Integrating the Healthcare Enterprise

IHE Radiology
Technical Framework Supplement

Encounter-Based Imaging Workflow (EBIW)

Rev. 2.0 – Draft for Public Comment
With extensions for Lightweight Devices

Deleted: Revision 1.1 – Trial Implementation

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

Foreword

Note: This document revises the published EBIW Revision 1.1 Trial Implementation Profile. To help readers who are familiar with Revision 1.1, Microsoft Word change tracking has been left in to highlight what has changed from Revision 1.1. The current intention is to accept all changes *after* resolving public comments to this document and then the resulting TI document will replace Revision 1.1. At that point, the usual use of **bold underline** and ~~**bold strikethrough**~~ will show changes this supplement makes to the existing Technical Framework.

This is a supplement to the IHE Radiology Technical Framework V17.0. 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 20, 2019 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 22, 2019.

This supplement describes changes to the existing technical framework documents.

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

Amend Section X.X by the following:

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

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

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

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

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

CONTENTS

Introduction to this Supplement

This supplement documents an Encounter-Based Imaging Workflow Profile to address medical imaging performed outside the context of an ordered procedure. Two classes of modalities are considered: "traditional" imaging modalities (such as ultrasound or x-ray devices that are used at the point-of-care), and "lightweight" devices (such as digital cameras, smartphones, and tablets). Encounter-based imaging is typically used to capture clinical images for documentation, follow-up care, and diagnostics.

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.

To Do

- Consult with DICOM®[1] WG-6 about 16-bit samples in the DICOM VL Photographic Image IOD. CP or new IOD? Are there analogies to the For-Processing / For-Presentation approach taken for some other modalities and Profiles?
- CP IHE Supplement template to rename Interaction Diagram section to Messages. Can make a figure title that says Interaction Diagram. I shouldn't have left Interaction Diagram as the title for the whole section.
- CP DICOM to add the Instruction Sequence (0018,9914) to the Scheduled Procedure Information Module of UPS and the Scheduled Procedure Step Module of MWL. Note IHE Eyecare puts instructions as a block of text in the Requested Procedure Comments (0040,1400) attribute which appears in the Requested Procedure Module of MWL and in the Referenced Request Sequence in the UPS Relationship Module of the UPS.
- CP DICOM to allow a Responder to support only UPS-RS Search and a DIMSE Service Group with just C-FIND. Add note in EBIW that the Responder can implement the rest which would allow tracking the performance of the EBIW. http://dicom.nema.org/medical/dicom/current/output/chtml/part04/sect_CC.2.html http://dicom.nema.org/medical/dicom/current/output/chtml/part18/sect_6.9.html
- CP DICOM to re-add "All other Attributes from the Patient Demographic Module" to the UPS Table CC.2.5-3 similar to Patient Medical Module. Covers Confidentiality, Ethnic, Weight and Size. Mention Confidentiality Code (0040,1008)?
- CP DICOM to add Institution elements as optional to the UPS data structure so they are inherited by the UPS-RS Service. Either add directly to the C.30.4 Unified Procedure Step Relationship Module next to Admission ID, or add the Visit Identification Module.

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

Deleted: introduces a new

Deleted: 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.¶
Page Break
¶

- CP DICOM to add Admission elements as optional. Either add directly to the C.30.4 Unified Procedure Step Relationship Module next to Admitting Diagnoses, or add the Visit Admission Module and Visit Status Module.
- CP DICOM to make Reason for the Requested Procedure (0040,1002) and Reason for Requested Procedure Code Sequence (0040,100A) to O/O as Q/R Keys.
- CP WIC (Maybe) to harmonize on Series Date/Time/Description rather than Performed Procedure Date/Time/Description.
- CP WIC (after EBIW PC) to remove the New Study use case since EBIW supports that better by providing the needed "reliable source" of metadata.
- CP WIC to fix several Reference numbers in the WIC option table. (off one level)
- Check with LOINC on semantics of 72170-4: Photographic Image (taken from a mobile device app, sent as a PDF with patient, doctor, body part, and title like "skin rash")

Open Issues

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

A. Public Comment requested.

The original draft of the profile used DICOM Modality Worklist for non-RESTful clients. This draft adds the UPS-RS protocol to RAD-130. The content is largely common. Servers would be required to support both.

The Technical Committee is investigating how to map the needed information to a series of FHIR®[2] Queries. The draft FHIR-based transaction [RAD-Y1b] will be circulated in a separate document (EBIW-FHIRQuery) when the issues have been worked out.

Servers would likely be required to support all protocols to allow clients to choose.

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Q. Are there any reasons that EBIW studies will not work smoothly with profiles like PDI, XCA-I, XDS-I, XDS, BIR, IRWF, etc. in the same way SWF does?

A. Probably no problems. Public Comment requested...

The incorporation of an Accession # and the use of DICOM storage in EBIW should make encounter-based imaging largely compatible with the other imaging profiles.

Are there any order-based assumptions in other profiles that are invalid for encounter-based images that might cause problems in the Enterprise Imaging space?

If so, can they be addressed by a CP (e.g., to change a required attribute to a conditional attribute)?

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

Consider a dermatology patient bringing a USB stick with some JPEGs for Encounter-based import using IRWF. Does IRWF cover all the EBIW details? Given this is similar to the Separate Capture use case (see Section 47.4.2.3), is that a better method? Can/should EBIW be used to "import" existing non-DICOM images in XDS with metadata?
Q. What devices/cases are not covered by PoCUS & Lightweight; and what's our plan? A. Public Comment requested… Modalities that are similar to PoCUS (i.e., mostly DICOM-capable already and also used for order-based imaging) can implement EBIW as an Acquisition Modality. Modalities that are similar to Lightweight (i.e., new to DICOM and mostly used for encounter-based imaging) can implement EBIW as a Lightweight Modality (using the RESTful interfaces defined here). Are there examples of modalities that do not fall neatly into one or the other camp? Where would Endoscopes, Laparoscopes, and Dermatoscopes fall? Would a modality want to be a hybrid that does a RESTful query and a DIMSE store? Is there value in un-pairing the query and the store transactions to allow mixing mechanisms? Would a laptop that does DIMSE Q/R/Display want to add SLR capture and storage?
Q. Should "header requirements" for different use cases in RAD-108 be encoded into a table? A. Probably. It would look like the Query/Matching Key tables, with rows for attributes, columns for Basic WIC, EBIW Lightweight, EBIW Regular, etc. Sort of a Content Definition for STOW.
Q. Can any of the Query/Return Key requirements in Table 4.130.4.1.2-1 be reasonably dropped? A. Public Comment requested. Fewer required fields makes it easier to implement, but we don't want to drop anything that is important to adequately meet the use cases and user needs.
Q. Where, if anywhere, should configuration of procedure lists be required? A. Public Comment requested

This draft (see Section 47.4.1.9) notes that lightweight modalities could configure "pick lists" of likely procedures from which users could select. E.g., the camera in the dermatology clinic would be configured with a different list than the camera in the burn unit.

Alternatively, the Encounter Manager could support such configurable lists and would provide the appropriate list to each modality based on its reported department. That would centralize configuration of the lists rather than having to configure and update each of the individual modalities.

Neither of the above are required, leaving it up to users and their set of vendors to work something out. Should we require one or the other end be configurable?

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-131 into a STOW version or re-use 3.108 Store Instances over the Web [RAD-108] depending on suitability to the use cases.
Q10. Should we make any Measurement SR IODs mandatory for the SCP? A: No.
Q. Bias toward older (DICOM/HL7®[3]) VS newer (DICOMweb/FHIR) 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.

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

Q. Should we use Accession Numbers? A. Yes Creating it and passing to the modality to include in the images means that if the EMR 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. 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
Q1. Do we need to profile John Doe cases? A: Explain how it could be handled but don't profile specific requirements. Procedure and Pixel metadata should be populated as usual. Encounter metadata will be mostly as usual, but perhaps a bit sparser due to likely urgent care context. If the John Doe is admitted, they will have a wristband and an Admission ID and the imaging device will still have whatever information it has about the department, operator, location context. Patient metadata will be sparser and the name/ID will likely be placeholders. Sites will have local methods for assigning John Doe MRNs etc. and modalities and encounter managers should be prepared to deal with those. Existing patient-merge/Patient Information Reconciliation methods on the PACS and RIS should work as usual for data stored with placeholder demographics.
Q2. Are Figure 47.4.1.1-1: Encounter-Based Imaging Information Model relationships OK? A: Basically, yes. Fixed a few cardinalities. Want to keep the Imaging Procedure entity and keep Studies as a child of the Procedure rather than the Encounter.
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.

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

A: Both.

The Encounter Manager is permitted but not required to be able to provide a Department based on such things as the device AE Title, or the operator or other clues.

At the same time, Modality devices should include the ability in their setup to configure the Department (along with the name of the Institution). If the modality has a configured value, but receives a different value (rather than no value) in the RAD-130 transaction, it should consider using the RAD-130 value since the Modality might be being used outside its original department. This too could be a configurable behavior.

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.

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. There are certainly portable x-ray use cases similar to those described in 47.4.2, 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.
Q3. Are the 130, 131, 132 Requirements adequate to reliably meet the metadata needs in 47.4.1.8 A: Seem to be, yes. Actually reduced some of the 130 requirements to keep it easy/practical on the Encounter Manager. Tradeoffs considered include: • If an attribute/field is made Type 1, might need a defined default or fallback value • If 131 or 132 requirements are too strict, systems might need to buffer the "bad" images in an exception queue until someone cleans them up. But maybe the clean data

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benefits outweigh the delay/inconvenience? Beyond the core attributes, this is perhaps a local policy and product design question?
Q8. Do we need to tinker with the RAD TF-2: 2.2 text? A: No. The semantics are not changed here. Note 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***."
Q5. How do we want to handle "location" of encounter-based imaging? A: Not a strong enough need to add an image IOD tag. The location where the images were acquired can be used to manage encounter images (in the sense of Department or perhaps a specific room), but it seems to be essentially a proxy for the care team/sub-organization/clinical specialty or workflow that generated the images. It might also be used to associate the images with other clinical artifacts. But generally a coarse location (i.e., Department) is more useful than a fine grained location (i.e., a specific room) 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 DICOM fields and tags considered include: 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 Related HL7 Segments/Fields considered include:

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

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 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?

A: Not in a way that affects profile requirements.

Room and operator are not as easily tied together and not as stable as for stationary equipment. It may also mean that the modality is only intermittently connected to the network, however that has been dealt with in Cardiology, and WiFi usage is becoming more prevalent making network connectivity less of an issue.

For portable modalities, they may remain in a given location, or they may be taken out of a supply rack (and hopefully returned later). They may change rooms/floors. The Facility/department/service is more stable and is more important that the specific room.

Departments will borrow equipment and people also span care teams and departments and take on different roles on different shifts. It would be helpful for the device to show the user what is being assumed, say for the current department, so the operator can confirm or modify from a pulldown or something.

Geotag values available on more and more digital photography devices could he useful, as could network clues and ITI patient tracking which might help populate short picklists of departments.

Mobility might also introduce security issues if the device gets outside the firewall, etc. in terms of attack surface. This may be discussed more in the next work.

Q. Should we require the EM and EMR to support a baseline mechanism for demographics?

A: No.

47.4.1.3 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
  - What distinguishes "temporary location" from "permanent location"? E.g., ADT^A10^ADT_A09 and vs movement ADT^Z99^ADT_A01 (ZBE)
  - 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

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

A: No definitive way. Left to implementations.

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-132 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.

Q9. Is the use of "auto-matching" matching keys in RAD-130 OK?

A. Yes.

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.

Q. Should the profile specify creating orders?

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

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-R01 (See also R01 vs R30 question)

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.

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

Q11. Is it OK for RAD-132 to use an ORU^R30 instead of an ORU^R01?

A: No.

