Integrating the Healthcare Enterprise

IHE Radiology
Technical Framework Supplement

Encounter-Based Imaging Workflow (EBIW)

Rev. 1.0 – Draft for Public Comment

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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 February 21, 2018 for public comment. Comments are invited and may be submitted at http://www.ihe.net/Radiology_Public_Comments. In order to be considered in development of the trial implementation version of the supplement, comments must be received by March 24, 2018.

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.

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Introduction to this Supplement

This supplement introduces a new Encounter-Based Imaging Workflow Profile to address medical imaging performed outside the context of an ordered procedure.

The profile specifies how to integrate the devices to capture appropriate context, populate relevant indexing fields, link to related data, and ensure the images are accessible and well-knit into the medical record.

The focus of this profile is imaging acquired by point-of-care ultrasound devices.

Note: There is a strong interest in addressing image capture devices such as mobile phones, tablets, digital cameras, and specialty imagers like stereoscopic dermatology cameras. Many departments capture clinical photos for documentation, follow-up care, and diagnostics. Those use cases are out-of-scope for this year but for the next IHE RAD cycle a proposal will be re-submitted to document and analyze those use cases and extend the profile to address them.

Open Issues and Questions

Q1. Do we need to profile John Doe cases? I.e., handle submitting untagged data to the archive with John Doe placeholder demographics? This is likely common in ER usage with temporary patient ids and sparsely populated metadata (male, 50's). Option 1: modality does a normal RAD-Y1 asking for John Doe; Encounter Manager provides John Doe demographics; modality acts normally, and reconciliation happens behind the scenes later Option 2: modality generates John Doe demographics, Encounter Manager is not involved, reconciliation occurs with perhaps a bit more gaps and variabilities.
Q2. Are Figure X.4.1.1-1: Encounter-Based Imaging Information Model relationships OK? Should Studies be children of Encounters rather than Procedures? If so are Series children of Procedures? Are the 1:1 vs 1:n relations right?
Q3. Are the Y1, Y2, Y3 Requirements adequate to reliably meet the metadata needs in X.4.1.6 Is there an attribute/field that should be Type 1 and if so do we need to define a default or fallback value?

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If our Y2 or Y3 requirements are too strict, systems may need to buffer the "bad" images in an exception queue until someone cleans them up. But maybe the clean data benefits outweigh the delay/inconvenience? Or is this a local policy and product design question?

Should we raise any requirements in Y2 (Storage) to promote effective metadata?

If so, are there any requirements in Y1 (Query Context) that should be raised to provide the needed/consistent values?

Q4. Is Department configured on the device or is it needed in the Encounter Context?

A: Maybe, maybe not.

Large capital devices (MR Scanner) are generally tied to a department. Smaller more mobile modalities (portable ultrasound, x-ray, digital camera) may stay in a single Institution and might be owned by one department but might be used in multiple departments.

If the Encounter Manager can figure out based on the operator, etc. it could return department values to the modality to include in the data.

Q5. How do we want to handle "location" of encounter-based imaging?

The location where the images were acquired (in the sense of Department or perhaps a specific room) is used to manage encounter images, but it seems to be essentially a proxy for the sub-organization/clinical specialty or workflow that generated the images. It is also used to associate the images with other clinical artifacts.

How should the Modality determine its location? Does it know better or does the Encounter Manager? Is Care Team a more direct attribute for this?

CMS has a Place of Service Code Set https://www.cms.gov/Medicare/Coding/place-of-service-codes/Place_of_Service_Code_Set.html

Related fields and tags:

Current Patient Location (0038,0300) in MWL

Requested Procedure Location (0040,1005) in MWL

Patient's Institution Residence (0038,0400) is "outpatient" or their home room, floor, ward

Scheduled Procedure Step Location (0040,0011) in MWL

Performed Location (0040,0243) in MPPS - Label of the encounter room or (small) facility

Performed Station Geographic Location Code Sequence (0040,4030) in UPS

PV1:3 00133 Assigned Pat. Loc. (See also discussion of ADT^A02 below.)

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AIL:3 Location Resource ID contains information about location resources (meeting rooms, operating rooms, examination rooms, or other locations) that can be scheduled.

AIP segment is for scheduled personnel (care team?)

HL7©[1] sometimes has fields for <point of care (IS)> ^ <room (IS)> ^ <bed (IS)> ^ <facility (HD)> ^ <location status (IS)> ^ <patient location type (IS)> ^ <building (IS)> ^ <floor (IS)>

Q6. How does the mobility of cameras and portable ultrasound affect things?

Room and operator are not as easily tied together and not as stable. Also, mobility might make it hard to target the right device and maintain the connection to update.

- May be hard to populate location/room if the device is moving continuously. Take it out of the supply rack and put it back when you're done. Don't know where it was used which is what we really want. Maybe we just acknowledge our data may be weak/bad.
- Dan – room/floor changes. Facility/dept/service is the important thing and is more stable. Still have shared devices so how do we tell who's using it? The worklist will likely overwrite the default device relationship. Depts will borrow equipment. But people also span care teams and depts maybe on different days, maybe float. Could notify user the device is assuming a certain dept based on the order/details and let them confirm or change (pulldown?).
- Geotag might be more and more useful. Might be able to use network clues too. ITI has patient location tracking. Some of this can help picklists based on the department, user role.
- Rob include a section in the security section on mobility. Device gets outside the firewall, etc. in terms of attack surface. Don't need details but note the issue.

Q7. How can "completed" work be filtered out and just return active and pending encounters?

It is more convenient if the query from the Acquisition Modality to the Encounter Manager can return a fairly short and relevant list of patients/encounters. For example, it would be good not to return patients/encounters that have already been completed, but that may be hard to determine. If the Encounter Manager monitors ADT discharge messages it can likely omit discharged patients. The Encounter Manager could also monitor RAD-Y3 notification messages and omit patients with completed imaging procedures, however it might not be unusual for patients to have multiple imaging procedures during a visit or periodically to have to repeat a completed procedure.

Suggestions on ways to filter departmental and other queries are welcome.

[1] HL7 is the registered trademark of Health Level Seven International.

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Q8. Do we need to tinker with the RAD TF-2: 2.2 text? Specifically, with respect to SCU required return keys it has the following general policy: "A key that the Query SCU requests from the Query SCP and receives in the query responses. The definition of ***the means offered to the user of the Query SCU to request a return key*** (e.g., by default, check a box) ***and to make it visible to the user is beyond the scope of IHE***. A Query SCU shall include as Return Keys in each C-FIND request all attributes specified as R, R+, R*, or R+*. ***A Query SCU shall display for the user the returned value of all attributes specified as R or R+ in the normal user interface***." Do we want to remove the reference to 2.2 in 4.Y1? Do we want to change the "shall display" behavior? Or do we just make most/everything R* or R+* and leave it to product design?
Q9. Is the use of "auto-matching" matching keys in RAD-Y1 OK? It is a convenient way for the SCU to communicate potentially relevant details (the Modality and AE Title of the SCU) to the SCP but it does play with the semantics a bit. Doing this also avoids having to tinker with the MWL service attribute requirements to downgrade those.
Q10. Should we make any Measurement SR IODs mandatory for the SCP?
Q11. Is it OK for RAD-Y3 to use an ORU^R30 instead of an ORU^R01? ORU-R30 is titled "Unsolicited Point-Of-Care Observation Message Without Existing Order" which very accurately described our intent, but some systems might not be familiar with ORU-R30 even though it can be structurally the same as the ORU^R01 used by the Results Distribution transaction on which RAD-Y3 is based.
Q12. What is the guidance for OBR:48 Medically Necessary Duplicate Procedure Reason For photos will sometimes retake images because of poor quality or need for different views/zoom in on portion (e.g., of a rash). Might also do for PoC US if confirmation images are inconclusive. Might like to bill for encounter image acquisitions so need to avoid double billing. If we try to populate this, what DICOM©[2] header field does the PACS get the value from to populate this?

[2] DICOM is the registered trademark of the National Electrical Manufacturers Association for its standards publications relating to digital communications of medical information.

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Q13. How should the IM/IA recognize an encounter-based study (so it can send [RAD-Y3] and how should the Result Aggregator/EMR recognize encounter-based Accessions?

Should the Modality put an explicit flag/indicator in the image header? If so, where?

Should the IM/IA look at the Issuer or Accession # to see if it's the Encounter Manager?

Should the IM/IA have a special AE Title for receiving encounter-based images?

If the Encounter Manager lists itself as the Issuer or if a prefix-suffix-knownrange is used, those could currently work. If there are multiple encounter managers then you need to check the list against issuer.

Alternatively we could do a DICOM CP to add Identifier Type Code (0040,0035) (like exists in the Issuer of Patient ID Qualifier Sequence) to flag explicitly that this accession # is an encounter accession #.

Q14. What else could we think about in conjunction with the digital camera proposal?

- Consider a "push flow" for Record Driven Acquisition (of interest to several participants). The practitioner might interact with the encounter manager or patient record viewer to initiate follow up or supportive imaging which results in some kind of push of associated context (and instructions?) to the modality. Or at least have the matching worklist item cued up to return.
- Consider the model of walking the operator through what they have to do. Maybe body map has the same 25 images and you guide them, e.g., the camera tells you what to shoot rather than you picking what you shoot. It becomes a camera protocol. Consider if there are other workflow changes/use cases needed to support medical photography process.
- What guidance can we provide on how encounter-based studies can/should be divided into Series?
- If a device spawns a new "encounter/procedure/study" for each acquisition, how do you relink those that are really part of the same actual encounter/procedure/study? E.g., photographic multiple body parts on the camera. Could have "bookend" images or signals that are processed by the "modality" (keeping in mind that the profile specifications are targeted at the software not the SLR).
- It's hard to find data that has been put into the patient record. Encounter images are used in more varied ways (in the EMR and beyond the EMR) than radiology perhaps. Launching a different viewer for each different data type and data source raises additional integration questions.

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- Consider diagramming Diagnostic Imaging, Procedural Imaging and Evidence Imaging. Delineate EBI vs Enterprise Imaging vs mobile vs consumer vs lightweight vs web APIs vs ...
- Address "deferred completion" patterns. E.g., for a patient in ICU during the day, they acquire and send images and then finish labelling/assigning body parts and procedure metadata posthoc on the encounter manager. Sometimes another patient might be acquired without having closed the prior encounter leading to miss-assigned images that are then (hopefully) corrected too during the posthoc processing. Potential problems of two systems editing the metadata without being fully on the same page.
- While PoC US deployment motivation might be driven/justified/funded by ability to properly track and bill for the procedures, managing cameras might be more about risk mitigation since their use is less diagnostic procedures and more operations and documentation.
- Might require the Modality Actor to populate the Original Attributes Sequence when tinkering with values generated by the digital camera.
- How much do we need to describe the capture device Device Type? Is a value for Modality and Model enough? Do we need modality subtype to hold something like "medical photography" to specialize VL?
- Consider guidance for populating Contributing Equipment Sequence (0018,A001) to describe the camera while allowing the Modality Actor to create the DICOM instance. The sequence includes many details that can then differ for each contributing device:
  - Institution Name
  - Institutional Department Name
  - Station Name
  - Operator's Name
  - Operator's ID
  - Contribution Datetime
  - Contribution Description

Q15. Anything else in the whitepapers we should incorporate?

