design.

4.Y1B.4.3 FHIR Encounter Query

The Requester sends a filter to the Responder in a request for matching Encounter metadata.

The Responder shall support handling such messages from more than one Requester. The Requester shall support making requests to more than one Responder.

4.Y1B.4.3.1 Trigger Events

4.Y1B.4.3.2 Message Semantics

The message is an HTTP GET executed by the Requester against the FHIR Encounter endpoint of the Responder.

The syntax of the message shall be:

```
GET [base]/Encounter?<query><result>
```


The `[base]` address is determined by the Responder. The Requester shall support configuration of the `[base]` address(es) to which it sends such requests.

Note: The `[base]` address is not necessarily the "main" organizational endpoint for accessing patient resources and might only be used for this encounter-based imaging metadata retrieval service.

The message shall conform to the FHIR specification for search operations. See http://hl7.org/fhir/R4/http.html#search

The `<query>` and `<result>` parameters shall conform to the FHIR specification for parameterized queries. See http://hl7.org/fhir/R4/search.html.

Some semantics and expected actions in this message are stated in terms of DICOM MWL Attributes and DIMSE Services. For FHIR semantics, the same requirements apply with the mappings between DICOM attributes to FHIR elements described here.

4.Y1B.4.3.2.1 Query Search Parameters

The `<query>` represents a series of encoded name-value pairs representing the filter for the query, as well as control parameters to modify the matching behavior of the Responder such as exact matching.

Note: This message uses the "basic" parameters of the search operation but does not make use of the FHIR _filter alternate syntax to encode the search parameters.

The Requester shall be capable of providing all query parameters indicated in the Query Keys Matching column as required for the SCU in the Encounter Metadata section of Table 4.130.4.1.2-1 using the corresponding FHIR parameter as mapped in Table 4.Y1B.4.2.2-1.

Table 4.Y1B.4.3.2-1: Encounter Metadata Mapping from Table 4.130.4.1.2-1 to FHIR

All query parameter values shall be encoded per RFC3986 "percent" encoding rules, which restrict the character set to a subset of ASCII characters.

The Requester may supply the "`:exact`" parameter modifier on query parameters of type `string`to request exact matching. The Responder shall support the "`:exact`" parameter modifier on all query parameters of type `string`.

Note: As mandated by FHIR, the Responder will return, in the response bundle, the parameters AS PERFORMED so the Requester can know if they were modified.

4.Y1B.4.3.3 Expected Actions

The Responder shall accept and process the request. This involves parsing the matching key values provided by the Requester and using those to determine matching encounters for return to the Requester in the Return Encounter References message.

Whether the Responder maintains a persistent set of Encounter Resources that it searches locally, or whether the Responder marshals the required content on-demand from one or more sources, or

whether it searches, obtains and returns Encounter Resources managed by another system is not specified by this transaction.

The Responder shall be capable of processing all query parameters indicated in the Query Keys Matching column as required for the SCP in the Encounter Metadata section of Table 4.130.4.1.2-1 using the corresponding FHIR parameter as mapped in Table 4.Y1B.4.3.2-1.

If search parameters other than those defined in Section 4.Y1B.4.3.2 are specified in the FHIR Encounter Query message, the Responder shall ignore parameters it does not support.

4.Y1B.4.4 Return Encounter Resource(s)

The Responder sends matching Encounter Resources back to the Requester.

4.Y1B.4.4.1 Trigger Events

The Responder receives a FHIR Encounter Query Message.

4.Y1B.4.4.2 Message Semantics

The message is a FHIR search response message from the Responder to the Requester.

It is the responsibility of the Responder to ensure that the encounter information is current in the Return Encounter message. For a list of some potential methods to obtain such information, see RAD TF-1: 47.4.1.4 and 47.4.1.5.

4.Y1B.4.4.3 Expected Actions

The Requester shall accept the returned bundle.

If the Responder returns an HTTP redirect response (HTTP status codes 301, 302, 303, or 307), the Requester shall follow the redirect, but may stop processing if it detects a loop. See RFC7231 Section 6.4 Redirection.

The Requester shall be prepared to process incremental responses returned from the Responder as specified FHIR Paging http://hl7.org/fhir/R4/http.html#paging.

4.Y1B.4.5 FHIR Service Request Query

The Requester sends a filter to the Responder in a request for matching Service Request metadata.

The Responder shall support handling such messages from more than one Requester. The Requester shall support making requests to more than one Responder.

4.Y1B.4.5.1 Trigger Events

4.Y1B.4.5.2 Message Semantics

The message is an HTTP GET executed by the Requester against the FHIR Service Request endpoint of the Responder.

The syntax of the message shall be:

```
GET [base]/ServiceRequest?<query><result>
```

The `[base]` address is determined by the Responder. The Requester shall support configuration of the `[base]` address(es) to which it sends such requests.