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-132 is based.

Andrei notes that the full name of R30 is "Unsolicited Point-Of-Care Observation Message Without Existing Order – Place An Order" and as such, the ORC segment is required. ORU^R01 does NOT require ORC and as such, it is preferable for use (we do NOT want to include ORC – and maybe we should even prohibit its use.

Committee agrees that R01 is the better choice. Teri consulted with Hans at HL7 to make sure we're not overlooking anything and Hans agrees.

Q12. What is the guidance for OBR:48 Medically Necessary Duplicate Procedure Reason

A: None.

The field is typically not populated. There is no need for special guidance from this profile.

For digital photography, 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.

But this field was for CDS and big bills. Usually, they will take a bunch of photos and then chose the one to upload. It is not take, upload, take, upload, etc.

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-132 could be populated based on the header of RAD-131.

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.

Q13. How should the IM/IA recognize an encounter-based study (so it can send [RAD-132] and how should the Result Aggregator/EMR recognize encounter-based Accessions?

A: Accession Number and Request Attribute Sequence are good clues

See text in 4.132.4.1.1 Trigger Events.

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If implemented, Issuer of Accession Number might also help to identify those from the Encounter Manager, or if a prefix-suffix-knownrange is used in the Accession Number value. If there are multiple encounter managers, one would need to check a list against issuer.

The presence and content of Procedure Scheduled [RAD-4], MPPS [RAD-7] and Filler Order Management [RAD-2] transactions.

Conceivably, the IM/IA could have a special AE Title for receiving encounter-based images. That would be permitted but is probably not necessary.

In addition to avoiding extraneous messages, this should also be able to avoid conflict with the SWF.b PIR behaviors which could otherwise trigger duplicate order creation (by EMR from 132 and by DSS/OF from SWF.b PIR)

Image Attribute	EBIW	SWF.b Simple	SWF.b Unsched.	SWF.b Group	Imported
Accession Number	***value***	***value***	***Empty***	***Value or Empty (if diff)***	***Empty or MWL Value***
Issuer of Accession#	EM	RIS	n/a	RIS	RIS or empty
Study Instance UID	Study UID	Study UID	Study UID	Study UID	Study UID
Referenced Study Seq.	<Study UID>	Study UID	Empty	2x Study UID	Copied either
Req. Attrib. Seq.	***Empty***	***1 item***	***Empty***	***2 items***	***1 copied item***
>Requested Proc. ID	n/a	Value (RIS)	n/a	Value (RIS)	
>SPS ID	n/a	Value (RIS)	n/a	Value (RIS)	
Admission ID	Yes	Maybe	No	Maybe	Maybe
Source Device					
RAD-4 Proc Scheduled Msg	*No*	*Yes*	*Later*	*Yes x2*	
RAD-7 MPPS Complete	*No?*	*Yes*	*Yes*	*Yes xN*	
Procurement Type	*ENCOUNTER*	*ORDER*	*UNSCHEDULED*	*ORDER/ GROUP*	*IMPORT*

Operator/Modality knows. Would be nice to indicate explicitly in the header. Probably needs a DICOM CP to either:

- add Identifier Type Code (0040,0035) to Issuer of Accession Number (like exists in the Issuer of Patient ID Qualifier Sequence) and consider encounter accession numbers to be a different "type" of identifier than other accession numbers
- add a Procurement Method attribute to indicate whether this site procured the images by ENCOUNTER, ORDER, IMPORT, or UNSCHEDULED, or something like that

The main flags in the SWF.b unscheduled case for unknown patient are that the modality sends an MPPS to the DSS/OF with the Referenced Study Sequence empty or absent and in the image, the **Accession Number shall be empty/zero length**. The DSS/OF recognizes the temporary patient ID and waits for the ADT to broadcast a merge after the patient is properly ID'd and registered. The DSS/OF echoes the patient update (merge) to the IM/IA and RM. Then the DSS/OF creates an order with a new requested procedure that matches the completed procedure, the new demographics and details of the completed procedure, and sends it to the OP. Then the DSS/OF sends a Procedure Scheduled with the new requested procedure and order to the IM/IA.

(The Referenced Study Sequence seems more relevant in the MPPS than in the Image IOD).

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

A: Current profile is appropriate to PoC US Devices. The following notes are for next cycle

The current intention for digital cameras next cycle is to introduce a RESTful push of images (WIC/STOW-RS) that is the JPEG with a dozen or so metadata tags, and a RESTful query to send the Admission/Patient ID and get back the handful of metadata tags that will be copied over into the STOW message.

Some other topics that can be revisited include:

- 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.

- 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?

A: Yes, list these in a concept section

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)
- 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

Q. What do you want to call the new actor?

A. Lightweight Modality

Briefly considered Image Capturer (from WIC) but the Separate Capture Use Case highlights the potential confusion since we distinguish the capture device from the Modality Actor that interacts with the other actors.

Q. How should the new requirements be added/packaged?

A. Option A

Option A: "Complete" existing EBIW Profile by adding a Lightweight Modality with RESTful transactions to the Encounter Manager and the Image Manager.

Option B: Add a RESTful Option and a DIMSE Option to the existing Profile?

Option C: Have two EBIW Profiles (EBIW and EBIW-RS?)

Q. How should the new material from this cycle be documented?

A. Change tracked edits to EBIW doc.

Q. Should we support RAW? If so, how?

A: Not yet. Include a Concept section to further the discussion.

Q. Should we address Record Driven Acquisition?

A: Not normatively. Added a concept section.

Q. Should we address biometric approaches to patient id?

A. Not normatively. Added a concept section.
Q. Should we address deferred completion cases? A. Not normatively. Added to the concept section on Recording Encounter and Procedure Metadata.
Q. Should we address Guided Acquisition; if so, how? (Not MUE) A. Added Concept section. Referenced CPs to UPS for Instruction Sequence.
Q. How much do we need to describe the capture device? A: Add some guidance (e.g., populate Contributing Equipment Sequence) but no requirements.
Q. Should we address mapping semantics between JPEG/EXIF tags and DICOM tags? A. Informative material provided in 47.4.1.6. No need for normative found.
Q. How should Store Encounter Images-RS be documented? A. Try Polymorphic RAD-108 (have STOW behave differently in different profiles) Need to blend the RAD-131 attribute requirements with the RAD-108 protocol and media type requirements. Option A: Clone STOW – copy and tweak; push JPEG with 20 tags or so? • Would duplicate a lot of option/behavior text for different media types • So would need to determine which are still relevant, and maybe include the ones that are by reference rather than by copying. Option B: Polymorphic RAD-108 – have STOW behave differently in different profiles. • (make subsections to clarify the differentiated requirements) – helps with review during PC, makes it clear for implementation, shouldn't be a burden for test organization either.

- Do we want to call our Actor Image Capturer? (Maybe but in the SLR-Laptop case that would be a bit misleading)

Q. Are photographs taken during a conventional modality acquisition considered EBIW?

A. Not really.

Basically, these kind of studies (e.g., fMRI + video of the patient during, Chest X-Ray plus photo of chest) are scheduled multi-modality procedures. So the "right" way is for the lightweight modality to use MWL (or a UPS proxy for it) to get the shared Study UID and Accession # resulting in a new series in the same study as the conventional modality. So either a clever Encounter Manager (linked to the worklist server) or a clever Lightweight Modality (query the Worklist Server) can make this happen.

IHE Card CATH Profile basically works this way.

Q. Should we document a FHIR variant of the STOW transaction?

A. No.

FHIR hasn't figured out yet how that might work. Go with the existing infrastructure.

Also there is a concern about fragmenting the image record. E.g., splitting the image record into different access APIs, formats and possibly locations (or in the case of VNA, one location with different APIs and formats for different subsets of the image record). Clients would then need to support a multitude of APIs and use different ones depending on what they are looking for and/or use all of them and collate the results.

Displays should present images regardless of which path was used for capture. If we fork capture, we want to avoid forking storage and indexing.

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.
Lightweight Modality	Acquires medical images and communicates using lightweight (RESTful) protocols.

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-130]	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-131]	Send images that were acquired in the course of a patient encounter (in contrast to those acquired for an ordered procedure).
Notify of Imaging Results [RAD-132]	Notify a data management system (e.g., EMR) that images (e.g., 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 represent anticipated encounters.

Volume 1 – Profiles

Modify Scheduled Workflow as shown (this paragraph is not modified by SWF.b so will persist when SWF.b is integrated):

3 Scheduled Workflow (SWF) Profile

The ***Scheduled Workflow Integration Profile*** establishes the continuity and integrity of basic departmental imaging data. It specifies a number of transactions that maintain the consistency of patient and ordering information as well as providing the scheduling and imaging acquisition procedure steps. This profile also makes it possible to determine whether images and other evidence objects associated with a particular performed procedure step have been stored (archived) and are available to enable subsequent workflow steps, such as reporting. It may also provide central coordination of the completion of processing and reporting steps as well as notification of appointments to the Order Placer.

For imaging workflow performed in the context of a patient encounter, rather than in the context of an ordered procedure, refer to the Encounter-Based Imaging Workflow (EBIW) Profile.

Add a new profile section

47 Encounter-Based Imaging Workflow (EBIW) Profile

Medical imaging is increasingly 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. This profile introduces these capabilities for encounter-based imaging procedures in ways that are analogous to those of order-based imaging procedures 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

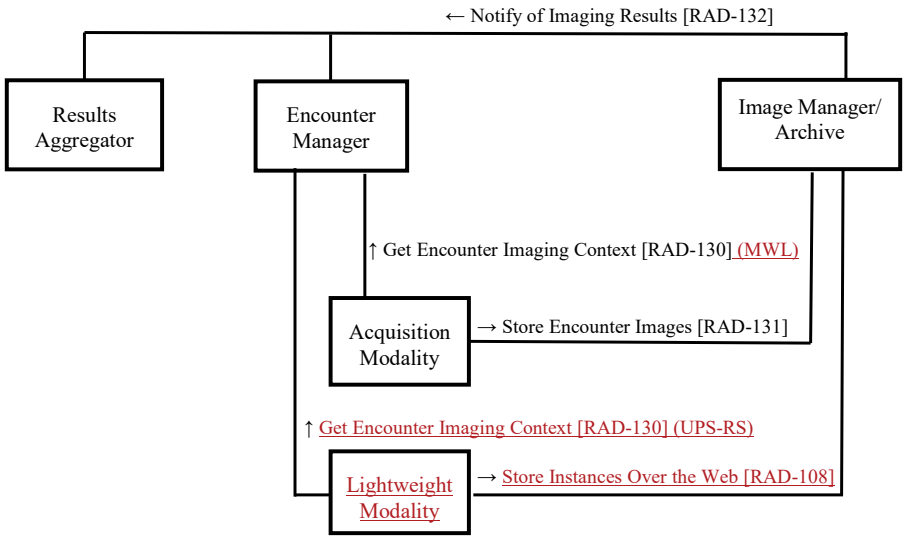
Encounter-based imaging should get the same end result (the ability to find, access, analyze and use acquired images) as if the clinician placed the order. This profile does not address display criteria for encounter-based imaging as new criteria relative to existing conventional medical imaging were not identified.

Deleted: Note: This profile currently addresses the Point-of-Care Ultrasound Use Case (see Section 47.4.2.1). The intention of the committee is to submit a proposal for the next IHE Radiology development cycle to add a lightweight modality actor, a RESTful context transaction, and a RESTful DICOMweb image storage transaction, to support effective but lightweight integration of encounter-based medical photography using digital cameras, tablets and smartphones.

47.1 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 47.1-1 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 due to their participation in other related profiles are shown in dotted lines. Actors which have a mandatory grouping are shown in conjoined boxes.