Relevant Whitepapers:

- SIIM-HIMSS Enterprise Imaging Workgroup - White Papers
- A Foundation for Enterprise Imaging - JDI Whitepaper
- Order-based vs Encounter-based Imaging - JDI Whitepaper (Andrei)

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- The Workflow Challenges of Enterprise Imaging - JDI Whitepaper (Kevin)
- Technical Challenges of Enterprise Imaging - JDI Whitepaper (Kevin)
- PCD Encounter-based Patient Identification Management whitepaper (Andrei)

http://ihe.net/uploadedFiles/Documents/PCD/IHE_PCD_WP_PCIM_Rev1.1_2017-06-16.pdf

Closed Issues

Q. How are final images encoded?

A. in DICOM

Q. Store in STOW-RS or C-STORE?

A. Expect Both (both transactions already exist)

However only C-STORE is included in this draft. STOW-RS will be examined as part of the support for digital cameras. Will likely either clone RAD-Y2 into a STOW version or re-use 3.108 Store Instances over the Web [RAD-108] depending on suitability to the use cases.

Q. Bias toward older (DICOM/HL7) VS newer (DICOMweb/FHIR©[3]) technologies?

A. Focus on HL7 v2 + DICOM + DICOMweb for this profile

Q. Should images be linked to reports or pasted directly into them?

A. Linked by using the shared encounter ID, which is part of the metadata.

Q. Should we use Accession Numbers?

A. Yes

Creating it and passing to the modality to include in the images means that if the EHR chooses to create an order, it can be linked to the Accession # and everything works like normal. URL linkages use Accession #'s a lot between the PACS and VNA. Patient ID is good but having both Patient and Accession is better.

If encounter images are referred for reporting, they will need an accession for billing and report linking.

[3] FHIR is the registered trademark of Health Level Seven International.

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Billing systems can use the encounter ID or procedure ID since they bill for encounters and procedures but having an accession # wouldn't hurt and some of them would like it. Generally Lab and Imaging procedures have accession #s.

Non-radiology device vendors are notoriously bad at following DICOM (miss study descriptions etc., etc., etc.) but as long as they include that one number, it can tie back to the GOOD metadata in the encounter manager.

Q. How are documents from the same encounter (images, notes, reports) grouped/linked?

A: Accession Number

Accession number mirrors how ordered procedures link the images to the report and link both to the EMR record. Date/time of acquisition (if known to reasonable accuracy) for known patient also helps.

Some sites use both an accession number and an encounter ID (visit id + department id). Others do a query template to match a combination of visit ID & department & doctor. Coded document titles are helpful (e.g., with LOINC codes).

Many EMR/DB products will store relationships internally in proprietary ways. Some EMRs will create an artificial order # after the fact to use for indexing in the record.

Later documents can also point to the encounter imaging procedure using the accession number. Accession number is associated with the Study Instance UID which can be used to invoke a display profile.

(Proprietary EMRs can also do things the hard way: query the VNA whenever a patient is launched in a patient browser and also get order data from the order database and use that to build an index. If no order, it use the DICOM metadata to add an entry to the browser index.)

Q. What is the scope of uniqueness for Encounter/Visit numbers?

A. Uniqueness is handled by qualifying the encounter ID with an assigning authority

For in-patient, encounter ID is unique in the EMR across the enterprise, or unique within the scope of issuing system

For out-patient, encounter ID is unique for each department.

Q. Does Encounter/Visit # link to Accession # for inpatients? Is implicit order required or not?

A. Maintain harmonization for workflow and data management between encounter-driven and order-driven environments, especially for people and devices that operate in both contexts

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Q. Should we create an Encounter Module?

A. Not for now.

We are looking for something that happens 1-n times during a visit.

If we created it, it would contain attributes like:

- Encounter ID
- Issuer of Encounter ID
- Encounter UID
- Reason for Encounter
- Reason for Encounter Code Sequence?
- Encounter Start Datetime
- Encounter End Datetime
- Encounter Location
- Encounter Care Team

HL7 makes Encounter a synonym for Visit so it doesn't really exist in the sense we want. FHIR renames Visit to Encounter but allows nesting so that there can be Encounters within Encounters which would serve our needs. Once FHIR gets there we may want to mirror that in DICOM/IHE. In the meantime, the Accession provides a proxy handle, and managing Imaging Procedures will likely serve most of our other purposes at the sub-encounter level.

PAM covers patient visit and account in great detail and complexity with national variations but doesn't model down to the level we're looking for. The U.S. uses X12 based on HHS definitions of Encounter etc.

Outpatient encounters tend not to have "sub-encounters" so it's a bit simpler.

Q. Is this a "Radiology" profile?

A. Yes

Historically RAD profiles have provided a basis for other imaging domains. RAD is the closest thing IHE has to a general Medical Imaging domain and we have TC members who understand the solution technologies well.

Q. Do we want to talk about portable X-ray at all during this draft of the profile?

A. Deferred. Keep it short for now. Add later.

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There are certainly portable x-ray use cases similar to those described in X.4.2, however ionizing radiation means it is more often necessary to have an order.
Q. Should the scope include "self-captured" data from patients at home or remote? A. Deferred, focus on workflow within hospitals.
Q. Who initiates encounter imaging? A: Usually the imaging device initiates; although we should consider Record Driven Acquisition that is initiated from the EMR/Encounter Manager ("repeat order for current date" since most metadata/context is inherited).
Q. Should the device get the context before starting imaging, or after, or both? A: Model before, allow for both. In principle the device gets the metadata, then acquires images, applies metadata, submits to archive. Can also acquire images, get metadata, apply metadata, submit to archive. The later might be handy for ad hoc workflow.
Q. Should we require the EM and EHR to support a baseline mechanism for demographics? A: No. X.4.1.3 lists the alternatives and leaves it as a deployment issue (like matching up profiles on integration statements usually is). PAM Encounter Consumer doing Patient Encounter Management [ITI-31] • 25 different ADT messages over 48 pages. Mostly about reporting what is currently happening, not setting up what will happen (except for pre-admit, pending transfer) • If a site does not support PAM, doing so for EBIW seems to be a significant load (French National Extension is 57 pages on PAM, German extension is only 6 but it's links to other documents, Patient Encounter Management transaction is 48 pages) • TF-4: 4.1.2.4 PV1 Segment (prohibits consulting, use ROL) • ADT^A02^ADT_A02 Transfer = location is PV1-3, was PV1-6, encoded as PL o What distinguishes "temporary location" from "permanent location"? E.g., ADT^A10^ADT_A09 and vs movement ADT^Z99^ADT_A01 (ZBE)

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- Permanent location is a bed. Temporary location is a consulting department or room. (Note Leave of Absence where patient leaves the facility without ending the visit)

- ADT^A14^ADT_A05 Pending Admit = arrival expected at PV2-8 (which is X??)
- ADT^A15^ADT_A15 Pending Transfer = location will presumably be PV1-3 at EVN-3
  - Be careful if we need to deal with cancellations etc.
- ADT^A54^ADT_A54 Change Attending Doctor = new doc is PV1-7; Field ROL-4-role begin date/time and ROL-5-role end date/time are used to communicate the begin and end date and time of the attending doctor (or of the admitting, consulting, and/or referring doctor, as appropriate and as designated in ROL-7-role code). When segment ROL is used to communicate this information, field ROL-2-action code should be valued UP.
- Do we want to constrain the PAM Options or just make it a required grouping? Pending Event Management Option (10 messages)
- Who is on the list vs what data elements are populated for that person
  - Might not have to worry about the length of the list if you use type-ahead filtering and/or barcodes. So have ultrasound know about every patient in the hospital.

B: Appointment Scheduling Management [EYE-16]

- S12 - Notification of New Appointment Booking
- S14 - Notification of Appointment Modification
- S15 - Notification of Appointment Cancellation
- S17 - Notification of Appointment Deletion
- S26 - Notification That Patient Did Not Show Up for Scheduled Appointment

C: Appointment Notification [RAD-48] conversely has the RIS notifying the HIS

- S12 - Notification of New Appointment Booking
- S13 - Notification of appointment rescheduling
- S15 - Notification of Appointment Cancellation

Q. Should the profile specify creating orders?

A. If the EMR wants an order, it can choose to create one internally.

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Orders aren't necessary for the profile to work. If the EMR depends on orders for something (like managing internal data indexing or billing) it is welcome to create orders based on the information provided to it as its choice, not something driven by the modality or the Encounter Manager.

The encounter manager will create an accession number so the images are populated with it, and that accession number is communicated to the Result Aggregator which is assumed to be part of the EMR or a proxy for the EMR. The EMR can then use the accession number to populate an order if it wants to create one and the main linking IDs are aligned just like in ordered images.

Note, sometimes there are other results in a single encounter that need to be linked (not just an image, but an image with other reports or data, progress notes, op note, etc.). If the EMR is creating orders it might create multiple orders for those and thus shoot itself in the foot?

Importantly, PoC docs don't like anything slowing down patient care. They dislike the implication that a physician authorized this in advance. If accession number is not inherently an order, it might be OK.

For radiology, Billing/workflow wise, order is used to gate processing since you don't get paid for orderable studies unless there actually is an order.

Q. How should the EMR/Result Aggregator be notified of new imaging content?

A. ORU-R30

EMRs are used to getting this kind of messages about new "results".

N.B. for ordered results, the metadata might often be just enough to match the result to the order and take the rest of the details from that order. Since the encounter case likely doesn't have an initiating order for these results, the message needs to include adequate metadata to properly link into the patient records and for the EMR to construct a proxy order if it needs to.

- patient, date, SUID, which department, anatomy, procedure name guidelines
- thumbnails are really nice
- If the metadata becomes too extensive, might just notify the EMR of the new objects and let it inspect them if it wants extensive metadata rather than try to replicate the full header in the ORU

Rejected Alternatives:

MDM (newer ORU with attachments) not selected because ORU is more widely supported and we don't need to ship the images as attachments. MDM-T01 uses TXA segment.