Note: The `[base]` address is not necessarily the "main" organizational endpoint for accessing patient resources and might only be used for this encounter-based imaging metadata retrieval service.

The message shall conform to the FHIR specification for search operations. See http://hl7.org/fhir/R4/http.html#search

The `<query>` and `<result>` parameters shall conform to the FHIR specification for parameterized queries. See http://hl7.org/fhir/R4/search.html.

Some semantics and expected actions in this message are stated in terms of DICOM MWL Attributes and DIMSE Services. For FHIR semantics, the same requirements apply with the mappings between DICOM attributes to FHIR elements described here.

4.Y1B.4.5.2.1 Query Search Parameters

The `<query>` represents a series of encoded name-value pairs representing the filter for the query, as well as control parameters to modify the matching behavior of the Responder such as exact matching.

Note: This message uses the "basic" parameters of the search operation but does not make use of the FHIR _filter alternate syntax to encode the search parameters.

The Requester and the Responder shall support multiple query parameters.

The Requester shall be capable of providing all query parameters indicated in the Query Keys Matching column as required for the SCU in the Procedure Metadata section of Table 4.130.4.1.2-1 using the corresponding FHIR parameter as mapped in Table 4.Y1B.4.5.2-1.

Table 4.Y1B.4.5.2-1: Procedure Metadata Mapping from Table 4.130.4.1.2-1 to FHIR

All query parameter values shall be encoded per RFC3986 "percent" encoding rules, which restrict the character set to a subset of ASCII characters.

The Requester may supply the "`:exact`" parameter modifier on query parameters of type `string` to request exact matching. The Responder shall support the "`:exact`" parameter modifier on all query parameters of type `string`.

Note: As mandated by FHIR, the Responder will return, in the response bundle, the parameters AS PERFORMED so the Requester can know if they were modified.

4.Y1B.4.5.3 Expected Actions

The Responder shall accept and process the request. This involves parsing the matching key values provided by the Requester and using those to determine matching service request references for return to the Requester in the Return Service Request References message.

Whether the Responder maintains a persistent set of Service Request Resources that it searches locally, or whether the Responder marshals the required content on-demand from one or more sources, or whether it searches, obtains, and returns Service Request Resources managed by another system is not specified by this transaction.

The Responder shall be capable of processing all query parameters indicated in the Query Keys Matching column as required for the SCP in the Procedure Metadata section of Table 4.130.4.1.2-1 using the corresponding FHIR parameter as mapped in Table 4.Y1B.4.5.2-1.

If search parameters other than those defined in Section 4.Y1B.4.5.2 are specified in the FHIR Service Request Query message, the Responder shall ignore parameters it does not support.

4.Y1B.4.6 Return Service Request Resource(s)

The Responder sends matching Service Request Resources back to the Requester.

4.Y1B.4.6.1 Trigger Events

The Responder receives a FHIR Service Request Query Message.

4.Y1B.4.6.2 Message Semantics

The message is a FHIR search response message from the Responder to the Requester.

The message shall conform to the FHIR specification for search responses. See http://hl7.org/fhir/R4/http.html#search.

Per ITI TF-2x: Appendix Z.6 (Populating the Expected Response Format), the Responder is required to support both XML and JSON encodings for the response. The Responder shall comply with the format indicated by the Requester in the FHIR Patient Query message.

The Responder may return an HTTP redirect response.

It is the responsibility of the Responder to ensure that the service request information is current in the Return Service Request message. For a list of some potential methods to obtain such information6The Requester shall accept the returned bundle.

If the Responder returns an HTTP redirect response (HTTP status codes 301, 302, 303, or 307), the Requester shall follow the redirect, but may stop processing if it detects a loop. See RFC7231 Section 6.4 Redirection.

The Responder shall accept and process the request. This involves parsing the matching key values provided by the Requester, using those to determine matching patient/encounter records, and composing worklist entries, containing the requested return keys, for return to the Requester in the Return Encounter Metadata message.

Whether the Responder maintains a list of planned or possible encounters/service requests that it searches locally, or whether the Responder marshals the contents of the return keys on-demand from one or more sources, is not specified by this transaction. Similarly, the Responder may or may not know whether encounters have been completed and can thus be omitted from the returned list of worklist entries. Such business logic likely cannot be definitive and is typically based on clues such as whether the patient has been discharged, transferred to another department, or whether Notify of Imaging Results [RAD-132] transactions have already been received for this patient/encounter and on configuration settings for which queries such clues affect. In contrast to the situation for the Query Modality Worklist [RAD-5] transaction, the imaging procedure that will be performed is typically not known or prescribed by the Responder. The Responder still returns requested metadata even though the encounter-based imaging procedure may not have been specifically scheduled.

Scheduled Station AE Title (0040,0001) will be present in the request as a Matching Key. The Responder shall return that same value as a Return Key in the response. The value may be helpful for the Responder to tailor the response based on the specific device making the request.