335 **Figure 47.1-1: EBIW Actor Diagram**

Table 47.1-1 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 47.1-1: EBIW Profile - Actors and Transactions

Actors	Transactions	Optionality	Reference
Encounter Manager	Get Encounter Imaging Context [RAD-130]	R	RAD TF-3: 4.130
	Notify of Imaging Results [RAD-132]	O	RAD TF-3: 4.132
Acquisition Modality	Get Encounter Imaging Context [RAD-130]	R	RAD TF-3: 4.130
	Store Encounter Images [RAD-131]	R	RAD TF-3: 4.131
Lightweight Modality	Get Encounter Imaging Context [RAD-130]	R	RAD TF-3: 4.130
	Store Instances Over the Web [RAD-108]	R	RAD TF-3: 4.108
Image Manager/ Archive	Store Encounter Images [RAD-131]	R	RAD TF-3: 4.131
	Notify of Imaging Results [RAD-132]	R	RAD TF-3: 4.132
	Store Instances Over the Web [RAD-108]	R	RAD TF-3: 4.108
Result Aggregator	Notify of Imaging Results [RAD-132]	R	RAD TF-3: 4.132

47.1.1 Actor Descriptions and Actor Profile Requirements

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

47.1.1.1 Encounter Manager

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

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

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

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

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

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

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

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

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

47.1.1.2 Acquisition Modality and Lightweight Modality

For brevity, the term "Modality" is used in this section to refer to both the Acquisition Modality and the Lightweight Modality.

The Modality assembles acquired pixels with associated metadata and perhaps operator input and then stores the resulting image IODs. The Modality may acquire/construct the pixels itself (e.g.,

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a point of care ultrasound device) or it may import pixels and device metadata from a separate image capture device (e.g., a digital camera). Details of such separate image capture devices and mechanisms for import are the responsibility of the Modality product and are outside the scope of this profile.

For digital photography and video, XC (external-camera photography) is an appropriate value for Modality (0008,0060). VL Photographic Image is an appropriate IOD for photography. Video Photographic Image is an appropriate IOD for generic video. There are other IODs for more specific

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

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

The Lightweight Modality shall implement the Store Instances Over the Web [RAD-108] transaction as the Image Capturer.

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

The Modality may also store non-image DICOM IODs. Such evidence documents (like accompanying measurements) will share an Accession Number with associated images and be stored in the same DICOM Study. Some Modalities might also store non-DICOM clinical documents, such as HL7 CDA®[4].

The Modality user interface, e.g., where it takes input from the operator or shows the operator the metadata that will be associated with the stored images, is left to product design and is outside the scope of profile requirements. It is recommended that the Modality be able to show the operator what values are being assumed and permit adjustment for metadata values like the department, operator, patient, procedure, etc.

The Lightweight Modality shall have a method of maintaining the correct time and UTC offset ("timezone") and ensuring that the time metadata (acquisition time, series time, etc.) are accurate to within seconds. The Acquisition Modality achieves this using the IHE Consistent Time Profile (based on NTP); the Lightweight Modality may choose to use the CT Profile or some other method. Mobile devices on a cellular network are likely time synchronized through that infrastructure, which is acceptable. See DICOM PS3.17 Annex NNNN for additional details on what EXIF metadata corresponds to which DICOM attributes.

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[4] CDA is the registered trademark of Health Level Seven International.

47.1.1.3 Image Manager/Archive

The Image Manager/Archive is required to send notifications to the Result Aggregator. Optionally, the Image Manager/Archive may be configurable to also send notifications to the Encounter Manager.

Consistent with the IHE Web Image Capture (WIC) Profile, the Image Manager/Archive is required to populate Image Pixel Macro fields that the Lightweight Modality may leave empty. See Section 3.108.4.1.3.

47.1.1.4 Result Aggregator

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

47.2 EBIW Actor Options

Options that may be selected for each actor in this profile, if any, are listed in the Table 47.2-1. Dependencies between options when applicable are specified in notes.

Table 47.2-1: Encounter-Based Imaging Workflow - Actors and Options

Actor	Option Name	Reference
Encounter Manager	No options defined	--
Acquisition Modality	No options defined	--
Lightweight Modality	~~**No options defined**~~ DICOM Instance Storage Option (See Note 1)	RAD TF-3: 3.108.4.1.2.3
	JPEG Storage Option (See Note 1)	RAD TF-3: 3.108.4.1.2.1.1
	PNG Storage Option (See Note 1)	RAD TF-3: 3.108.4.1.2.1.2
	MPEG4 Storage Option (See Note 1)	RAD TF-3: 3.108.4.1.2.2.1
Image Manager/Archive (See Note 2)	~~**No options defined**~~	--
	PNG Storage Option	RAD TF-3: 3.108.4.1.3.1
Result Aggregator	No options defined	--

Note 1: The Lightweight Modality shall support at least one option.

Note 2: The Image Manager is required to support JPEG, MPEG4, and DICOM Instance Storage.

47.3 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 47.5 describes some optional groupings that may be of interest for security considerations and Section 47.6 describes some optional groupings in other related profiles.

Table 47.3-1: 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	--
Lightweight Modality	None	--	--
Image Manager/Archive	None	--	--
Result Aggregator	ITI CT / Time Client	ITI TF-1: 7	--

47.4 EBIW Overview

47.4.1 Concepts

The primary goal of the EBIW Profile is to ensure that images acquired in the context of a patient encounter are combined and stored 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.

Many of the concepts in this profile were influenced by a set of whitepapers on Enterprise Imaging done by members of a joint working group of the Society for Imaging Informatics in Medicine (www.siim.org) and the Healthcare Information and Management Systems Society (www.himss.org). The whitepapers (available from http://siim.org/page/himss_siim_white_pap) include:

- A Foundation for Enterprise Imaging
- Order-based vs Encounter-based Image Capture
- Workflow Challenges of Enterprise Imaging
- Technical Challenges of Enterprise Imaging

Readers may also find useful the whitepaper from the IHE Patient Care Device Domain entitled Point-of-Care Identity Management (PCIM) which is available here: http://ihe.net/uploadedFiles/Documents/PCD/IHE_PCD_WP_PCIM_Rev1.1_2017-06-16.pdf

47.4.1.1 Encounter Information Model

The information model diagram (see Figure 47.4.1.1-1) 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.

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.

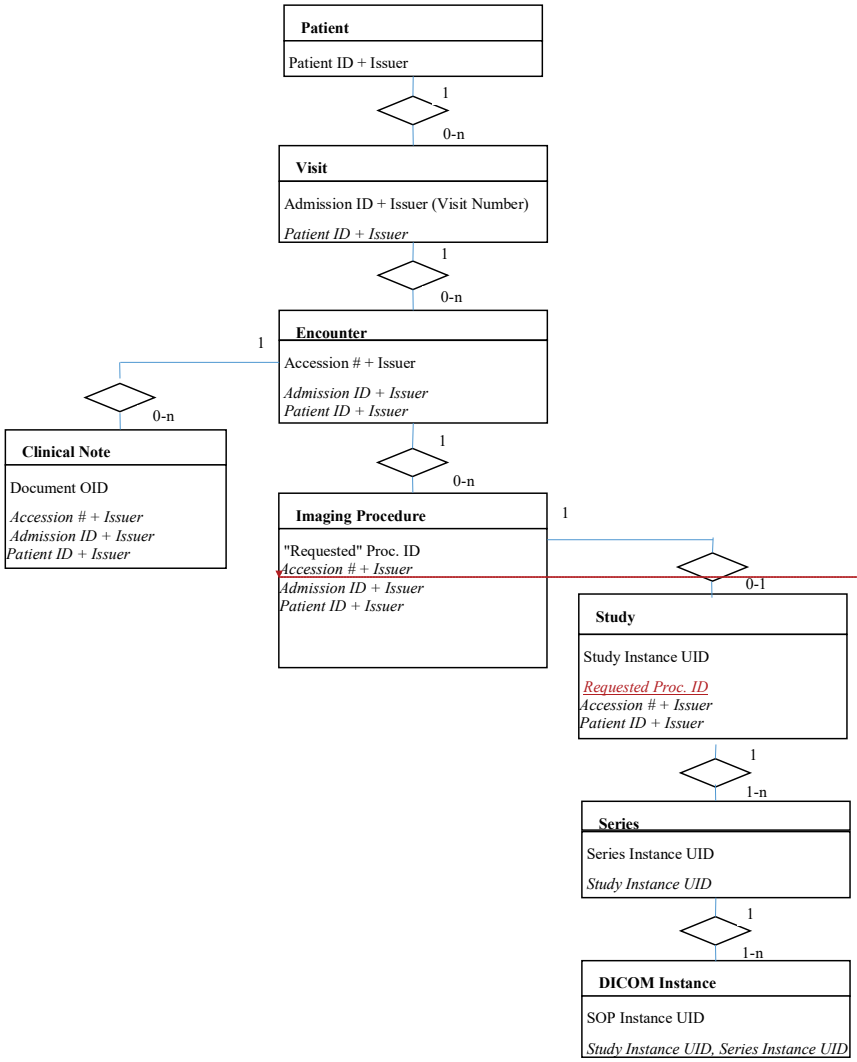

Figure 47.4.1.1-1: Encounter-Based Imaging Information Model

Deleted: *Add RP ID in study box*

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 subsequent imaging.

It is often left to the modality operator to control when to make a new Study within an encounter. The DICOM header includes attributes for the Body Part Examined and the Modality of each Series. For Encounters that image multiple body parts, imaging of each body part should be in separate Series to allow proper population of the Body Part Examined attribute in the DICOM header. Similarly, if images are produced from multiple modalities during the same encounter, they must at least be put in different Series. It is also acceptable to consider the Encounter as having multiple Imaging Procedures, which each have a Study and one or more Series.

Deleted: acquisition

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.

Figure 4.1.1-1 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. It is expected that notes will always have an OID (a unique Object Identifier) allowing them to be uniquely identified. If such notes also include the Accession # and Issuer, the note could be unambiguously linked to the Encounter and thus to the other artifacts generated in the encounter. Clinical notes might be encoded as HL7 CDA documents.

For many encounter-based images, there will not necessarily be an associated diagnostic report. If diagnostic findings are recorded, they might be put into a procedure note as described in the previous paragraph. It is also possible that a formal diagnostic report will be made about the imaging procedure, similar to that produced for a radiology procedure. Such reports are associated with the Accession # and the Study Instance UID. Reports may refer to images acquired over multiple encounters (e.g., priors).

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.

47.4.1.2 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 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.

47.4.1.3 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 implemented as a component of 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 of Imaging Results [RAD-132] 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.

47.4.1.4 Obtaining Patient Metadata

The Encounter Manager is responsible for obtaining relevant patient metadata which it provides to the encounter-based imaging modality. A variety of HL7 v2.5.1 message segments and fields contain relevant patient details. This profile does not mandate support for any specific set of HL7v2 messages containing those segments, but several IHE profiles are worth considering.

The Encounter Manager could group with a Patient Demographics Consumer in the Patient Administration Management (PAM) Profile to receive a feed of patient demographics for all patients in the facility. The Patient Identity Management [ITI-30] transaction 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 47.4.1.4) since [ITI-31] also contains patient demographics.

The Encounter Manager could group with a Patient Demographics Consumer in the 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] transaction 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 Patient Demographics Query v3 (PDQv3) Profile to get patient demographics on demand. The Patient 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 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 EMR and thus has direct internal access to the required patient records even if the EMR has not implemented any demographics related profiles.

47.4.1.5 Obtaining Encounter Metadata

The Encounter Manager is also responsible for obtaining relevant encounter metadata which it provides to the encounter-based imaging modality. A variety of HL7 v2.5.1 message segments and fields contain relevant encounter details. This profile does not mandate support for any specific set of HL7 messages containing those segments, but several IHE profiles are worth considering.

The Encounter Manager could group with a Patient Encounter Consumer in the 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 Patient Demographics Query (PDQ) Profile to get some encounter details on demand. The Patient Demographics and Visit Query [ITI-22] transaction 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 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 EMR and thus has direct internal access to the required visit and encounter records.