CARD-14 does this from the Archive to the EMR, sending Study UID, a URI and the Filler/Placer Order # and Universal Service ID (in OBR-4)) but CARD IEO does not mention accession number.

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The IRWF.b approach of Automated Order Placement was deemed too heavy-weight and too order centric. That made sense for IRWF where there was generally an ordered read, but that doesn't apply to most encounter-based imaging. Request Filling of Order [RAD-78] was an OMI msg and ORI response from OF. DICOM Instance Availability Notification service [RAD-49] likely not supported by EMR. Filler Order Management (New Order) [RAD-3] or Procedure Scheduled [RAD-4] are again too order centric. Appointment Notification [RAD-48] conversely has the RIS notifying the HIS using SIU S12, S13, S15
Q. Which actor should notify the EMR/Result Aggregator of new encounter-based results? A. Image Manager The Image Manager could do it automatically when the images are stored. RAD-Y3 could be populated based on the header of RAD-Y2. The operator knows when the encounter is over and could also signal when studies within the encounter or series within the study are over, but don't want to burden them. The modality knows when data has been captured, the image manager knows when data has been stored, the encounter manager knows when the encounter is over if the operator tells it.

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General Introduction

Update the following Appendices to the General Introduction as indicated below. Note that these are not appendices to Volume 1.

Appendix A – Actor Summary Definitions

Add the following actors to the IHE Technical Frameworks General Introduction list of actors:

Actor	Definition
Encounter Manager	Coordinates encounters (between a care provider and a patient) and associated data. E.g., a practice management system.
Result Aggregator	Aggregates information about clinical results to facilitate practitioners finding and accessing them. Often a component of an EMR.

Appendix B – Transaction Summary Definitions

Add the following transactions to the IHE Technical Frameworks General Introduction list of transactions:

Transaction	Definition
Get Encounter Imaging Context [RAD-Y1]	Obtain contextual metadata, such as patient demographics and encounter details, for encounter(s) during which imaging procedure(s) may take place.
Store Encounter Images [RAD-Y2]	Send images that were acquired in the course of a patient encounter (in contrast to those acquired for an ordered procedure).
Notify Encounter Imaging Results [RAD-Y3]	Notify a data management system (e.g., EMR) that images (typically newly acquired in the course of a patient encounter) are available to the patient record.

Glossary

Add the following glossary terms to the IHE Technical Frameworks General Introduction Glossary:

Glossary Term	Definition
Encounter-based Imaging	The capture of medical images and associated data in the context of a patient encounter, such as an office visit. This is in contrast to Order-Based Imaging where imaging is captured in the context of an ordered procedure. Patient encounters can involve a patient going to a physician location, or a physician going to a patient location. Appointments are anticipated encounters.

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Volume 1 – Profiles

Add a new profile section

X Encounter-Based Imaging Workflow (EBIW) Profile

Increasingly medical imaging is done outside the context of an ordered procedure. The primary goal of the EBIW Profile is to ensure that images acquired in the context of a patient encounter are combined with the corresponding metadata about the patient, the encounter, and the performed imaging procedure. This facilitates managing the imaging data, linking it into the patient medical record, and accessing it later in ways analogous to those for order-based imaging as coordinated by the Scheduled Workflow (SWF.b) Profile.

This Encounter-Based Imaging Workflow Profile specifies how to capture appropriate context, populate relevant indexing fields, link to related data, and ensure the images are accessible and well-knit into the medical record.

When such acquisition solutions are not integrated, complete and consistent, the efficiency and quality of care is negatively affected:

- Time is lost to lack of automation and awkward workflow
- Images are absent from the EMR, or are lumped together on the EMR in a single "container" without easy ways to differentiate and navigate them
- The medical imaging record is "siloed" across many department systems
- Images are placed in a paper record or scanned into the EMR without the metadata needed to readily locate and access them again when needed
- Images are not available to the Care Team
- Data sharing with affiliated hospitals is limited or non-existent

The EBIW Profile follows the pattern of SWF.b: Establish encounter/patient/context, convey metadata, capture/store image data, index/archive images, find/access images, analyze/use images. Encounter-based imaging should get the same end result as if the clinician placed the order.

X.1 EBIW Actors, Transactions, and Content Modules

This section defines the actors, transactions, and/or content modules in this profile. General definitions of actors are given in the Technical Frameworks General Introduction Appendix A at http://ihe.net/Technical_Frameworks/#GenIntro.

Figure X.1-1 shows the actors directly involved in the EBIW Profile and the relevant transactions between them. If needed for context, other actors that may be indirectly involved

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due to their participation in other related profiles are shown in dotted lines. Actors which have a mandatory grouping are shown in conjoined boxes.

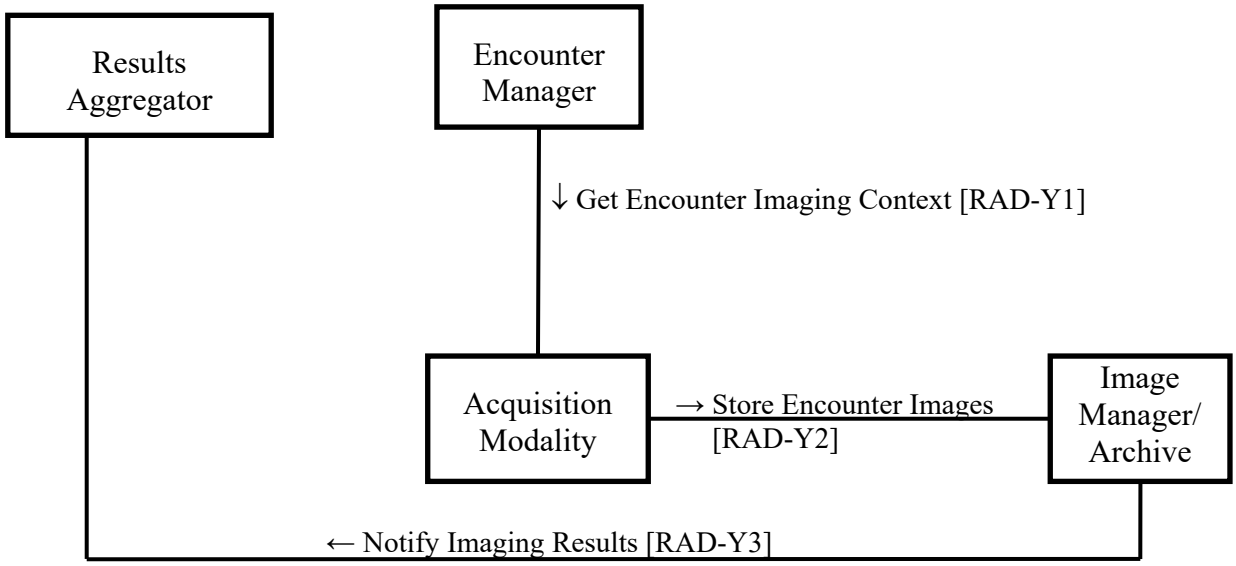

Figure X.1-1: EBIW Actor Diagram

Table X.1-1 lists the transactions for each actor directly involved in the EBIW Profile. To claim compliance with this profile, an actor shall support all required transactions (labeled "R") and may support the optional transactions (labeled "O").

Table X.1-1: EBIW Profile - Actors and Transactions

Actors	Transactions	Optionality	Reference
Encounter Manager	Get Encounter Imaging Context [RAD-Y1]	R	RAD TF-3: 4.Y1
Acquisition Modality	Get Encounter Imaging Context [RAD-Y1]	R	RAD TF-3: 4.Y1
	Store Encounter Images [RAD-Y2]	R	RAD TF-3: 4.Y2
Image Manager/ Archive	Store Encounter Images [RAD-Y2]	R	RAD TF-3: 4.Y2
	Notify Encounter Imaging Results [RAD-Y3]	R	RAD TF-3: 4.Y3
Result Aggregator	Notify Encounter Imaging Results [RAD-Y3]	R	RAD TF-3: 4.Y3

X.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.

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X.1.1.1 Encounter Manager

The Encounter Manager manages and provides encounter metadata and marshaled patient demographics.

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

X.1.1.2 Acquisition Modality

The Acquisition Modality assembles acquired pixels with worklist metadata and perhaps operator input. The Acquisition 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 Acquisition Modality product and are outside the scope of this profile.

The Acquisition Modality may also store non-image IODs. Such evidence documents will share an Accession Number with associated images and be stored in the same DICOM Study.

X.1.1.3 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.

X.2 EBIW Actor Options

Options that may be selected for each actor in this profile, if any, are listed in the Table X.2-1. Dependencies between options when applicable are specified in notes.

Table X.2-1: Encounter-Based Imaging Workflow - Actors and Options

Actor	Option Name	Reference
Encounter Manager	No options defined	--
Acquisition Modality	No options defined	--
Image Manager/Archive	No options defined	--
Result Aggregator	No options defined	--

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X.3 EBIW Required Actor Groupings

An actor from this profile (Column 1) shall implement all of the required transactions and/or content modules in this profile ***in addition to*** all of the transactions required for the grouped actor (Column 2).

If this is a content profile, and actors from this profile are grouped with actors from a workflow or transport profile, the Content Bindings Reference column references any specifications for mapping data from the content module into data elements from the workflow or transport transactions.

In some cases, required groupings are defined as at least one of an enumerated set of possible actors; this is designated by merging column one into a single cell spanning multiple potential grouped actors. Notes are used to highlight this situation.

Section X.5 describes some optional groupings that may be of interest for security considerations and Section X.6 describes some optional groupings in other related profiles.

Table X.3-1: Encounter-Based Imaging Workflow - Required Actor Groupings

EBIW Actor	Actor to be grouped with	Reference	Content Bindings Reference
Encounter Manager	ITI CT / Time Client	ITI TF-1: 7	--
Acquisition Modality	ITI CT / Time Client	ITI TF-1: 7	--
Image Manager/Archive	None	--	--
Result Aggregator	ITI CT / Time Client	ITI TF-1: 7	--

X.4 EBIW Overview

X.4.1 Concepts

The primary goal of the EBIW Profile is to ensure that images acquired in the context of a patient encounter are combined with the corresponding metadata about the patient, the encounter, and the performed imaging procedure. This facilitates managing the imaging data, linking it into the patient medical record, and accessing it later in ways analogous to those for order-based imaging as coordinated by the Scheduled Workflow (SWF.b) Profile.

X.4.1.1 Encounter Information Model

The information model diagram (See Figure X.4.1.1-1) for relates operational entities (a Patient has Visits to a facility which may include Encounters with clinicians which may result in performed Imaging Procedures) to DICOM entities (a Patient has Studies which contain Series which contain image Instances) and to other documents.