Modality (0008,0060) will be present in the request as a Matching Key. The Responder shall return that same value as a Return Key in the response. The value may be helpful for the Responder to tailor the response based on the specific modality type making the request.

If a worklist entry in the response does not correspond to a specifically scheduled datetime, the Responder shall populate the Scheduled Procedure Step Start Date (0040,0002) and Scheduled Procedure Step Start Time (0040,0003) with the current date and time.

The Responder shall populate both the Accession Number (0008,0050) and the Requested Procedure ID (0040,1001) with the Accession Number value.

When required to return a value for Scheduled Procedure Step Description (0040,0007), Requested Procedure Description (0032,1060) and/or Requested Procedure Code Sequence (0032,1064), the Responder may provide a description of the planned procedure or next imaging step if known. Since a specific imaging procedure might not have been scheduled, the Responder is permitted to provide a generic code or description such as "Perform Imaging".

4.Y1B.4.7 FHIR Get Patient

The Requester requests a specific Patient resource from the Responder.

The Responder shall support handling such messages from more than one Requester. The Requester shall support making requests to more than one Responder.

4.Y1B.4.7.1 Trigger Events

The Requester needs to obtain metadata about a Patient using a Patient reference it has obtained.

In the context of this transaction, the Patient reference will have been obtained from the subject element of an Encounter resource or a Service Request resource.

4.Y1B.4.7.2 Message Semantics

The message is an HTTP GET executed by the Requester against the FHIR Patient endpoint of the Responder.

The syntax of the message shall be:

The `[base]` address is determined by the Responder. The Requester shall support configuration of the `[base]` address(es) to which it sends such requests.

Note: The `[base]` address is not necessarily the “main” organizational endpoint for accessing patient resources and might only be used for this encounter-based imaging metadata retrieval service.

The message shall conform to the FHIR specification for a read operation. See http://hl7.org/fhir/R4/http.html#read

The Requester shall indicate its preferred response encoding as described in ITI TF-2x: Appendix Z.6 (Populating the Expected Response Format). The Requester shall support at least one of XML and JSON.

4.Y1B.4.7.3 Expected Actions

The Responder shall accept and process the request. This involves providing the referenced Patient resource to the Requester in the Return Patient Resource message.

Whether the Responder maintains a persistent set of Patient Resources locally, or whether the Responder obtains and returns Patient Resources managed by another system is not specified by this transaction.

4.Y1B.4.8 Return Patient Resource

The Responder sends the referenced Patient Resource back to the Requester.

4.Y1B.4.8.1 Trigger Events

The Responder receives a FHIR Get Patient message.

4.Y1B.4.8.2 Message Semantics

The message is a FHIR read response message from the Responder to the Requester.

The message shall conform to the FHIR specification for read responses. See http://hl7.org/fhir/R4/http.html#read.

Per ITI TF-2x: Appendix Z.6 (Populating the Expected Response Format), the Responder is required to support both XML and JSON encodings for the response. The Responder shall comply with the format indicated by the Requester in the FHIR Get Patient message.

The Responder may return an HTTP redirect response.

If the Responder returns an HTTP redirect response (HTTP status codes 301, 302, 303, or 307), the Requester shall follow the redirect, but may stop processing if it detects a loop. See RFC7231 Section 6.4 Redirection.

4.Y1B.4.9 FHIR Get Encounter

The Requester requests a specific Encounter resource from the Responder.

The Responder shall support handling such messages from more than one Requester. The Requester shall support making requests to more than one Responder.

4.Y1B.4.9.1 Trigger Events

The Requester needs to obtain metadata about an Encounter using an Encounter reference it has obtained.

In the context of this transaction, the Encounter reference will have been obtained from the encounter element of a Service Request resource.

4.Y1B.4.9.2 Message Semantics

The Responder may return an HTTP redirect response.

If the Responder returns an HTTP redirect response (HTTP status codes 301, 302, 303, or 307), the Requester shall follow the redirect, but may stop processing if it detects a loop. See RFC7231 Section 6.4 Redirection.

4.Y1B.4.2

The Requester shall accept the returned responses.

The Requester has no other expected actions in the context of completing the transaction; however, profiles using this transaction will typically incorporate the details from the Return Encounter Metadata message into subsequent actions and transactions.

RAD TF-2:2.2 specifies that the Query SCU (in this case the Requester) shall display for the user the returned value of all attributes specified as R or R+ in the normal user interface. While this transaction uses the notation of RAD TF-2:2.2, the most effective method of presenting response entries to the operator for selection is left to the product design.

4.Y1B.5 Security Considerations

The patient demographics and encounter details returned in the response, and potentially matching details contained in the query, typically constitute personal health information.

4.Y1B.5.1 Security Audit Considerations

This transaction is associated with a Query Information ATNA Trigger Event.