The Encounter Manager could be a recipient of HL7 SIU messages (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 EMR and can create appropriate values for the required fields itself.

47.4.1.6 Recording Encounter and Procedure Metadata

The ability to properly manage, locate, access, and use encounter-based images depends on key encounter and procedure metadata being properly captured and recorded with the images. In particular, information about the imaging procedure (such as the body part examined, and the reason the image was captured) are best known at the moment the image is captured. The further away in time and space this information is recorded, the less available and accurate it will be.

The Acquisition Modality and Lightweight Modality are responsible for meeting the full requirements for stored images as documented in the Store Encounter Images [RAD-131] transaction and the Store Instances Over the Web [RAD-108] transaction. Some of the information will be available in the response received in the Get Encounter Imaging Context [RAD-130] transaction. Populating the rest of these details will likely require some interaction with the operator. This profile does not dictate how this takes place but advises that it should be as automated and convenient as possible. This might include picklists for the operator to avoid manual entry. Those picklists might be configurable or filtered based on details of the encounter to keep them as short and manageable as possible. E.g., given the care team specialty and the reason for visit, a table might be able to provide a short list for the body part and/or procedure type.

The Acquisition Modality and Lightweight Modality may also supplement the encounter metadata. For example, based on who is logged into the modality, or from scanning a care provider badge, the modality may know more accurately which care provider the patient is having an encounter with, or which department or specialty is currently using the device. Again, configurable picklists might be a useful feature.

47.4.1.7 Recording Image Metadata

Image (pixel) metadata is captured by traditional Acquisition Modalities in ways particular to those medical devices. Lightweight Modalities will likely capture and submit images in

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consumer image or video formats that support EXIF tags that record metadata relevant to the procedure and to the image encoding.

Much of the information that may exist in EXIF tags can be recorded in the DICOM VL Photographic Equipment Module (see DICOM PS3.3 Section C.8.12.10), the DICOM VL Photographic Acquisition Module (see DICOM PS3.3 Section C.8.12.11), and the Photographic Geolocation Module (see DICOM PS3.3 Section C.8.12.12).

For further guidance on mapping EXIF values into DICOM attributes, refer to DICOM PS3.17 Annex NNNN Mapping of Visible Light Photography Related Attributes to EXIF and TIFF/EP Tags (Informative).

In the case where the image capture device is separate from the Lightweight Modality that is generating the stored DICOM image instance, the General Equipment Module will describe the Lightweight Modality, but the image capture device can be described in the Contributing Equipment Sequence (0018,A001), which includes details such as:

- Manufacturer, Model, Serial Number
- Software Version
- Spatial Resolution
- Last Calibration
- Institution Name. Institutional Department Name
- Station Name
- Operator's Name, Operator's ID
- Contribution Datetime
- Contribution Description

Although not required by this profile, if the Lightweight Modality modifies values from EXIF tags before recording them in DICOM attributes, it might consider recording the original EXIF values in the Original Attributes Sequence (0400,0561).

47.4.1.8 Consumption of Encounter-Based Images

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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
- To support medico-legal proceedings
- To support billing

The key is being able to find relevant images amongst a potentially very large collection.

The most important metadata, 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
- Purpose/reason for performed procedure (code and text), Study description , Series description

The Care Team associated with images is also a useful axis for organizing and accessing images. A Care Team may capture a list of members and also associate the team with a care task or clinical specialty. The metadata that is useful for finding relevant images may also be useful for ranking relevancy or for grouping and presenting images (e.g., hanging 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.

- Procedure documentation
- Observation evidence
- Diagnostic images

For further discussion of the organization of encounter-based imaging, refer to Roth, C.J., Lannum, L.M. & Persons, K.R. J Digit Imaging (2016) Volume 29. https://doi.org/10.1007/s10278-016-9882-0

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47.4.1.9 Codesets

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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 performed imaging. This profile does not mandate the use of particular codesets but makes the following recommendations.

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. An important consideration for sites establishing local codes and conventions is what level of granularity is most appropriate. While fine-grained codes (anterior of distal left index finger) can provide greater specificity, more coarse codes (left hand) can provide shorter picklists and simpler queries.

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

Point-of-Care Ultrasound systems should consider the code list provided in RAD TF-3:Appendix Z Table Z-1 for populating the Reason for Performed Procedure Code Sequence (0040,1012).

Digital photography is used in a wide range of settings and for a wide variety of purposes; however, a given device in a given department will likely be used for a much smaller subset of purposes. Moreover, the local department may have specific conventions for how the procedures are named. Supporting the ability to configure a departmental list of codes is a sensible approach. The list could either be configured into the Encounter Manager which would return an appropriate list in the Get Encounter Imaging Context [RAD-130] transaction based on the department details in the query, or the lists could be individually configured on each of the Lightweight Modality Actors depending on where they are currently being used.

A few medical photography-related codes are provided for consideration in RAD TF-3:Appendix Z Table Z-2. Ultimately though, many images are taken as supportive evidence for an associated procedure (e.g., dermabrasion, or alveolar recontouring). Recording the associated "primary" procedure (rather than the secondary procedure of "medical photography") can make it easier to find relevant images later and understand the purpose of each. In a similar vein, Reason for Visit (0032,1066) or Reason for Visit Code Sequence (0032,1067) might be a practical analog for the reason for imaging.

47.4.1.10 Unidentified Patients

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It is to be expected that some patients being imaged have not yet been identified (e.g., admitted while unconscious). This is sometimes referred to as the "John Doe" scenario.

Procedure and Pixel metadata should be populated as usual in this case since they are not affected by the patient identity.

Encounter metadata can be mostly populated as usual but might be a bit sparser since this scenario often occurs in an urgent care context. If the John Doe patient has been admitted, they should have the normal identification mechanisms (e.g., a wristband with an Admission ID) and

the imaging device will still have whatever information it has about the department, operator, and location context.

Patient metadata will be sparser and the name/ID will likely be placeholders. The Modality and the Encounter Manager should be prepared to work with commonly used methods for handling John Doe patients. This may include:

- Having a list of temporary Patient ID values (MRNs) and conventions for Patient Name, sex and age.
- Registering the John Doe with sex and estimated age and assigning a temporary Patient ID which makes those details available to the Encounter Manager the same as for regular patients. The Modality would receive these from the Get Encounter Imaging Context [RAD-130] transaction by searching for the patient ID or admission ID from the wristband or manual entry.
- Managing a list of temporary IDs on the Encounter Manager, which are provided to the Modality in the Get Encounter Imaging Context [RAD-130] transaction when the Modality uses some mechanism defined by the Encounter Manager, e.g., query for a Patient ID of 000.

Existing methods on the PACS and RIS for merging records with placeholder demographics after the patient has been properly identified should also work effectively for Encounter-Based imaging data. For more details, refer to the Unidentified Patient use cases in the Scheduled Workflow.b Profile and materials on Patient Information Reconciliation.

47.4.1.11 RAW Camera Images

Some Lightweight Modalities are capable of recording images in vendor-specific file formats often referred to collectively as RAW. Those RAW images are typically converted to formats like JPEG and PNG for general distribution. This profile covers the JPEG and PNG but does not currently address RAW formats.

Compared to the JPEG images, the RAW images typically contain more bits per pixel, span a wide color gamut, and thus don't impose particular white balance and exposure choices associated with the loss of data when "downsampling" and compressing into JPEG. The extra bits can be important when there is medical value in the extended sensitivity of the sensors; for example, infrared can be relevant to dermatology applications.

DICOM attributes support multiple samples per pixel and high numbers of bits per sample, however most current IODs do not support both at the same time. The DICOM VL Photographic Image IOD has 3 samples per pixel, but the VL Image Module places a limit of 8-bit samples. A number of Image IODs allow 16-bit samples, but only 1 sample per pixel. The VL Whole Slide Microscopy Image IOD demonstrates the precedent of 3 samples per pixel and 16-bit samples.

Note that DICOM requires image storage SCPs to be capable of providing an uncompressed version of stored images that are losslessly compressed.

Although the DICOM Raw Data IOD has "raw" in the name, it was not named for the RAW image format. The Raw Data IOD was developed to provide a way to leverage the DICOM storage infrastructure for opaque blobs of binary data, such as unreconstructed CT sinogram data. Aside from storage, the Raw Data instances are otherwise non-interoperable since the payload remains proprietary. Since the use case only involved storage and retrieval back to a corresponding proprietary system, the lack of interoperability was not an issue.

47.4.1.12 Record-Driven Acquisition

For some EBIW use cases, an operator might find it convenient for the current imaging to inherit its context from an existing entry in the patient record. For example, a practitioner who is interacting with the encounter manager or a patient record viewer might initiate imaging to capture a current image of a previously imaged skin lesion ("take follow-up image"), or to capture an image of a wound to accompany the existing evaluation of the current state of the wound (supportive).

Inheriting the context could avoid re-entry of details such as patient, body part, reason for imaging, etc. This profile does not specifically require such functionality, but some possible implementations are described here. One might think of this as a "push workflow" where the procedure is initiated from somewhere other than the modality, or perhaps as a "repeat order for current date" where the existing image represents the "prior order" to be repeated.

An Encounter Manager that is integrated with an EMR or enterprise imaging system could extract metadata from the record that is currently being viewed and use that to populate an Encounter Imaging Context entry combined with a new Study UID, Accession #, Admission ID, etc. The entry might identify the Lightweight Modality in the Scheduled Station AE Title (0040,0001) or the operator in the Scheduled Performing Physician's Name (0040,0006), allowing a pre-configured query on the Lightweight Modality to get the current task semi-automatically.

Depending on the situation, the Encounter Manager might search the archive for relevant priors for the current list of patients and populate Encounter Imaging Context entries from which the operator could select.

A Lightweight Modality that is grouped with an EMR Viewer, for example a tablet with a camera, could pull much of the context from the record and only use the query to the Encounter Manager to get the Study UID, Accession # and other administrative details. From the operators' point of view, they would select the "Follow-up" button in the viewer and the tablet camera would be activated. The rest would happen in the background with perhaps a metadata confirmation screen at completion of the imaging.

A Lightweight Modality could do Deferred Completion (see Section 47.4.1.16) and associate the new images with the existing patient record entry after the images have been acquired.

47.4.1.13 Biometric-based Patient Identification

In recent years, the use of biometric information (such as fingerprints, facial recognition, iris scans, voiceprints, etc.) to identify people has been gradually seeing wider use in a variety of contexts. One could imagine the camera on a smartphone being used for facial recognition prior to acquiring medical images.

This Profile does not dictate how the modality obtains a patient ID with which to query for demographic and encounter metadata. It is expected that it will be most common to either scan a patient wristband or enter the ID manually, however implementers are not restricted from exploring more advanced technologies.

It should be noted, however, that such technologies typically depend on local infrastructure. For example, reference biometrics will need to be collected for a large enough portion of the patient populate to make this useful, and a "mapping service" will be needed to match the biometrics of the current patient undergoing encounter-based imaging against the reference biometrics to generate a positive ID.

Also, biometric-based patient identification will likely have a non-zero error rate so corresponding exception handling and related measures will be needed. The Patient Information Reconciliation Profile provides some guidance on handling mis-identified patients.

Security and privacy issues might also be raised if either the current patient biometrics or the reference biometrics were stored on the modality or in the clinical record.

47.4.1.14 Guided Acquisition

The diagnostic quality of medical photography could benefit from presenting instructions to the operator describing important details such as how the anatomy is to be positioned and illuminated, how the camera should be oriented, how the field of view should be framed, etc., effectively a protocol for acquiring the images. An Instruction Sequence (0018,9914) containing such instructions might be returned by the Get Encounter Imaging Context [RAD-130] transaction.