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Each entity has a primary identifier (shown in regular text) for instances of that entity, and sometimes references (shown in italics) to other identifiers that provide links to related entities.

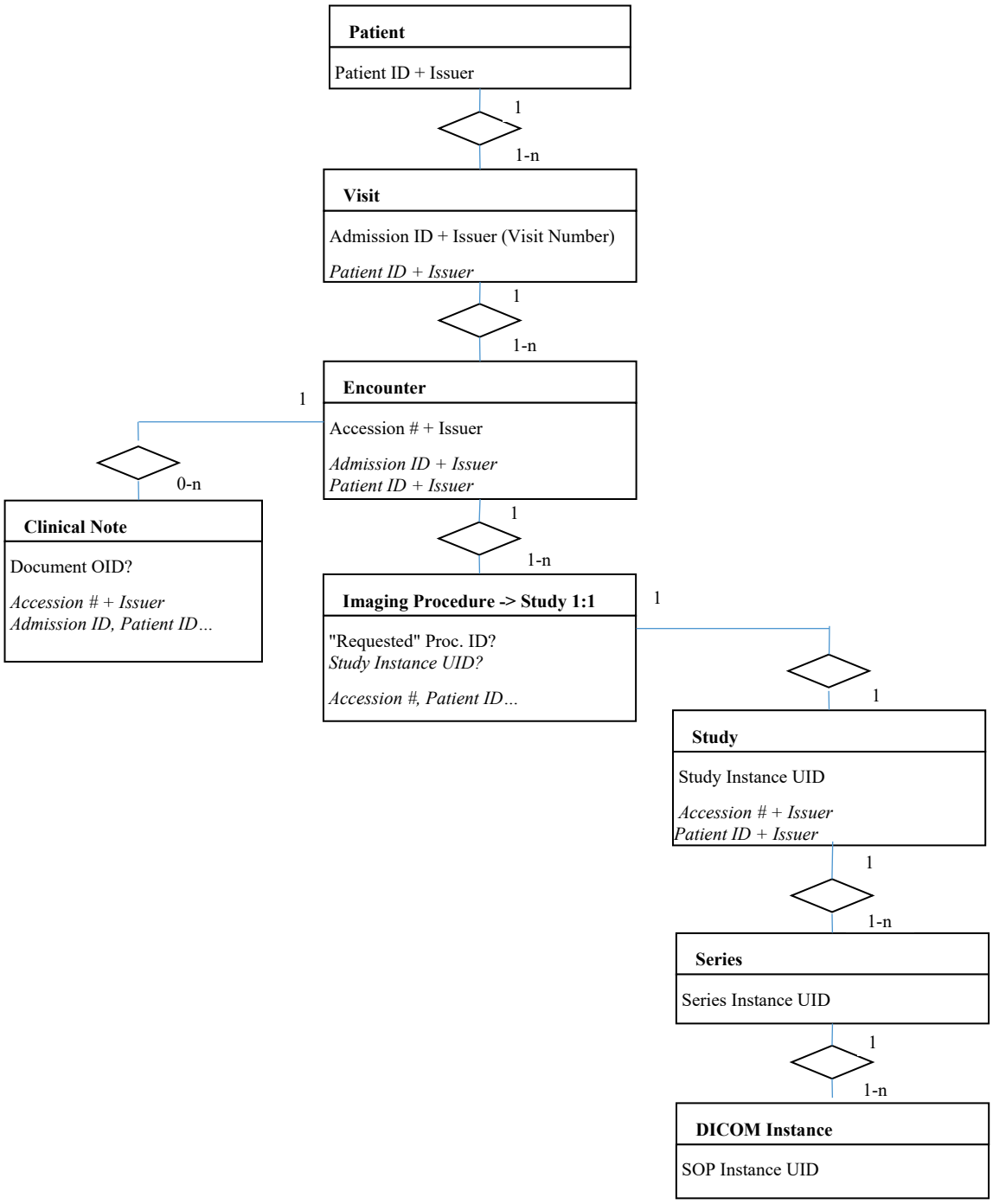

Figure X.4.1.1-1: Encounter-Based Imaging Information Model

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An Encounter is part of a Visit associated with a particular department or practitioner.

An Encounter may have multiple Imaging Procedures and thus there may be multiple Studies associated with an encounter, although typically it will only be one, possibly with multiple Series. Current encounter-based imaging devices are sometimes prolific about spawning multiple Studies when they could be a single Study with multiple Series. Some PACS compensate for such behavior by auto-merging Studies with the same Accession Number.

Per the DICOM data model, a Series does not contain images belonging to more than one performed Imaging Procedure.

In principle a Study could span multiple encounters, however this is uncommon and this profile does not address coordinating the Study Instance UID and Accession Number for re-use during the subsequent imaging.

It is often left up to the operator to indicate to the device when to make a new Study within an encounter. For Encounters that image multiple body parts, imaging of each body part should generally be in separate Series to allow proper population of the Body Part Examined.

Note that some or all of the images acquired during an Encounter might not be persistently stored (i.e., to PACS) if the acquiring physician judges them to be not clinically significant/relevant. There is often a selection step between acquisition and storage.

The diagram shows a Clinical Note to represent other Encounter documentation with which images might be associated such as visit notes, operative procedure notes, office notes, nursing notes, treatment reports, procedure reports, or discharge notes.

For many encounter-based images, there will not necessarily be an associated diagnostic report. Sometimes there will be reports that refer to images acquired over multiple encounters.

The Service Episode, and corresponding Service Episode ID in the DICOM Visit Identification Sequence, are not included in the information model. A Service Episode encompasses multiple Visits and as such is "larger" than a Visit, not "smaller" so it does not correspond to the Encounter entity in this profile. Service Episodes were intended to model the illness onset/treatment cycle which is not significantly relevant to the finer grained encounter-based imaging workflow.

X.4.1.2 Accession Numbers

The accession number has become the primary index for managing an imaging study in the electronic medical record. It also serves a key role in linking images with associated reports and other documents. This profile preserves this role of accession number in the context of encounter-based imaging.

Accession numbers are generated by departmental information systems, such as the RIS, for use by the modalities, PACS, reporting systems, HIS and EMR systems, and cross-enterprise image sharing infrastructure. For order-based imaging, the accession number is associated with the order that provided the context for, and often initiated, the order-based imaging procedure. For

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encounter-based imaging, the accession number is associated with the encounter that provided the context for, and initiated, the imaging procedure.

In both order-based and encounter-based imaging, an accession number may span multiple imaging procedures related to the same order or encounter. Sites may choose to use procedures that are "fine-grained" (several procedures sharing an accession number) or "coarse-grained" (one procedure per accession number) in orders and encounters.

X.4.1.3 Orders

Placing an order for an encounter-based imaging procedure is generally not necessary and in some cases would be disruptive to clinical care activities. That being said, some EMRs are dependent on having an order with which to associate imaging procedures.

The profile does not require the Result Aggregator (likely grouped with an EMR) to create an order and the profile is not dependent on such an order. The profile does try to ensure that the necessary details have been provided via the Notify Encounter Imaging Results [RAD-Y3] transaction so that the EMR can create such an order if it wishes. Some EMRs use such orders as a substitute tracker for an encounter and/or for billing purposes.

X.4.1.4 Obtaining Patient Metadata

The Encounter Manager is responsible for obtaining relevant patient metadata which it provides to the encounter-based imaging modality. Appendix Z describes HL7 v2.5.1 message segments and fields from which key details can be obtained, but this profile does not mandate support for any specific set of HL7 messages containing those segments. Several IHE profiles are worth considering.

The Encounter Manager could group with a Patient Demographics Consumer in the IHE Patient Administration Management (PAM) Profile to receive a feed of patient demographics for all patients in the facility. The Patient Identity Management [ITI-30] profiles 6 HL7 ADT messages, although depending on the option selected the actor only needs to implement 4 or 5 of them. Implementers of the PAM Profile are advised to pay close attention to the additional regional requirements described in ITI TF-4 for National Extensions. Note that the Encounter Manager could alternatively group with a Patient Encounter Consumer (see Section X.4.1.4) since [ITI-31] also contains patient demographics.

The Encounter Manager could group with a Patient Demographics Consumer in the IHE Patient Demographics Query (PDQ) Profile to get patient demographics on demand. The Patient Demographics Query [ITI-21] transaction provides at least basic name, MRN, sex, DOB and address information. The Patient Demographics and Visit Query [ITI-22] additionally provides a variety of PV1 fields identifying the visit number, care team members, hospital service, patient location and admission type.

The Encounter Manager could group with a Patient Demographics Consumer in the IHE Patient Demographics Query v3 (PDQv3) Profile to get patient demographics on demand. The Patient

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Demographics Query HL7 v3 [ITI-47] transaction provides a few more details and handles MRN assigning authorities (Issuer of Patient ID).

The Encounter Manager could group with a Patient Demographics Consumer in the IHE Patient Demographics Query for Mobile (PDQm) Profile to get patient demographics on demand. The Mobile Patient Demographics Query [ITI-78] transaction provides the same details as PDQv3 using RESTful services.

If the Encounter Manager is grouped with the active Patient Demographics Supplier in any of the above profiles that would give it access to the information internally.

It is also possible that an Encounter Manager exists as a component of the EHR and thus has direct internal access to the required patient records even if the EHR has not implemented any demographics related profiles.

X.4.1.5 Obtaining Encounter Metadata

The Encounter Manager is also responsible for obtaining relevant encounter metadata which it provides to the encounter-based imaging modality. Appendix Z describes HL7 v2.5.1 message segments and fields from which key details can be obtained, but this profile does not mandate support for any specific set of HL7 messages containing those segments. Several IHE profiles are worth considering.

The Encounter Manager could group with a Patient Encounter Consumer in the IHE Patient Administration Management (PAM) Profile to receive a feed of encounter details for all patients in the facility. The Patient Encounter Management [ITI-31] transaction profiles 25 HL7 ADT messages, although an implementation that only needs admit/discharge information only needs to implement 5 of them, while an implementation that needs notification of pending changes to the patient location, visit status and care team would implement 17 of them. Note that [ITI-31] provides patient data in addition to encounter data.

The Encounter Manager could group with a Patient Demographics Consumer in the IHE Patient Demographics Query (PDQ) Profile to get some encounter details on demand. The Patient Demographics and Visit Query [ITI-22] provides a variety of PV1 fields identifying the visit number, care team members, hospital service, patient location and admission type (in addition to patient demographics information).

If the Encounter Manager is grouped with the active patient information Supplier in any of the above profiles that would give it access to the information internally.