For example, instructions could be sent to the camera ("First photo the whole left arm", "confirm", "Now zoom halfway in to the lesion", "Now turn on the special lighting and fill 75% of the image with the lesion", ...) and displayed to the operator, allowing them to confirm as each image is acquired.

Such guided acquisition might support automatically assigning the correct metadata for the body part and type of photo without further interaction by the operator.

Note that the acquisition is guided in the sense of "static" instructions, not in the sense of an interactive feedback loop.

47.4.1.15 Study and Series Organization

DICOM requirements cover when data *must* be put into separate studies or series, but beyond that deliberately leaves to implementations and operators the choice of when to further separate studies and series of acquired images.

At a minimum, switching to a different acquisition device, operator, protocol, or body part results in a new series; and a different referring physician, consulting physician, physician of record, or service results in a new study.

Typically, one would expect that different encounters, even if during the same admission, would be recorded in different studies and the images from a single encounter would usually be in the same study unless they were being acquired for different purposes.

It is also common that images that are reported together are kept in the same study.

Implementations may also find it useful to interact with the operator to determine groupings when many images are acquired on a patient during one encounter, especially if several procedures have been performed. For example, photos may be taken documenting multiple surgical procedures during a single encounter in the operating room.

There is precedent for the Image Manager to coerce/re-organize the Series and Study groupings submitted by the Acquisition Modality based on facility conventions and that remains true in this Profile.

See Section 47.4.1.2 for a related discussion of accession numbers.

47.4.1.16 Deferred Completion

Metadata obtained and incorporated at the time of acquisition is the most readily available and likely to be the most accurate. It is, however, conceivable that products may be developed that devise mechanisms to reliably incorporate accurate metadata some time after acquisition, perhaps as a batch job. For example, a product consisting of a camera and software might involve the camera photographing a barcode or QR code before and after photographing the corresponding patient. This might be sufficient for the software to correlate the code to a schedule or metadata query when images are transferred from the camera to the software system some time later. The completion activity might also include human operation to confirm or assign body part labels or other metadata. Such software might be grouped with the Image Manager or Encounter Manager Actors.

Although such solutions are not further described here, they would be compatible with this profile with the software playing the role of the Lightweight Modality. The interface between the image sensor device and the modality software is out of scope of this profile (in the same way that the interface between a CT gantry and the modality console is out of scope of the Scheduled Workflow.b Profile).

47.4.2 Use Cases

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

- 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 EMR imaging description
- Associate report or note describing the visit where the images were obtained with images displayed in an enterprise viewer

An important aspect of all these use cases 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 imaging may also be a Standard of Care component of the larger procedure or treatment plan.

47.4.2.1 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.

47.4.2.1.1 Point of Care Ultrasound Use Case Description

The Point of Care Ultrasound Use Case is intended to generalize 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:
    - 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 specialist's report.

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 47.4.1.4 and 47.4.1.5) and is not formally part of the EBIW Profile.

Deleted: 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.¶

47.4.2.1.2 Point of Care Ultrasound Process Flow

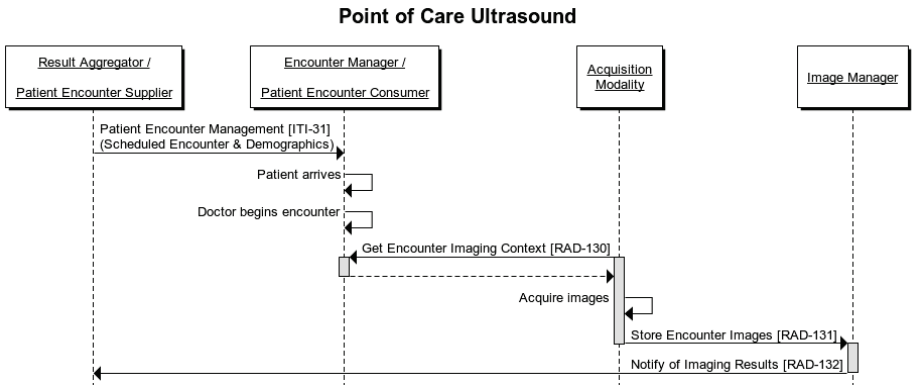

Figure 47.4.2.1.2-1: Point of Care Ultrasound Process Flow in EBIW Profile

The text in Figure 47.4.2.1.2-2 was used to generate the diagram in Figure 47.4.2.1.2-1. 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-130]
activate Modality
EM-->-Modality:
Modality->Modality: Acquire images
Modality->-Image Manager: Store Encounter Images [RAD-131]
activate Image Manager
Image Manager->-RA: Notify of Imaging Results [RAD-132]
```

Figure 47.4.2.1.2-2: Diagram Pseudocode for Point of Care Ultrasound Process Flow

47.4.2.2 Use Case #2: Lightweight Modality

Images are captured at the point-of-care using a "lightweight" device such as a smartphone, tablet or digital camera that is capable of being programmed to use RESTful HTTP messages. The workflow is typically "order-less" in that it is not driven by an order from a referring physician.

47.4.2.2.1 Lightweight Modality Use Case Description

The Lightweight Modality Use Case is intended to generalize the following scenarios:

- Patient Status Check
  - A registered inpatient is in their bed in a ward, or an outpatient has come to visit a clinic.
  - In the course of checking the status of a condition (e.g., changing the dressing on a wound or burn) the care provider captures images of the current state.
  - Although the image is typically evidentiary or for simple assessment rather than "diagnostic", it might still be referred to a specialist if potential anomalies are observed. There are also examples of clinical applications that could analyze the current (and prior) images to identify potential issues (such as necrotized tissue or infection) or estimate the rate of healing.
- Consultation
  - A care provider captures images of the patient to supplement a consultation request to a colleague.
- Procedure Evidence
  - A patient (either inpatient or outpatient) is having a procedure such as an excision.
  - The care provider captures images of the procedure site before and/or after the procedure.
  - The imaging may be kept in the medical record as evidence of the nature of the tissue on which the procedure was performed, the outcome of the procedure, and perhaps the state of the patient before and after the procedure.
- 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 dermatologist evaluating a skin lesion detected by the patient's primary care physician.
  - The specialist decides to take additional photographs to evaluate/characterize the condition or to document the absence of the suspected condition.
  - The findings from the imaging would be included in the specialist's report.

The Process Flow below shows the Lightweight 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 47.4.1.4 and 47.4.1.5) and is not formally part of the EBIW Profile.

47.4.2.2.2 Lightweight Modality Process Flow

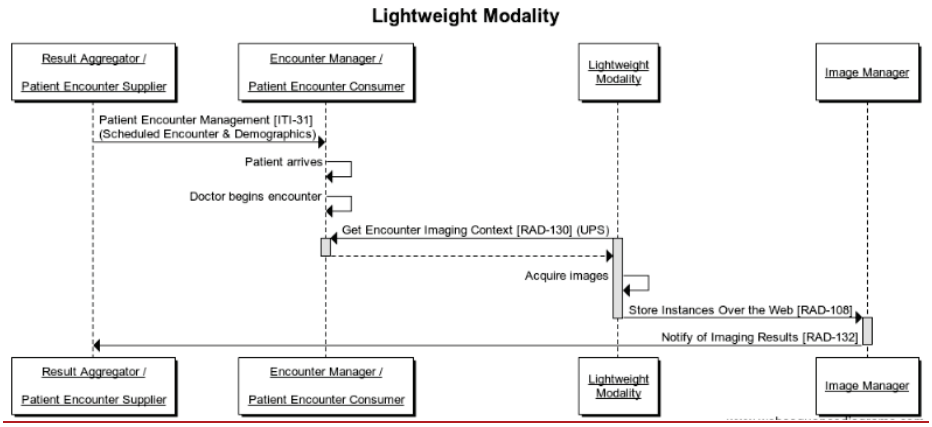

Figure 47.4.2.2.2-1: Lightweight Modality Process Flow in EBIW Profile

The text in Figure 47.4.2.2.2-2 was used to generate the diagram in Figure 47.4.2.2.2-1. Readers will generally find the diagram more informative. The text is included here to facilitate editing.

```
title Lightweight Modality

participant Result Aggregator /\n\nPatient Encounter Supplier as RA
participant Encounter Manager /\n\nPatient Encounter Consumer as EM
participant Lightweight\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-130] (UPS)
activate Modality
EM-->-Modality:
Modality->Modality: Acquire images
Modality->-Image Manager: Store Instances Over the Web [RAD-108]
activate Image Manager
Image Manager->-RA: Notify of Imaging Results [RAD-132]
```

Figure 47.4.2.2.2-2: Diagram Pseudocode for Lightweight Modality Process Flow

47.4.2.3 Use Case #3: Separate Capture

Images are captured at the point-of-care using a device, such as a digital camera, that is not programmed to use RESTful HTTP messages. The images from this separate capture device are communicated to another system that plays the role of the Lightweight Modality. This is analogous to the way the gantry of a CT scanner, which does the actual image data acquisition, communicates with the console using vendor proprietary mechanisms, while the console plays the role of the Acquisition Modality in profiles such as Scheduled Workflow, using the prescribed standard interfaces.

The EBIW Profile does not dictate how a modality communicates with the image capture component. A digital camera might be directly tethered to the modality system, or it might use a WiFi-enabled SD Card, or it might depend on the operator manually removing a memory card from the camera and inserting it in a reader on the modality.

47.4.2.3.1 Separate Capture Use Case Description

The Separate Capture Use Case is intended to handle the same scenarios described in the Lightweight Modality Use Case (see Section 47.4.2.2).

In the following diagram, the operator acquires the images first, then confirms and cues up the metadata second whereupon they are combined and stored. In principle, the operator could get the encounter metadata before using the capture device to acquire the images.

Separating the capture device from the Lightweight Modality introduces design questions, a few of which are mentioned here, that are left to the implementation to resolve.

Separate capture devices typically have internal clocks and will need some process to keep their date/time accurately synchronized with the Lightweight Modality system.

If the operator interacts with the capture device and the Lightweight modality separately, care will need to be taken to keep the acquired images associated with the correct patient/procedure/bodypart metadata. Such issues can be exacerbated when using Deferred Completion (see Section 47.4.1.16)

47.4.2.3.2 Separate Capture Process Flow

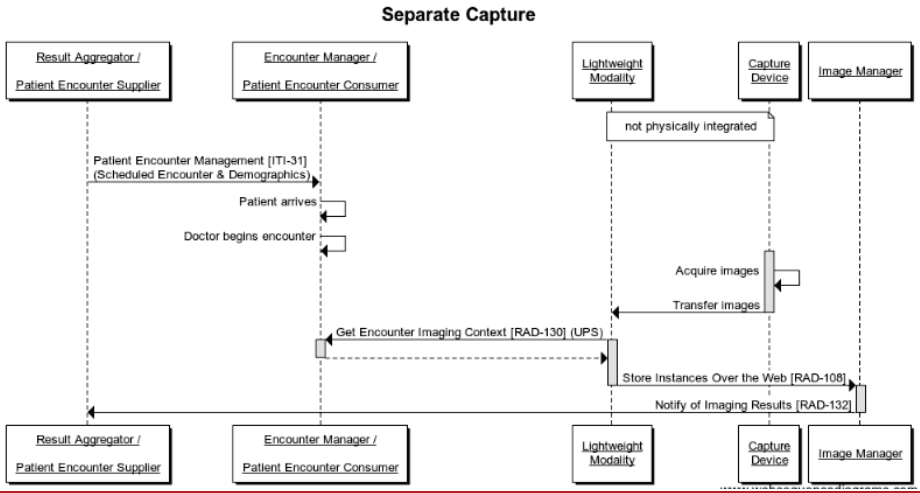

Figure 47.4.2.3.2-1: Separate Capture Process Flow in EBIW Profile

The text in Figure 47.4.2.3.2-2 was used to generate the diagram in Figure 47.4.2.3.2-1. Readers will generally find the diagram more informative. The text is included here to facilitate editing.