It is also possible that an Encounter Manager exists as a component of the EHR and thus has direct internal access to the required visit and encounter records.

The Encounter Manager could be a recipient of HL7 SIU transactions (such as those profiled for eye care appointments in the Appointment Scheduling Management [EYECARE-16] transaction) to get appointment details for encounters and associated metadata.

Finally, it is possible that the Encounter Manager manages encounter scheduling independent of the EHR and can create appropriate values for the required fields itself.

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X.4.1.6 Consumption of Encounter-Based Images

Encounter-based images that have been stored may be sought out and accessed for a variety of reasons including:

- To view images referenced in an encounter note or report
- To compare current images to the corresponding priors when a physician is evaluating a condition such as a mole, wound, or burn.
- To access encounter-based images as relevant priors or clinical context when reading order-based images to generate a report
- To explain clinical progress/situation to a patient
- To consult with a specialist on recently acquired images
- To support medico-legal proceedings
- To support billing

Key metadata for finding relevant images, considering the above reasons, includes:

- Accession Number
- Admission ID
- Acquisition Datetime (Study datetime, Series datetime)
- Body Part Examined, Anatomical Region, Primary Anatomical Structure
- Clinical Specialty (dermatology, burn care, wound care)
- Location of Acquisition (room, department, facility, institution)
- Operator, Performing Physician, and/or Attending Physician
- Modality type
- Procedure Type, Performed Procedure Code
    - (Although "bedside ultrasound" may be inadequate when browsing imaging records and better/finer grained codes would be useful. We can lead the horse to water…)
- Purpose/reason for requested procedure (code and text), Study description , Series description

The metadata that is useful for finding relevant images may also be useful for ranking relevancy or for grouping and presenting images (e.g., handing protocols or layouts).

It may be useful to organize images into categories that are used/managed differently or to which different policies (e.g., retention) apply. See also the Roth Whitepaper:

- Procedure documentation

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- Observation evidence
- Diagnostic images

X.4.1.7 Codesets

Being able to manage and find relevant encounter-based images depends significantly on the consistent use of appropriate codesets for things like procedure codes, anatomy/body part and reason for imaging. This profile does not mandate the use of particular codesets but makes the following recommendations.

The Radlex Playbook set of procedure codes from LOINC are worth investigating for ultrasound.

DICOM provides several good anatomy codesets in PS3.16. CID 4 Anatomic Region is a good place to start since it in turn references several sub-codesets. New codes are being added to better support dermatological conventions for anatomical site coding.

Point-of-Care Ultrasound systems should consider the following code list for populating Reason for Performed Procedure Code Sequence (0040,1012).

Table X.4.1.7-1: Point-of-Care Ultrasound Procedure Reasons

Coding Scheme Designator	Code Value	Code Meaning
99IHE	xxxxx1	Check State of Bladder
99IHE	xxxxx2	Evaluate Breast Lump
99IHE	xxxxx3	Confirm Placement of Needle
99IHE	xxxxx4	Confirm Placement of Line (Arterial, central venous)
99IHE	xxxxx5	Confirm Placement of PICC Line
99IHE	xxxxx6	Localize/Evaluate Fluid
99IHE	xxxxx7	Guide Fluid Collection
99IHE	xxxxx8	Guide Placement of Needle/Catheter
99IHE	xxxxx9	Guide Procedure
99IHE	xxxx10	Collect Procedural Evidence
99IHE	xxxx11	Evaluate Cardiac Function
99IHE	xxxx12	FAST (Focused Assessment with Sonography in Trauma) (See http://pubs.rsna.org/doi/full/10.1148/radiol.2017160107)

X.4.2 Use Cases

Encounter-based imaging can be found in a variety of clinical contexts. This profile is specifically considering the following:

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- Point of Care Ultrasound
- Dermatology
- Wound Care/Management
- Infectious Diseases
- Burn Care
- Plastic Surgery
- Nursing/Clinic Photography

Goals:

- Easily identify the type of imaging performed and the anatomical region through an EHR imaging description
- Associate report or note describing the visit where the images were obtained with images in enterprise viewer

X.4.2.1 Use Case #1: Point of Care Ultrasound

Images are captured at the point-of-care using a DICOM-capable ultrasound modality device. The workflow is typically "order-less" in that it is not driven by an order from a referring physician.

X.4.2.1.1 Point of Care Ultrasound Use Case Description

The Point of Care Ultrasound Use Case is intended to generalize and cover the following scenarios:

- Inpatient Status Check
  - A registered inpatient is in their bed in a ward
  - The care provider (nurse, tech, clinician) performs an ultrasound to determine the state of the bladder (empty, partial, full), or to confirm placement of a needle or a PICC line (peripherally inserted central catheter)
  - Although the image is typically evidentiary or for simple assessment rather than "diagnostic", it might still be referred to a radiologist if potential anomalies are observed.
- Emergency Room Evaluation
  - A patient presents in the Emergency Room and is registered with an ER designation (between in-patient and out-patient)
  - The ER physician captures ultrasound images as part of their evaluation of the patient:

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        - to diagnose, detect or confirm a disorder or disease state such as internal bleeding, soft tissue infection, pulmonary edema, pericardial effusion, deep venous thrombosis, gallstones, residual urine in the bladder or subcutaneous abscesses
        - to localize fluid and evaluate the amount present
    - When such imaging is diagnostic, it may be "interpreted locally" rather than in a subsequent reading step by a radiologist.
- Procedure Guidance
    - A patient (either inpatient or outpatient) requires a procedure such as a biopsy, venous catheter placement, paracentesis or thoracentesis.
    - The care provider performs ultrasound to guide the procedure by visualization of the procedure device (needle, catheter, etc.) in relation to the relevant anatomy (tumor, blood vessel, abscess, etc.)
    - The ultrasound imaging may be kept as procedural evidence.
- Outpatient Supplemental Information
    - A patient makes scheduled visit to a specialist and is registered as an outpatient.
    - The specialist is consulting on an identified condition, such as a breast surgeon evaluating an abnormal lump detected by the patient's primary care physician.
    - The specialist decides to take ultrasound images to evaluate/characterize the condition or to document the absence of the suspected condition.
    - The findings from the imaging would be included in the specialists report.

An important aspect of this use case is that the imaging procedure is not ordered. There may be no need for an order for the imaging and due to the ad hoc nature of the decision to use imaging manually placing an order could interrupt the flow of care.

The Process Flow below shows the Acquisition Modality getting the encounter imaging context prior to the acquisition of images. In principle, the Acquisition Modality just needs to get the context prior to storing the images to the Image Manager, so it could acquire the images and then get the context to compose the DICOM instances for storage. The diagram also shows the Encounter Manager grouped with a Patient Encounter Consumer which is just one of several ways to obtain patient and encounter metadata (see Sections X.4.1.4 and X.4.1.5) and is not formally part of the EBIW Profile.

X.4.2.1.2 Point of Care Ultrasound Process Flow

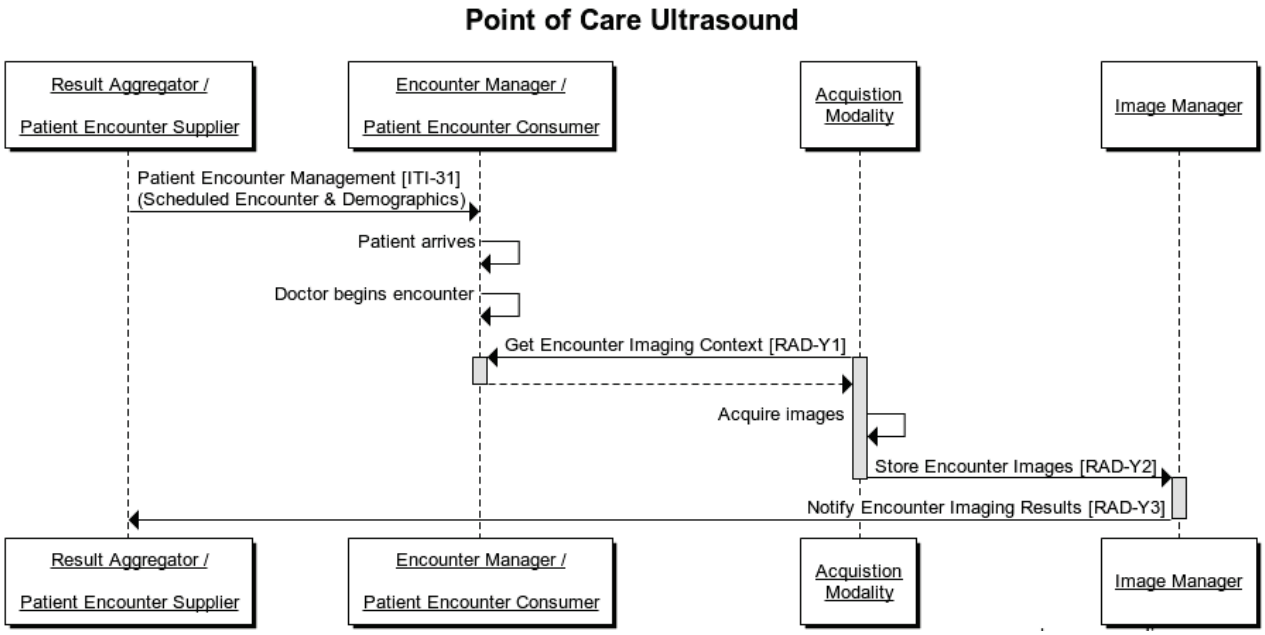

Figure X.4.2.1.2-1: Point of Care Ultrasound Process Flow in EBIW Profile

The text in Figure X.4.2.1.2-2 was used to generate the diagram in Figure X.4.2.1.2-1. Readers will generally find the diagram more informative. The text is included here to facilitate editing.

```
title Point of Care Ultrasound

participant Result Aggregator /\n\nPatient Encounter Supplier as RA
participant Encounter Manager /\n\nPatient Encounter Consumer as EM
participant Acquisition\nModality as Modality

RA->EM: Patient Encounter Management [ITI-31]\n(Scheduled Encounter & Demographics)
EM->EM: Patient arrives
EM->EM: Doctor begins encounter
Modality->+EM: Get Encounter Imaging Context [RAD-Y1]
activate Modality
EM-->-Modality:
Modality->Modality: Acquire images
Modality->-Image Manager: Store Encounter Images [RAD-Y2]
activate Image Manager
Image Manager->-RA: Notify Encounter Imaging Results [RAD-Y3]
```

Figure X.4.2.1.2-2: Diagram Pseudocode for Point of Care Ultrasound Process Flow

X.5 EBIW Security Considerations

Refer to RAD TF-1: Appendix F Security Environment Considerations.