```
title Separate Capture

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

note over Modality, Capture: not physically integrated
RA->EM: Patient Encounter Management [ITI-31]\n(Scheduled Encounter & Demographics)
EM->EM: Patient arrives
EM->EM: Doctor begins encounter
activate Capture
Capture->Capture: Acquire images
Capture->-Modality: Transfer images
Modality->+EM: Get Encounter Imaging Context [RAD-130] (UPS)
activate Modality
EM-->-Modality:
Modality->-Image Manager: Store Instances Over the Web [RAD-108]
activate Image Manager
Image Manager->-RA: Notify of Imaging Results [RAD-132]
```

Figure 47.4.2.3.2-2: Diagram Pseudocode for Separate Capture Process Flow

47.5 EBIW Security Considerations

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

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

47.5.1 Security Considerations for Actors

All actors in the EBIW Profile should consider grouping with a Secure Application or Secure Node Actor in the 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] transaction 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 modality being exposed to people who are not authorized to use it or access the information it contains. The Acquisition Modality and Lightweight 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.

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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.

47.5.2 Security Considerations for Encounter-based Images

Images contain personal demographic information and clinical information.

47.6 EBIW Cross Profile Considerations

Table 47.6-1 describes various actors in various other profiles that might be useful to group with EBIW Profile actors.

Table 47.6-1: 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.

EBIW Actor	Might group with	Potential Purpose
	PDQ/PDQv3/PDQm Patient Demographics Consumer	To query for patient demographics that could populate the encounter-based imaging context. See Section 47.4.1.4 for discussion of usage. See ITI TF-1: 8, ITI TF-1:24, ITI TF-1:38 for profile details.
	PAM Patient Demographics Consumer	To receive a feed of patient demographics that could populate the encounter-based imaging context. See also Section 47.4.1.4 for discussion of usage. See ITI TF-1: 14 for profile details.
	PAM Patient Encounter Consumer	To receive a feed of encounter details that could populate the encounter-based imaging context. See also Section 47.4.1.5 for discussion of usage. See ITI TF-1: 14 for profile details.
	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. See ITI TF-1: 9 for profile details.
	IRWF.b Importer	To import prior images on media that a patient has brought to an encounter.
Acquisition Modality or Lightweight 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. See ITI TF-1: 9 for profile details.
Image Manager/ Archive	XDS-I.b Image Document Source	To make encounter-based images available for sharing across the enterprise. Since the images have all the relevant metadata, including Accession #, this should work transparently.
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.

Volume 3 – Transactions

Add new transaction 4.130

4.130 Get Encounter Imaging Context [RAD-130]

4.130.1 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.

4.130.2 Actor Roles

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

Table 4.130.2-1: 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 Lightweight Modality
Role:	Responder: Processes a request and returns metadata results that matches the requested filter (if any).
Actor(s):	The following actors may play the role of Responder: Encounter Manager

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

4.130.3 Referenced Standards

DICOM PS3.4: Modality Worklist SOP Class

DICOM PS3.18: DICOM UPS-RS Worklist Service

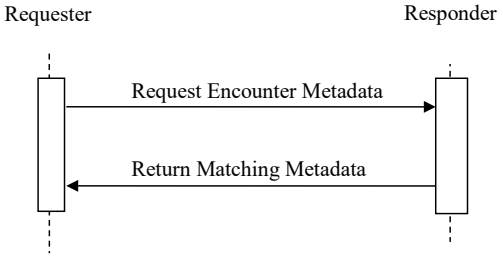
DICOM PS3.4: Unified Procedure Step Service and SOP Classes

DICOM PS3.3: Unified Procedure Step Information Object

DICOM PS3.17: Unified Worklist and Procedure Step - UPS (Informative)

4.130.4 Messages

Deleted: Interaction Diagram



4.130.4.1 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.

4.130.4.1.1 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.

4.130.4.1.2 Message Semantics

Message semantics are defined here for both the DICOM Modality Worklist Service (MWL Semantics) and the DICOM UPS-RS Worklist Service (UPS Semantics). Profile, and/or Options being claimed that incorporate this transaction will specify whether actors are required to support one, the other, or both sets of semantics.

In MWL 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.

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In UPS Semantics, the message is a SearchForUPS Action of the DICOM UPS-RS Worklist Service. The Requestor is the User-Agent, and the Responder is the Origin-Server.

The semantics and expected actions in this message are stated in terms of DICOM MWL Attributes and DIMSE Services. For UPS semantics, the same requirements apply with the correspondence from DIMSE to RESTful semantics described in DICOM PS 3.18 Section 6.9 and the mappings from MWL attributes to UPS attributes described in Table 4.130.4.1.2-2

Note: This transaction uses the RESTful C-FIND and response of UPS-RS but does not presume any intention to actually instantiate and manage workitems (e.g., to claim, update, subscribe to, or send notifications about workitems).

The Requester shall support the required SCU query keys listed in Table 4.130.4.1.2-1.

Table 4.130.4.1.2-1 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 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 the Store Encounter Images [RAD-131] transaction. 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. The value is intended to ~~**be informative for**~~ influence the business logic of the Responder (see Section 4.130.4.1.3).

The Requester shall include the Modality (0008,0060) as Matching Key populated with its own modality. The value is intended to ~~**be informative for**~~ influence the business logic of the Responder (see Section 4.130.4.1.3).

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

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
Patient Metadata					
Patient Identification					
Patient's Name	(0010,0010)	R+	R	R+	R
Patient ID	(0010,0020)	R+	R	R+	R
Issuer of Patient ID	(0010,0021)	O	R+	R+	R+
Other Patient IDs Sequence	(0010,1002)	O	O	O	R+
Patient Demographic					
Patients Birth Date	(0010,0030)	O	O	R+	R+
Patient's Sex	(0010,0040)	O	O	R+	R+
Confidentiality constraint on patient data	(0040,3001)	O	O	O	R+

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
~~Ethnic Group~~	~~(0010,2160)~~	~~O~~	~~O~~	~~O~~	~~O~~
~~Patient Medical~~					
~~Pregnancy Status~~	~~(0010,21C0)~~	~~O~~	~~O~~	~~O~~	~~O~~
~~Contrast Allergies~~	~~(0010,2110)~~	~~O~~	~~O~~	~~O~~	~~O~~
~~Patient's Weight~~	~~(0010,1030)~~	~~O~~	~~O~~	~~O~~	~~O~~
~~Patient's Size~~	~~(0010,1020)~~	~~O~~	~~O~~	~~O~~	~~O~~
Encounter Metadata					
Visit Identification					
Institution Name	(0008,0080)	O	R+	R+	R+
Institution Code Sequence	(0008,0082)	O	O	R+	R+
Institution Address	(0008,0081)	O	O	R+	R+
Institutional Department Name	(0008,1040)	R+	R+	R+	R+
Institutional Department Type Code Sequence ~~[IHE-6]~~	(~~xxxx,yyyy~~ 0008,1041)	R+	R+	R+	R+
Admission ID	(0038,0010)	R+	R+	R+	R+
Issuer of Admission ID Sequence	(0038,0014)	R+	R+	R+	R+
Visit Admission					
Admitting Date	(0038,0020)	O	O	O	R+
Admitting Time	(0038,0021)	O	O	O	R+
Admitting Diagnoses Description	(0008,1080)	O	O	O	O
Admitting Diagnoses Code Sequence	(0008,1084)	O	O	O	O
Reason~~(s)~~ for Visit ~~[IHE-6]~~	(~~xxxx,yyyy~~ 0032,1066)	O	O	O	R+
Reason~~(s)~~ for Visit Code Sequence ~~[IHE-6]~~	(~~xxxx,yyyy~~ 0032,1067)	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	O
Procedure Metadata					
Imaging Service Request					
Accession Number	(0008,0050)	O [IHE-4]	O [IHE-4]	R+	R+ [IHE-3]
Issuer of Accession Number Sequence	(0008,0051)	O	O	R+	R+
Requesting Service	(0032,1033)	O	O	O	O

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
Requesting Service Code Sequence	(0032,1034)	O	O	O	O
Requested Procedure					
Requested Procedure Description	(0032,1060)	O	O	O	R [IHE-5]
Requested Procedure Code Sequence	(0032,1064)	O	O	O	R [IHE-5]
Reason for the Requested Procedure	(0040,1002)	O	O	O	O
Reason for Requested Procedure Code Sequence	(0040,100A)	O	O	O	O
Study Instance UID	(0020,000D)	O	O	R+*	R
Scheduled Procedure Step					
Scheduled Procedure Step Sequence	(0040,0100)			[IHE-1]	[IHE-2]
>Scheduled Station AE Title	(0040,0001)	R+	R	R+	R
>Scheduled Procedure Step Start Date	(0040,0002)	O	R	O	R
>Scheduled Procedure Step Start Time	(0040,0003)	O	R	O	R
>Scheduled Procedure Step Location	(0040,0011)	O	O	O	O
>Modality	(0008,0060)	R+	R	R+	R
>Scheduled Performing Physician's Name	(0040,0006)	O	R	O	O
~~**>Scheduled Procedure Step ID**~~	~~**(0040,0009)**~~	~~**O**~~	~~**O**~~	~~**O**~~	~~**R**~~
>Scheduled Protocol Code Sequence	(0040,0008)	O	O	O	O
>Scheduled Procedure Step Description	(0040,0007)	O	O	O	R

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

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

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

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

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

~~**[IHE-6]: The Tag numbers for these attributes is pending completion of a Change Proposal in DICOM. When that CP is complete, a corresponding CP in IHE Radiology will update this table.**~~

The following table applies to UPS Semantics. Implementers of MWL Semantics can ignore it.

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

Attribute Name	Tag	UPS Mapping
Patient Metadata		
Patient Identification		
Patient's Name	(0010,0010)	Same
Patient ID	(0010,0020)	Same
Issuer of Patient ID	(0010,0021)	Same
Other Patient IDs Sequence	(0010,1002)	Same
Patient Demographic		
Patients Birth Date	(0010,0030)	Same
Patient's Sex	(0010,0040)	Same
Confidentiality constraint on patient data	(0040,3001)	*Same*
Ethnic Group	(0010,2160)	*Same*
Patient Medical		
Pregnancy Status	(0010,21C0)	Same
Contrast Allergies	(0010,2110)	Same
Patient's Weight	(0010,1030)	*Same*
Patient's Size	(0010,1020)	*Same*
Encounter Metadata		
Visit Identification		
Institution Name	(0008,0080)	*Same*
Institution Code Sequence	(0008,0082)	*Same*
Institution Address	(0008,0081)	*Same*
Institutional Department Name	(0008,1040)	*Same*
Institutional Department Type Code Sequence	(0008,1041)	*Same*
Admission ID	(0038,0010)	Same
Issuer of Admission ID Sequence	(0038,0014)	Same
Visit Admission		
Admitting Date	(0038,0020)	*Same*
Admitting Time	(0038,0021)	*Same*
Admitting Diagnoses Description	(0008,1080)	Same
Admitting Diagnoses Code Sequence	(0008,1084)	Same
Reason for Visit	(0032,1066)	*Same*
Reason for Visit Code Sequence	(0032,1067)	*Same*
Consulting Physician's Name	(0008,009C)	O
Consulting Physician Identification Sequence	(0008,009D)	*Same*

Commented [OK1]: >Requesting Physician (0032,1032) (Consulting in General Study and Visit Admission modules)

Attribute Name	Tag	UPS Mapping
Referring Physician's Name	(0008,0090)	Same. (in Referenced Request Sequence (0040,A370))
Referring Physician Identification Sequence	(0008,0096)	*Same*
Referring Physician's Telephone Numbers	(0008,0094)	*Same*
Visit Status		
Current Patient Location	(0038,0300)	*Same*
Procedure Metadata		
Imaging Service Request		
Accession Number	(0008,0050)	Same. (in Referenced Request Sequence (0040,A370))
Issuer of Accession Number Sequence	(0008,0051)	Same. (in Referenced Request Sequence (0040,A370))
Requesting Service	(0032,1033)	Same. (in Referenced Request Sequence (0040,A370))
Requesting Service Code Sequence	(0032,1034)	Same. (in Referenced Request Sequence (0040,A370))
Requested Procedure		
Requested Procedure Description	(0032,1060)	Same. (in Referenced Request Sequence (0040,A370))
Requested Procedure Code Sequence	(0032,1064)	Same. (in Referenced Request Sequence (0040,A370))
Reason for the Requested Procedure	(0040,1002)	Same. (in Referenced Request Sequence (0040,A370))
Reason for Requested Procedure Code Sequence	(0040,100A)	Same. (in Referenced Request Sequence (0040,A370))
Study Instance UID	(0020,000D)	Same.
Scheduled Procedure Step		
Scheduled Procedure Step Sequence	(0040,0100)	Some of the following attributes not nested in UPS
>Scheduled Station AE Title	(0040,0001)	Station Name Code Sequence (0040,4025) putting AE Title in the code meaning with a local coding scheme