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Personal Healthcare Information (PHI) is present in the context query response, the stored images and the notification message.

X.5.1 Security Considerations for Actors

All actors in the EBIW Profile should consider grouping with a Secure Application or Secure Node Actor in the ITI Audit Trail and Node Authentication (ATNA) Profile.

This profile strongly recommends implementation of the ATNA Record Audit Event [ITI-20] transaction to record when and where encounter-based imaging is distributed.

The ATNA Profile also requires that all actors implement the Authenticate Node [ITI-19] transaction to further ensure the integrity of transactions. Implementers are advised to take advantage of the authentication and communication encryption capabilities that Authenticate Node [ITI-19] provides between Secure Nodes and to take advantage of TLS when communicating over the Internet or other environments where the communications might be vulnerable to cybersecurity attacks.

Modalities used for encounter-based imaging are often mobile and used by a variety of users in a variety of settings over the course of a day. This raises challenges with authenticating the operator, and with the Acquisition Modality being exposed to people who are not authorized to use it or access the information it contains. The Acquisition Modality will need to implement access control mechanisms consistent with the organization's policies, e.g., which care team members and non-members are permitted to view images, etc.

The Image Manager/Archive is expected to often be the same as that used for order-based imaging. The security considerations are similar for both cases.

X.5.2 Security Considerations for Encounter-based Images

Images contain personal demographic information and clinical information.

X.6 EBIW Cross Profile Considerations

Table X.6-1 describes various actors in various other profiles that might be useful to group with EBIW Profile actors.

Table X.6-1: Encounter-Based Imaging Workflow - Optional Actor Groupings

EBIW Actor	Might group with	Potential Purpose
Encounter Manager	SWF.b Order Filler	To manage both order-based and encounter-based imaging, and potentially leverage existing support for handling patient demographics and providing modality worklist.
	PDQ/PDQv3/ PDQm Patient Demographics Consumer	To query for patient demographics that could populate the encounter-based imaging context.

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EBIW Actor	Might group with	Potential Purpose
	PAM Patient Demographics Consumer	To receive a feed of patient demographics that could populate the encounter-based imaging context.
	PAM Patient Encounter Consumer	To receive a feed of encounter details that could populate the encounter-based imaging context.
	SOLE Event Reporter	To capture timestamps of encounter-based imaging activity for departmental analytics.
	ATNA Secure Node	To establish secure connections to the Acquisition Modality and ADT, and to log security related events.
	IRWF.b Importer	To import prior images on media that a patient has brought to an encounter.
Acquisition Modality	SWF.b Acquisition Modality	To support both order-based and encounter-based imaging.
	PDI Portable Media Creator	To export encounter-based images on media.
	SOLE Event Reporter	To capture timestamps of encounter-based imaging activity for departmental analytics.
	ATNA Secure Node	To establish secure connections to the Encounter Manager and Image Manager/Archive, and to log security related events.
Result Aggregator	BIR Image Display	To present to clinicians for review encounter-based images it has indexed.
	IID Image Display Invoker	To launch a viewer for clinicians to review encounter-based images it has indexed.

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Volume 3 – Transactions

Add new transaction 4.Y1

4.Y1 Get Encounter Imaging Context [RAD-Y1]

4.Y1.1 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.

4.Y1.2 Actor Roles

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

Table 4.Y1.2-1 Actor Roles

Role:	Requester: Requests contextual metadata for an encounter-based imaging acquisition.
Actor(s):	The following actors may play the role of Requester: Acquisition 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.Y1.3 Referenced Standards

DICOM PS3.4: Modality Worklist SOP Class

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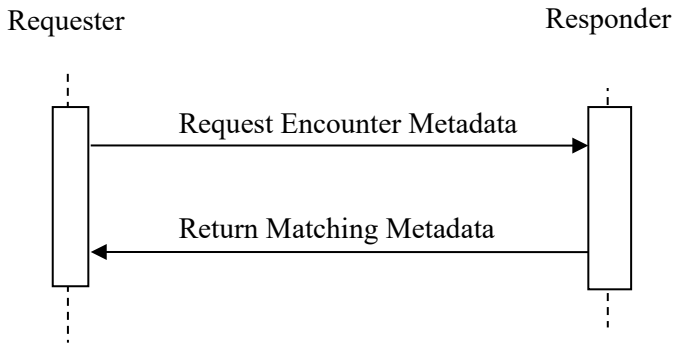
4.Y1.4 Interaction Diagram



4.Y1.4.1 Request Encounter Metadata

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.Y1.4.1.1 Trigger Events

A user or an automated function on the Requester needs to obtain information 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 may need to be configurable to support such variations in automatic queries.

4.Y1.4.1.2 Message Semantics

The message is a DICOM C-FIND request of the DICOM Modality Worklist SOP Class. The Requester is the SCU, and the Responder is the SCP.

The Requester shall support the required SCU query keys listed in Table 4.Y1.4.1.2-2.

Table 4.Y1.4.1.2-2 summarizes the matching key requirements and lists the optional and required attributes that may be requested by the SCU (Requester) and shall be returned by the SCP (Responder). Requirements indicated with R+ or R+* highlight the requirements added by the IHE Technical Framework. See RAD TF-2: 2.2 for more information. All display

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requirements are an addition to the DICOM Standard requirements for the Modality Worklist SOP Class.

Specific attributes (return keys) in these requirements support compliance with requirements in [RAD-Y2]. See Appendix Z for the correspondence. Additional attributes that are not used to populate objects may be queried for use on the Requester (e.g., attributes displayed to the operator).

The Requester shall include the Scheduled Station AE Title (0040,0001) as a Matching Key populated with its own AE Title so the Responder can return the same value in the query response.

The Requester shall include the Modality (0008,0060) as Matching Key populated with its own modality so the Responder can return the same value in the query response.

Table 4.Y1.4.1.2-1: 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	R
Ethnic Group	(0010,2160)	O	O	O	O
Patient Medical					
Pregnancy Status	(0010,21C0)	O	O	O	R
Contrast Allergies	(0010,2110)	O	O	O	R
Patient's Weight	(0010,1030)	O	O	O	R
Patient's Size	(0010,1020)	O	O	O	R
Encounter Metadata					
Visit Identification					
Institution Name	(0008,0080)	O	R+	O	R+
Institution Code Sequence	(0008,0082)	O	O	O	R+
Institution Address	(0008,0081)	O	O	O	R+
Institutional Department Name	(0008,1040)	R+	R+	R+	R+
Institutional Department Code Sequence	(xxxx,yyyy)	R+	R+	R+	R+
Admission ID	(0038,0010)	R+	R+	R+	R

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Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
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(s) for Visit	(xxxx,yyyy)	O	O	O	R+
Reason(s) for Visit Code Sequence	(xxxx,yyyy)	O	O	O	R+
Consulting Physician's Name	(0008,009C)	O	O	O	O
Consulting Physician Identification Sequence	(0008,009D)	O	O	O	O
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	R
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	R+	R [IHE-5]
Requested Procedure Code Sequence	(0032,1064)	O	O	R+	R [IHE-5]
>Code Value	(0008,0100)	O	O	R+*	R
>Coding Scheme Version	(0008,0103)	O	O	O	O
>Coding Scheme Designator	(0008,0102)	O	O	R+*	R
>Code Meaning	(0008,0104)	O	O	R+	R+
Requested Procedure ID	(0040,1001)	O [IHE-4]	O [IHE-4]	R+	R
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]

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Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
>Scheduled Station AE Title	(0040,0001)	R+	R	R+*	R
>Scheduled Procedure Step Start Date	(0040,0002)	R+	R	R+	R
>Scheduled Procedure Step Start Time	(0040,0003)	O	R	R+	R
>Scheduled Procedure Step Location	(0040,0011)	O	R+	O	R+
>Modality	(0008,0060)	R+	R	R+	R
>Scheduled Performing Physician's Name	(0040,0006)	O	R	O	R
>Scheduled Procedure Step ID	(0040,0009)	O	O	R+*	R
>Scheduled Protocol Code Sequence	(0040,0008)				
>>Code Value	(0008,0100)	O	O	R+*	R
>>Coding Scheme Version	(0008,0103)	O	O	O	O
>>Coding Scheme Designator	(0008,0102)	O	O	R+*	R
>>Code Meaning	(0008,0104)	O	O	R+	R+
>Scheduled Procedure Step Description	(0040,0007)	O	O	R+	R

[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 Requested Procedure ID and Accession Number attributes 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.

4.Y1.4.1.2.1 Example Matching Key Usage

Due to the variety of encounter contexts, one can expect a variety of query patterns using the matching keys.

- Wristband-driven Query

  Patients often have an identification wristband with a barcode or RFID that a reader connected to the Acquisition Modality could scan. Typically the value returned is either a value for Patient ID (0010,0020) or Admission ID (0038,0010) that could be matched. The Acquisition Modality may need to be configured to know which attribute is coded on

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the wristbands at its institution and may need to be configured with the value for the local Issuer of Patient ID (0010,0021) or Issuer of Admission ID (0038,0014). Wristbands often also have the Patient Name printed in text, although that would have to be entered on the modality console by the operator.

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

- Query by Department

Using Institutional Department Name (0008,1040) or the Institutional Department Code Sequence (xxxx,yyyy), the Acquisition Modality can query for all patient encounters planned for this clinical unit. The Acquisition Modality 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 Acquisition Modality 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.

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

- Query by Room/Location

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

- Query by Operator

By including Scheduled Performing Physician's Name (0040,0006) in the query, the Acquisition Modality 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.

4.Y1.4.1.3 Expected Actions

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 which 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.

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

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Responder still includes an item in the Scheduled Procedure Step Sequence (0040,0100) even though the encounter-based imaging procedure may not have been specifically scheduled.

If Scheduled Station AE Title (0040,0001) is present in the request as a Matching Key, the Responder shall return that same value as a Return Key in the response.

If Modality (0008,0060) is present in the request as a Matching Key, the Responder shall return that same value as a Return Key in the response.

If worklist entry 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.

The Responder is required to return a value (Type 1 or 1C) if asked for Scheduled Procedure Step Description (0040,0007) and for one of Requested Procedure Description (0032,1060) and Requested Procedure Code Sequence (0032,1064). The Responder may provide a description of the planned procedure or next imaging step if known, but since a specific imaging procedure may not have been scheduled, the Responder is permitted to provide a generic code or description such as "Perform Imaging".

4.Y1.4.2 Return Encounter Metadata

The Responder sends matching worklist entries back to the Requester.

4.Y1.4.2.1 Trigger Events

The Responder receives a Request Encounter Metadata Message.

4.Y1.4.2.2 Message Semantics

The message is a DICOM C-FIND response of the DICOM Modality Worklist SOP Class. The Requester is the SCU, and the Responder is the SCP.

The Responder shall support the matching and return keys as shown for the SCP in Table 4.Y1.4.1.2-2.

The primary purpose of this message is to convey details, such as the patient demographics and encounter metadata, to the point of care where it can be properly associated with acquired data. The Responder is not necessarily the definitive source of those details, but may have obtained them via other transactions. Populating the C-FIND responses may include transcoding the metadata from HL7 fields into DICOM attributes.

Appendix Z provides guidance on the origin and mappings of the attributes returned in an MWL response.

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It is the responsibility of the Responder to ensure that the patient and encounter information is current in the Modality Worklist response. For a list of some potential methods to obtain such information, see RAD TF-1: X.4.1.4 and X.4.1.5.

4.Y1.4.2.3 Expected Actions

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.

4.Y1.5 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.Y1.5.1 Security Audit Considerations

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

4.Y2 Store Encounter Images [RAD-Y2]

4.Y2.1 Scope

This transaction is used to send images that were acquired in the course of a patient encounter (i.e., not as an ordered imaging procedure).

This transaction is analogous to the Modality Images Stored [RAD-8] transaction that is used in the context of order-based imaging procedures.

4.Y2.2 Actor Roles

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

Table 4.Y2.2-1 Actor Roles

Role:	Sender: Sends encounter-based imaging data.
Actor(s):	The following actors may play the role of Sender: Acquisition Modality
Role:	Receiver: Receives and stores imaging data.

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Actor(s):	The following actors may play the role of Responder: Image Manager/Archive

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.Y2.3 Referenced Standards

DICOM PS3.4: Storage Service Class.

4.Y2.4 Interaction Diagram

4.Y2.4.1 Images Stored

The Sender sends images to the Receiver.

The Receiver shall support handling such messages from more than one Sender. The Sender shall support making requests to more than one Receiver.

4.Y2.4.1.1 Trigger Events

A user or an automated function on the Sender determines that imaging objects should be sent to the Receiver.

Typically, the trigger is associated with an intention that the Receiver persistently store the images.

4.Y2.4.1.2 Message Semantics

The message is a DICOM C-STORE request. The DICOM SOP Class depends on the type of data being stored. The Sender is the SCU, and the Receiver is the SCP.

The Sender can transfer images to the Receiver sequentially within one or more DICOM associations, as the images become available or collectively.

The Sender shall conform to the requirements in Table 4.Y2.4.1.2-1. Effectively, this table strengthens the type definition of some DICOM attributes for the IHE Technical Framework.

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725 For additional information on how information that may have been obtained from modality worklist or HL7 messages mapping can be mapped into these attributes, refer to Appendix Z. The information in Table 4.Y2.4.1.2-1 mirrors the content of the Store SCU column of Table Z-1.

Table 4.Y2.4.1.2-1: Required Attributes

Attribute	Tag	Type	Rationale
Patient's Name	(0010,0010)	2	Important for organizing/finding images
Patient ID	(0010,0020)	2	Important for organizing/finding images
Issuer of Patient ID	(0010,0021)	2+	Important for organizing/finding images
Issuer of Patient ID Qualifiers Sequence	(0010,0024)	2+	Important for organizing/finding images
Other Patient IDs Sequence	(0010,1002)	2+	Important for organizing/finding images
Patients Birth Date	(0010,0030)	2	Important for organizing/finding images
Patient's Sex	(0010,0040)	2	Important for organizing/finding images
Ethnic Group	(0010,2160)	3	
Patient's Weight	(0010,1030)	3	
Patient's Size	(0010,1020)	3	
Patient State	(0038,0500)	3	
Pregnancy Status	(0010,21C0)	3	
Medical Alerts	(0010,2000)	3	
Contrast Allergies	(0010,2110)	3	
Institution Name	(0008,0080)	2+	Important for organizing/finding images
Institution Address	(0008,0081)	2+	Important for organizing/finding images
Institution Code Sequence	(0008,0082)	2+	Important for organizing/finding images
Institutional Department Name	(0008,1040)	2+	Important for organizing/finding images
Institutional Department Code Sequence	(xxxx,yyyy)	2+	Important for organizing/finding images
Admission ID	(0038,0010)	2+	Important for organizing/finding images
Issuer of Admission ID	(0038,0011)	2+	Important for organizing/finding images
Consulting Physician's Name	(0008,009C)	3	
Consulting Physician Identification Sequence	(0008,009D)	3	
Referring Physician's Name	(0008,0090)	3	
Referring Physician's Address	(0008,0092)	3	
Referring Physician's Telephone Numbers	(0008,0094)	3	
Referring Physician Identification Sequence	(0008,0096)	3	
Admitting Diagnoses Description	(0008,1080)	3	

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Attribute	Tag	Type	Rationale
Admitting Diagnoses Code Sequence	(0008,1084)	3	
Reason(s) for Visit	(xxxx,yyyy)	3	
Reason(s) for Visit Code Sequence	(xxxx,yyyy)	3	
Route of Admissions	(0038,0016)	3	
Study Instance UID	(0020,000D)	1	Important for organizing/finding images
Accession Number	(0008,0050)	1+	Important for organizing/finding images
Issuer of Accession Number Sequence	(0008,0051)	1+	Important for organizing/finding images. Can also be an indicator to differentiate encounter-based imaging from unscheduled radiology.
Study Date	(0008,0020)	2	Important for organizing/finding images
Study Time	(0008,0030)	2	Important for organizing/finding images
Study Description	(0008,1030)	1+	Andrei wants it.
Study ID	(0020,0010)	2	
Procedure Code Sequence	(0008,1032)	3	
Reason for Performed Procedure Code Sequence	(0040,1012)	3	
Name of Physician(s) Reading Study	(0008,1060)	3	
Physician(s) Reading Study Identification Sequence	(0008,1062)	3	
Physician(s) of Record	(0008,1048)	2+	Contains Admitting Physician
Physician(s) of Record Identification Sequence	(0008,1049)	2+	
Series Date	(0008,0021)	2+	Important for organizing/finding images
Series Time	(0008,0031)	2+	Important for organizing/finding images
Series Description	(0008,103E)	2+	Important for organizing/finding images
Series Description Code Sequence	(0008,103F)	3	
Modality	(0008,0060)	1	Important for organizing/finding images
Performing Physician's Name	(0008,1050)	2+	Important for organizing/finding images
Performing Physician Identification Sequence	(0008,1052)	2+	Important for organizing/finding images
Operators' Name	(0008,1070)	2+	Important for organizing/finding images
Operator Identification Sequence	(0008,1072)	2+	Important for organizing/finding images
Body Part Examined	(0018,0015)	2+	Important for organizing/finding images
Laterality	(0020,0060)	3	Note that laterality is handled in several ways
Anatomic Region Sequence	(0008,2218)	2+	Important for organizing/finding images

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Attribute	Tag	Type	Rationale
Anatomic Region Modifier Sequence	(0008,2220)	2+	Important for organizing/finding images
Primary Anatomic Structure Sequence	(0008,2228)	3	
Primary Anatomic Structure Modifier Sequence	(0008,2230)	3	

See Section 2.2 DICOM Usage Conventions.

4.Y2.4.1.2.1 DICOM Image Storage SOP Classes

Receivers claiming the Encounter-Based Imaging Workflow Profile shall support all SOP Classes listed in Table 4.Y2.4.1.3.1-1. Senders claiming the Encounter-Based Imaging Workflow Profile shall support one or more of the SOP Classes listed in Table 4.Y2.4.1.3.1-1.

Table 4.Y2.4.1.2.1-1: Encounter-based Imaging SOP Classes

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.6.1	Ultrasound Image Storage
1.2.840.10008.5.1.4.1.1.3.1	Ultrasound Multi-frame Image Storage

4.Y2.4.1.2.2 Study UIDs and Series UIDs

Study UID creation details and timing are clearly defined by the IHE. The Encounter-Based Imaging Workflow Profile explains how the Study information and Study Instance UID are generated by the Encounter Manager and made available to the Acquisition Modality through RAD-Y1. Generation of these items by the Acquisition Modality or workstation are restricted in general and are only permitted in specifically outlined exception cases, when the encounter imaging context information is not available to the modality.

Series UID creation must be compatible with a number of DICOM rules.

Multiple performed procedure steps are not permitted to reference the same series. So conversely, one series cannot contain the output of different performed procedure steps. Therefore, adding images to a series in a procedure step which has been completed is not permitted since a procedure step cannot be modified.

Adding images after completion of a procedure step shall trigger the creation of a new series.

One series cannot contain the output of different equipment (in part because a series must have a single Frame Of Reference). Creating images on different equipment shall trigger the creation of a new series.

All images in a series must share the same Frame Of Reference. Generally this means creating images with different patient positioning shall trigger the creation of a new series. Note that if the Frame Of Reference is not present (at the Series level), this requirement is avoided.

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Images reconstructed on a different piece of equipment are required to be in a separate Series.

4.Y2.4.1.3 Expected Actions

The Receiver will store the received DICOM objects.

The DICOM objects shall be stored such that they can be later retrieved (see RAD TF-2: 4.16 Retrieve Images) in a fashion meeting the requirements defined for a DICOM Level 2 Storage SCP (Refer to DICOM PS3.4 B.4.1).

4.Y2.5 Security Considerations

The DICOM objects conveyed typically constitute personal health information.

4.Y2.5.1 Security Audit Considerations

This transaction is associated with a Begin-storing-instances ATNA Trigger Event on the Sender and an Instances-Stored ATNA Trigger Event on the Receiver.

4.Y3 Notify Encounter Imaging Results [RAD-Y3]

4.Y3.1 Scope

This transaction is used to notify a system that images (typically newly acquired in the course of a patient encounter) are available to the patient record. The notification is an HL7 v2.5.1 Unsolicited Observation (ORU) message.

The metadata provided is intended to be sufficient for an EMR to manage the imaging entry in the patient record, which may include creating a proxy order at the discretion of the EMR.

4.Y3.2 Actor Roles

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

Table 4.Y3.2-1: Actor Roles

Role:	Sender: Sends a notification of the availability of encounter-based imaging data.
Actor(s):	The following actors may play the role of Sender: Image Manager/Archive
Role:	Receiver: Receives the notification.

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Actor(s):	The following actors may play the role of Responder: Result Aggregator

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.