>Scheduled Procedure Step Start Date	(0040,0002)	Scheduled Procedure Step Start Date and Time (0040,4005)
>Scheduled Procedure Step Start Time	(0040,0003)	
>Scheduled Procedure Step Location	(0040,0011)	Scheduled Station Geographic Location Code Sequence (0040,4027)
>Modality	(0008,0060)	Scheduled Station Class Code Sequence (0040,4026) using codes from DICOM PS 3.16 CID 29 Acquisition Modality
>Scheduled Performing Physician's Name	(0040,0006)	Human Performer's Name (0040,4037) in Scheduled Human Performers Sequence (0040,4034)
>Scheduled Protocol Code Sequence	(0040,0008)	Scheduled Workitem Code Sequence (0040,4018)
>Scheduled Procedure Step Description	(0040,0007)	Procedure Step Label (0074,1204)

4.130.4.1.2.1 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 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: SCUs 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~~0008,1041), the Acquisition Modality can query for all patient encounters planned for this clinical unit. Ideally, the department value reflects the context of the acquisition, rather than ownership of the device. The 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 SCU is concerned about how a single value matching of dates and times is performed by an SCP, it may consider using range matching instead (e.g., "<today>-<today>"), which is always performed by meaning.

- Query by Operator/Physician

  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, or the operator may scan their own badge when activating the modality to perform the procedure.

- Query by Room/Location

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

4.130.4.1.3 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.

The Manager shall identify Workitems with a matching Patient ID and Issuer either inside the Other Patient IDs Sequence (0010,1002) or outside that sequence (i.e., in the "primary" ID) when a query is made using both Patient ID (0010,0020) and Issuer of Patient ID (0010,0021).

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

The Responder still includes "scheduled" details (e.g., an item in the Scheduled Procedure Step Sequence (0040,0100) or attributes in the Unified Procedure Step Scheduled Procedure Information Module) even though the encounter-based imaging procedure may not have been specifically scheduled.

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

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

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

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

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

4.130.4.2 Return Encounter Metadata

The Responder sends matching entries back to the Requester.

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4.130.4.2.1 Trigger Events

The Responder receives a Request Encounter Metadata Message.

4.130.4.2.2 Message Semantics

In MWL 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.

In UPS Semantics, the message is a SearchForUPS Action Response Message of the DICOM UPS-RS Worklist Service. The Requestor is the User-Agent, and the Responder is the Origin-Server. Both the Requestor and Responder shall support application/dicom+json for the search results.

The semantics and expected actions in this message are stated in terms of DICOM MWL Attributes and DIMSE Services. For UPS semantics, the same requirements apply with the correspondence from DIMSE to RESTful semantics described in DICOM PS 3.18 Section 6.9 and the mappings from MWL attributes to UPS attributes described in Table 4.130.4.1.2-2

The Responder shall support the matching and return keys as shown for the SCP in Table 4.130.4.1.2-1.

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 original source of those details but may have obtained them via other transactions. Populating the responses may include transcoding the metadata from HL7 fields into DICOM attributes.

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

4.130.4.2.3 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.

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

4.130.5 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.

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Deleted: Modality Worklist response

Although the UPS semantics are described above using HTTP, it is permitted to use HTTPS.

4.130.5.1 Security Audit Considerations

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

4.131 Store Encounter Images [RAD-131]

4.131.1 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.

4.131.2 Actor Roles

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

Table 4.131.2-1: Actor Roles

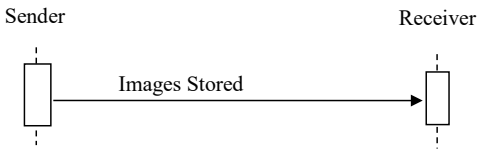
Role:	Sender: Sends encounter-based imaging data.
Actor(s):	The following actors may play the role of Sender: Acquisition Modality
Role:	Receiver: Receives and stores imaging data.
Actor(s):	The following actors may play the role of Responder: Image Manager/Archive

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.

4.131.3 Referenced Standards

DICOM PS3.4: Storage Service Class.

4.131.4 Interaction Diagram



4.131.4.1 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.

4.131.4.1.1 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.

4.131.4.1.2 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 4.131.4.1.2-1. Effectively, this table strengthens the type definition of some DICOM attributes for the IHE Technical Framework.

The Sender shall omit the Request Attributes Sequence (0040,0275). This transaction is for encounter-based images for which there was no ordered Imaging Service Request.

Table 4.131.4.1.2-1: Required Attributes

Attribute	Tag	Type	Notes
Patient's Name	(0010,0010)	R+	Important for organizing/finding images
Patient ID	(0010,0020)	R+	Important for organizing/finding images
Issuer of Patient ID	(0010,0021)	R+	Important for organizing/finding images
Issuer of Patient ID Qualifiers Sequence	(0010,0024)	O	Important for organizing/finding images
Other Patient IDs Sequence	(0010,1002)	O	Important for organizing/finding images
Patients Birth Date	(0010,0030)	R+	Important for organizing/finding images

Attribute	Tag	Type	Notes
Patient's Sex	(0010,0040)	R+	Important for organizing/finding images
Ethnic Group	(0010,2160)	O	
Patient's Weight	(0010,1030)	O	
Patient's Size	(0010,1020)	O	
Patient State	(0038,0500)	O	
Pregnancy Status	(0010,21C0)	O	
Medical Alerts	(0010,2000)	O	
Contrast Allergies	(0010,2110)	O	
Institution Name	(0008,0080)	R+	Important for organizing/finding images
Institution Address	(0008,0081)	R+	Important for organizing/finding images
Institution Code Sequence	(0008,0082)	R+	Important for organizing/finding images
Institutional Department Name	(0008,1040)	R+	Important for organizing/finding images
Institutional Department Type Code Sequence ~~[IHE-1]~~	(~~xxxx,yyyy~~ 0008,1041)	R+	Important for organizing/finding images
Admission ID	(0038,0010)	R+	Important for organizing/finding images
Issuer of Admission ID	(0038,0011)	R+	Important for organizing/finding images
Consulting Physician's Name	(0008,009C)	O	
Consulting Physician Identification Sequence	(0008,009D)	O	
Referring Physician's Name	(0008,0090)	O	
Referring Physician's Address	(0008,0092)	O	
Referring Physician's Telephone Numbers	(0008,0094)	O	
Referring Physician Identification Sequence	(0008,0096)	O	
Admitting Diagnoses Description	(0008,1080)	O	
Admitting Diagnoses Code Sequence	(0008,1084)	O	
Reason~~(s)~~ for Visit ~~[IHE-1]~~	~~(xxxx,yyyy)~~ (0032,1066)	O	
Reason~~(s)~~ for Visit Code Sequence ~~[IHE-1]~~	~~(xxxx,yyyy)~~ (0032,1067)	O	
Route of Admissions	(0038,0016)	O	
Study Instance UID	(0020,000D)	R	Important for organizing/finding images
Accession Number	(0008,0050)	R+	Important for organizing/finding images
Issuer of Accession Number Sequence	(0008,0051)	R+	Important for organizing/finding images. Can also be an indicator to differentiate encounter-based imaging from unscheduled radiology.
Study Date	(0008,0020)	R+	Important for organizing/finding images
Study Time	(0008,0030)	R+	Important for organizing/finding images

Attribute	Tag	Type	Notes
Study Description	(0008,1030)	R+	Important for organizing/finding images. Many hanging protocols and data browsing interfaces use this prominently.
Study ID	(0020,0010)	O	
Procedure Code Sequence	(0008,1032)	O	
Reason for Performed Procedure Code Sequence	(0040,1012)	O	This is strongly recommended since it is important for organizing/finding images, however since some modalities might lack a user interface to select this, it is optional in this transaction. See RAD TF-3: Appendix Z for potential codes.
Name of Physician(s) Reading Study	(0008,1060)	O	
Physician(s) Reading Study Identification Sequence	(0008,1062)	O	
Physician(s) of Record	(0008,1048)	O	May contain Admitting Physician
Physician(s) of Record Identification Sequence	(0008,1049)	O	
Series Date	(0008,0021)	R+	Important for organizing/finding images
Series Time	(0008,0031)	R+	Important for organizing/finding images
Series Description	(0008,103E)	R+	Important for organizing/finding images
Series Description Code Sequence	(0008,103F)	O	
Modality	(0008,0060)	R	Important for organizing/finding images
Performing Physician's Name	(0008,1050)	O	Important for organizing/finding images
Performing Physician Identification Sequence	(0008,1052)	O	Important for organizing/finding images
Operators' Name	(0008,1070)	R+	Important for organizing/finding images. Also important for attributing the images to a specific person for quality purposes. The Operator may also be the Performing Physician.
Operator Identification Sequence	(0008,1072)	R+	Important for organizing/finding images
Body Part Examined	(0018,0015)	R+	Important for organizing/finding images
Laterality	(0020,0060)	O	Note that laterality is handled in several ways
Anatomic Region Sequence	(0008,2218)	O	The Anatomic Region describes the anatomy visible in the imaging, which is often more than the Body Part Examined. This is strongly recommended since it is important for organizing/finding images, especially for use as priors, however since some modalities might lack a user interface

Attribute	Tag	Type	Notes
			to select this, it is optional in this transaction. See DICOM PS3.16. CID 4 Anatomic Region for potential codes.
Anatomic Region Modifier Sequence	(0008,2220)	O	Important for organizing/finding images
Primary Anatomic Structure Sequence	(0008,2228)	O	The Primary Anatomic Structure describes the focus of the imaging procedure. This typically corresponds to the text value in Body Part Examined (0018,0015). See DICOM PS3.16. CID 4 Anatomic Region for potential codes.
Primary Anatomic Structure Modifier Sequence	(0008,2230)	O	

~~**[IHE-1]: The Tag numbers for these attributes is pending completion of a Change Proposal in DICOM. When that CP is complete, a corresponding CP in IHE Radiology will update this table.**~~

See RAD TF-2: 2.2 DICOM Usage Conventions.

4.131.4.1.2.1 DICOM Image Storage SOP Classes

Receivers claiming the Encounter-Based Imaging Workflow Profile shall support all SOP Classes listed in Table 4.131.4.1.3.1-1. Senders claiming the Encounter-Based Imaging Workflow Profile shall support one or more of the SOP Classes listed in Table 4.131.4.1.3.1-1.

Table 4.131.4.1.2.1-1: 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

4.131.4.1.2.2 Study UIDs and Series UIDs

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-130]. 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 Instance UID creation must comply with a number of DICOM rules.

Deleted: be compatible

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 does not apply.

Deleted: is avoided

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

4.131.4.1.3 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).

4.131.5 Security Considerations

The DICOM objects conveyed typically constitute personal health information.

4.131.5.1 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.

4.132 Notify of Imaging Results [RAD-132]

4.132.1 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.

4.132.2 Actor Roles

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

Table 4.132.2-1: Actor Roles

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

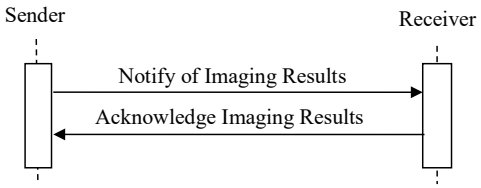
4.132.3 Referenced Standards

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

4.132.4 Interaction Diagram