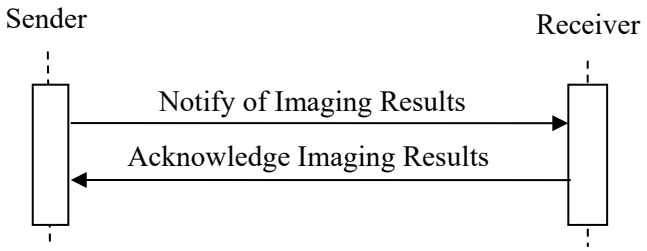
4.Y3.3 Referenced Standards

HL7 Messaging Standard v2.5.1, Observation Reporting (Chapter 7)

HL7 Messaging Standard v2.5.1, Control (Chapter 2)

RAD TF-2: 2.3.1 Conventions for HL7 v2.5.1 messages

4.Y3.4 Interaction Diagram



4.Y3.4.1 Notify of Imaging Results

The Sender sends a notification to the Receiver.

The Receiver shall support handling such messages from more than one Sender. The Sender shall support making requests to more than one Receiver.

4.Y3.4.1.1 Trigger Events

New imaging objects have been acquired, for example as part of encounter-based imaging.

Typically, the trigger is associated with an intention that the Receiver catalog the information as part of the electronic medical record of the patient.

It is conceivable that multiple notifications might be sent for the same Study, but the contents would be consistent so it is not expected to be a problem for the Receiver.

4.Y3.4.1.2 Message Semantics

The message is an HL7 v2.5.1 Observation Reporting (ORU) message. The Sender is the HL7 sender. The Receiver is the HL7 recipient.

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This message specification is based on the Send Imaging Result Message in the Send Imaging Result [RAD-128] transaction with minor changes. For example, [RAD-Y3] is an ORU^R30 "Unsolicited Point-Of-Care Observation Message Without Existing Order" and does not include an imaging report.

Note: The [RAD-128] transaction is currently specified in the Results Distribution (RD) Trial Implementation Supplement.

This HL7 v2.5.1 ORU message is very similar to an HL7 v2.3 ORU message with the addition of the TQ1 segment.

Note that the physician with whom the patient had the encounter belongs in the Attending Physician field of the PV1 segment.

The Sender shall encode the ORU message and segments as defined in this section.

Table 4.Y3.4.1.2-1: HL7 v2.5.1 Notify of Imaging Results (ORU) Message

Segments	Message Content	HL7 v2.5.1 Chapter	Reference
MSH	Message Header	2	Section 4.128.4.1.2.2 MSH Segment
PID	Patient Identification	3	Section 4.128.4.1.2.3 PID Segment
PV1	Patient Visit	3	Section 4.128.4.1.2.4 PV1 Segment
[ORC]	Order Common	4	Section 4.128.4.1.2.5 ORC Segment
OBR	Order Detail	4	Section 4.Y3.4.1.2.1 OBR Segment
TQ1	Timing/Quantity	4	Section 4.Y3.4.1.2.2 TQ1 Segment
OBX	Observation/Result (DICOM Study Instance UID)	7	Section 4.128.4.1.2.8 OBX Segment

Adapted from the HL7 Standard, version 2.5.1

See RAD TF-2: 2.3.1 “Conventions for HL7 v2.5.1 messages” for a complete definition of the notation used in the sections referenced by Table 4.Y3.4.1.2-1.

4.Y3.4.1.2.1 OBR Segment

The Observation Request (OBR) Segment defines attributes (“metadata”) for the imaging result. The contents of Table 4.Y3.4.1.2.1-1 are the same as Table 4.128.4.1.2.6-1; however, the guidance differs for a number of the elements.

The OBR segment definition is based on HL7 Version 2.5.1 (Chapter 4, Order Entry, Section 4.5.3).

This OBR Segment shall be further constrained as specified in Table 4.Y3.4.1.2.1-1.

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Table 4.Y3.4.1.2.1-1: HL7 v2.5.1 ORU OBR Segment

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
2	22	EI	R2		00216	Placer Order Number
3	22	EI	R2		00217	Filler Order Number
4	250	CE	R		00238	Universal Service ID
5	2	ID	X		00239	Priority (retired)
6	26	TS	X		00240	Requested Date/time
7	26	TS	R		00241	Observation Date/Time
12	250	CE	X		00246	Danger Code
18	60	ST	R		00251	Placer Field 1
19	60	ST	R2		00252	Placer Field 2
24	10	ID	R	0074	00257	Diagnostic Serv Sect ID
25	1	ID	R	0123	00258	Result Status
27	200	TQ	R		00221	Quantity/Timing
28	250	XCN	O		00260	Result Copies To
31	250	CE	R2		00263	Reason for Study
32	200	NDL	R2		00264	Principal Result Interpreter
33	200	NDL	R2		00265	Assistant Result Interpreter
34	200	NDL	R2		00266	Technician
44	250	CE	R		00393	Procedure Code
46	250	CE	R2	0411	01474	Placer Supplemental Service Information
48	250	CWE	R2		01646	Medically Necessary Duplicate Procedure Reason

Adapted from the HL7 Standard, version 2.5.1

Fields *OBR-2 Placer Order Number* and *OBR-3 Filler Order Number* will typically be empty since encounter-based imaging is usually unordered.

Field *OBR-4 Universal Service ID* shall contain a procedure code in the first three components: *OBR-4.1 Identifier*, *OBR-4.2 text code meaning*, *OBR-4.3 coding system*. The use of codes from a standardized coding system for procedures, such as the RadLex Playbook LOINC codes, is recommended. In order of preference, the procedure code may be taken from:

- Procedure Code Sequence (0008,1032)
- Requested Procedure Code Sequence (0032,1064)
- A code for a generic imaging procedure

Field *OBR-7 Observation Date/Time* shall contain a date/time representative of the imaging procedure. When choosing the date/time to use, consider that an EMR might use this date/time to find other clinical entries for the patient at or near this time which might provide context for the

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imaging procedure. The date/time might be taken from one of the following attributes in the associated DICOM image objects:

- Study Date (0008,0020) & Study Time (0008,0030)
- Series Date (0008,0021) & Series Time (0008,0031)

Field *OBR-18 Placer Field 1* shall contain the Accession Number (0008,0050) of the associated DICOM image objects. Note that in the HL7 v2.5.1 semantics for the Procedure Scheduled [RAD-4] transaction the Accession Number is provided in IPC-1, but the IPC Segment is not included in an ORU Message, so the HL7 v2.3.1 interpretation of this field is used.

Field *OBR-19 Placer Field 2* shall contain the Assigning Authority that corresponds to the contents of the Issuer of Accession Number Sequence (0008,0051) in the associated DICOM image objects. Note that the string in OBR-18 may contain a prefix or suffix that also hints at the Assigning Authority for the Accession Number.

Field *OBR-24 Diagnostic Serv Sect ID* shall be populated based on the value of Institutional Department Code Sequence (xxxx,yyyy) in the associated DICOM image objects. This may require a mapping table to match locally used of the diagnostic service section IDs (which for some sites may be HL7 Table 0074).

Field *OBR-25 Result Status* shall contain values from Table 4.Y3.4.1.2.1-2. The value "F" is a final, signed imaging result. The value "C" is for an amended/final imaging result.

Table 4.Y3.4.1.2.1-2: OBR-25 Result Status Values

Value	Description
R	Results stored; not yet verified (see Note)
F	Final results; results stored and verified. Can only be changed with a corrected result.
C	Correction to results

Adapted from the HL7 Standard, version 2.5.1, Table 0123

Note: Table 0123 in HL7 v2.5.1 contains a value of "P" for "Preliminary". Unverified imaging results, also referred to as "preliminary imaging results", are sent with status value "R" rather than "P". The value "P" is used more often for laboratory results, where a final result may be awaiting development of a culture, but the preliminary results are usable for clinical treatment planning.

Field *OBR-27 Quantity/Timing* shall be retained for backwards compatibility only. The value of *OBR-27.6 Priority* shall match *TQ1-9.1 Priority*, as described in Section 4.Y3.4.1.2.2. Other components of *OBR-27* shall not be valued.

Field *OBR-28 Copy Results To* will typically be empty but may be used to trigger further notifications from an EMR based on local workflow/policies.

Field *OBR-31 Reason for Study* shall be valued, if known. This might be taken from one of the following attributes in the associated DICOM image objects:

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- Reason for Performed Procedure Code Sequence (0040,1012)
- Reason for the Requested Procedure (0040,1002) or Code Sequence (0040,100A)
- Reason(s) for Visit (xxxx,yyyy) or Code Sequence (xxxx,yyyy)
- Admitting Diagnoses Description (0008,1080) or Code Sequence (0008,1084)

Field *OBR-32 Principal Result Interpreter* will typically be empty. Most encounter-based images are not formally interpreted. Even if they are, interpretation would often occur some time after the images are initially stored and this [RAD-Y3] notification was sent. The resulting report would be a separate submission to the Receiver.

Field *OBR-33 Assistant Result Interpreter* will typically be empty but shall be valued if known and contributed to generating these imaging results.

Field *OBR-34 Technician* shall be valued, if the person who acquired the images is known. This might be taken from one of the following attributes in the associated DICOM image objects:

- Operators' Name (0008,1070) or Operator Identification Sequence (0008,1072)
- Performing Physician's Name (0008,1050) or Performing Physician Identification Sequence (0008,1052)

Field *OBR-44 Procedure Code* shall match *OBR-4.*

Field *OBR-46 Placer Supplemental Service Information* shall contain the laterality (Left/Right) indicator (when used) in the <site modifier (CE)> component. See RAD TF-2: Appendix B for details.

4.Y3.4.1.2.2 TQ1 Segment

The HL7 v2.5.1 TQ1 Segment defines the priority of the imaging results. The Timing/Quantity (TQ1) Segment definition is based on HL7 Version 2.5.1 (Chapter 4, Order Entry, Section 4.5.4).

The imaging procedure has been completed and encounter-based imaging results are not typically urgent. The TQ1 Segment may be sent empty. If populated, a value of R^Routine^HL70078 would be appropriate for many cases.

4.Y3.4.1.3 Expected Actions

The Receiver shall accept and process the message.

The Receiver shall support receiving multiple imaging result messages for the same DICOM Study Instance UID. That is, multiple imaging Series may each result in a separate notification message despite being part of a single DICOM Study.

Receiver actions subsequent to receiving an image result will depend on internal business logic and/or the profile in which the transaction is being performed.

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4.Y3.4.2 Acknowledge Imaging Result

The Sender and Receiver shall implement the Acknowledge Imaging Result message as described in Section 4.128.4.2.

4.Y3.5 Security Considerations

905 The metadata and referenced imaging data in this message typically constitute personal health information.

4.Y3.5.1 Security Audit Considerations

This transaction is associated with a Procedure-record-event ATNA Trigger Event.

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