4.132.4.1 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.

4.132.4.1.1 Trigger Events

New imaging objects have been acquired that the Receiver is likely unaware of, 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.

This transaction is not typically used for new order-based imaging (e.g., in the context of the Scheduled Workflow Profile (SWF.b)) since the Receiver will already have been made aware of the order driving the imaging procedure. The Sender can generally distinguish between encounter-based images, order-based images and imported images by examining the Accession Number (0008,0050) and the Request Attributes Sequence (0040,0275) in the new imaging objects. The Request Attributes Sequence (0040,0275) will be absent for encounter-based images and for the Unscheduled Case of Scheduled Workflow.b, while it will be populated for imported or other Scheduled Workflow.b cases. Accession Number (0008,0050) will have a value for encounter-based images, but be empty for Unscheduled SWF.b images, allowing those two to be distinguished.

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. For example, a Sender might send a notification as it becomes aware of each new series. A Sender cannot presume that a study is "complete" in the sense that no new data will be added since new series may be added to a study at any time.

4.132.4.1.2 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.

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-132] does not include an imaging report. In this message the physician with whom the patient had the encounter belongs in the Attending Physician field of the PV1 segment.

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

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

Table 4.132.4.1.2-1: 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

Segments	Message Content	HL7 v2.5.1 Chapter	Reference
OBR	Order Detail	4	Section 4.132.4.1.2.1 OBR Segment
TQ1	Timing/Quantity	4	Section 4.132.4.1.2.2 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 4.132.4.1.2-1.

4.132.4.1.2.1 OBR Segment

The Observation Request (OBR) Segment defines attributes ("metadata") for the imaging result.

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 4.132.4.1.2.1-1.

Table 4.132.4.1.2.1-1: 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

SEQ	LEN	DT	OPT	TBL#	ITEM #	ELEMENT NAME
44	250	CE	R		00393	Procedure Code
46	250	CE	R2	0411	01474	Placer Supplemental Service Information

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 in the case of encounter-based imaging since that 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 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: The string in OBR-18 may contain a prefix or suffix that may hint at the Assigning Authority for the Accession Number or otherwise make it unique.

Field *OBR-24 Diagnostic Serv Sect ID* shall be populated based on the value of Institutional Department **Type** Code Sequence (~~**xxxx,yyyy**~~**0008,1041**) 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 4.132.4.1.2.1-2.

Table 4.132.4.1.2.1-2: 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, such as an amended final imaging result

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 4.132.4.1.2.2. 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:

- 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~~0032,1066) or Code Sequence (~~xxxx,yyyy~~0032,1066)
  - The Tag numbers for these attributes is pending completion of a Change Proposal in DICOM. When that CP is complete, a corresponding CP in IHE Radiology will update this text.
- Admitting Diagnoses Description (0008,1080) or Code Sequence (0008,1084)

Field *OBR-32 Principal Result Interpreter* will typically be empty in the case of encounter-based images, since most are not formally interpreted. Even if they are, interpretation would often occur some time after the images are initially stored and this [RAD-132] 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 in the <site modifier (CE)> component if laterality is relevant to the procedure and laterality is not conveyed in the code value in OBR-4 *Universal Service ID*. Otherwise, OBR-46 is typically omitted.

4.132.4.1.2.2 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).

At the time RAD-132 is sent in the Encounter Based Imaging Workflow Profile, the imaging procedure will have been completed. Encounter-based imaging results are not typically urgent. The TQ1 Segment may be sent empty. If populated, a TQ1-9 *Priority* value of R^Routine^HL70078 would be appropriate for many cases.

4.132.4.1.3 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.

4.132.4.2 Acknowledge Imaging Result

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

4.132.5 Security Considerations

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

4.132.5.1 Security Audit Considerations

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

3.108 Store Instances over the Web [RAD-108]

3.108.1 Scope

This transaction is used by the Sender to send well-formed DICOM composite objects in either DICOM binary format, or in metadata and bulk data format to the Receiver for storage.

The instances may be images, video, DICOM evidence documents (such as Key Image Notes, or Presentation States) or binary DICOM objects. Typically, the instances will have been newly created by the Sender. The instances may be sent as part of an existing DICOM Study, or part of a new Study.

3.108.2 Actor Roles

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

Table 3.108.2-1: Actor Roles

Role:	**Sender**: Creates and sends well-formed DICOM composite objects
Actor(s):	The following actors may play the role of Sender: Image Capturer **Lightweight Modality**
Role:	**Receiver**: Receives objects from the Sender
Actor(s):	The following actors may play the role of Receiver: Image 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.

3.108.3 Referenced Standards

DICOM PS3.3: Information Object Definitions

DICOM PS3.4: Service Class Specifications

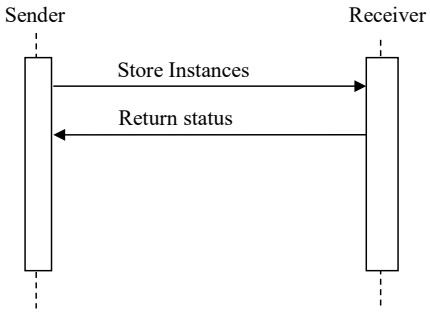
DICOM PS3.5 Section B.2: UUID Derived UID (http://medical.nema.org/medical/dicom/current/output/chtml/part05/sect_B.2.html)

DICOM PS3.18 Section 6.6: STOW-RS Request/Response (http://medical.nema.org/medical/dicom/current/output/html/part18.html#sect_6.6)

DICOM PS3.19 Section A.1: Native DICOM Model

ISO/IEC 14496-14:2003: MPEG-4 Part 14

3.108.4 Interaction Diagram



3.108.4.1 Store Instances Message

The Sender creates one or more instances and sends these instances to the Receiver for storage.

There may be one or more Senders storing instances to the same Receiver at any given time.

3.108.4.1.1 Trigger Events

User or application initiates transfer of the acquired or created instances to the Receiver.

3.108.4.1.2 Message Semantics

This message is a DICOM STOW-RS request. The Sender is the User-Agent. The Receiver is the Origin-Server.

The Sender shall use the Store Instances action type.

The Sender shall encode the instances using either the binary DICOM method or the DICOM PS3.18 metadata and bulk data method.

The Sender shall encode the metadata and bulk data request in one of the following two manners:

- Array of DICOM JSON Model Object as defined in DICOM PS3.18 Annex F
- XML request messages as defined in the Native DICOM Model defined in DICOM PS3.19 with one message part per XML object

Note: STOW-RS specifies Native DICOM Model as a baseline and JSON Model Object is optional. In WIC, the Sender may support either one.

A Sender that is a Lightweight Modality in the Encounter-Based Imaging Workflow (EBIW) Profile shall populate attributes as shown in Table 4.131.4.1.2-1 (superseding Tables 3.108.4.1.2-1 and 3.108.4.1.2-2).

Commented [OK2]: Note: re-added bullets

When sending metadata, patient demographics shall be populated by the Sender according to Table 3.108.4.1.2-1 in order to provide the appropriate patient context for the created DICOM Instances. Additional patient demographics can be populated by the Sender according to DICOM PS3.3 C.7.1.1.

Note: The means by which the Sender obtains specific values to ~~**may be**~~ populate the attributes is not specified here but might include using the ITI PDQm Profile, or from another transaction, or extracting the patient demographics from the integrated viewer, or via the user interface provided by the Sender~~**, or via some other means**~~.

Table 3.108.4.1.2-1: Critical Patient Demographics Attributes

DICOM Attribute	New Study Case (RAD TF-1: 38.4.2.1)	Existing Study Case (RAD TF-1: 38.4.2.2)
Patient's Name (0010,0010)	Shall be populated (Note 1)	Equal to existing study
Patient ID (0010,0020)	Shall be populated (Note 1)	Equal to existing study
Issuer of Patient ID (0010,0021)	Shall be populated (Note 2)	Equal to existing study
~~**Issuer of Patient ID Qualifier Sequence (0010,0024)**~~	~~**Shall be populated (Note 2)**~~	~~**Equal to existing study**~~
Patient's Birth Date (0010,0030)	Shall be populated (Note 3)	Equal to existing study
Patient's Sex (0010,0040)	Shall be populated (Note 3)	Equal to existing study

Note 1: Pre-registered values for Patient ID and Patient's Name will be used in the Unidentified Patient cases.

Note 2: A default value will be provided if it is not known.

Note 3: Attribute may be zero length if reliable value cannot be obtained.

When sending metadata, ~~**required**~~ Type 1 study attributes and Type 2 study attributes for which the value is known are required to ~~**shall**~~ be populated by the Sender. If a reliable source of metadata attributes is available, values from that source shall be used; otherwise the Sender shall populate study attributes according to Table 3.108.4.1.2-2. The Sender populates additional study attributes according to DICOM PS3.3 C.7.2.1 and C.7.3.1. In the case where the Sender is integrated with a patient record viewer and is sending a new image associated with a selected existing study, the study attributes may be populated by either extracting the study attributes from the integrated viewer, or via the user interface provided by the Sender.

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Table 3.108.4.1.2-2: Critical Study Attributes

DICOM Attribute	New Study Case (RAD TF-1: 38.4.2.1)	Existing Study Case (RAD TF-1: 38.4.2.2)
Study Instance UID (0020,000D)	Internally generated	Equal to existing study
Accession Number (0008,0050)	May be empty (Note 1)	Equal to existing study
Issuer of Accession Number Sequence (0008,0051)	Shall be populated (Note 2)	Equal to existing study
Performed Procedure Step ID (0040,0253)	Internally generated	Internally generated
Performed Procedure Step Start Date (0040,0244)	Acquisition date	Acquisition date
Performed Procedure Step Start Time (0040,0245)	Acquisition time	Acquisition time

DICOM Attribute	New Study Case (RAD TF-1: 38.4.2.1)	Existing Study Case (RAD TF-1: 38.4.2.2)
Performed Procedure Step Description (0040,0254)	Shall be populated (Note 3)	Shall be populated
Reason for Requested Procedure (0040,1002)	Shall be populated (Note 3)	Shall be populated
Reason for Requested Procedure Code Sequence (0040,100A)	May be populated	May be populated

Note 1: Accession Number may be populated if appropriate value can be obtained. For example, an appropriate value may be obtained from a reliable source such as Modality Worklist, or automatically generated based on a well-defined method (e.g., A unique ID with a site code prefix).

Note 2: The Sender will provide a default value if it is not otherwise known.

Note 3: The Sender will use pre-configured values or user input if it is not otherwise known.

If the Sender needs to create new unique identifiers (e.g., for Study Instance UID, Series Instance UID or SOP Instance UID), it may want to consider using the UUID Derived UID mechanism specified in DICOM PS3.5 Section B.2, although using an Organizationally Derived UID as specified in DICOM PS3.5 Section B.1 is also valid.

Details about when it is appropriate to trigger the creation of a new Study/Series/SOP Instance are described in RAD TF-2: 4.8.4.1.1.1 "Study UIDs and Series UIDs".

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3.108.4.1.2.1 Single-frame Image

The Sender shall encode compressed single-frame image pixel data elements in one message part per instance.

The Sender shall include all required attributes in the Native DICOM Model or DICOM JSON Model Object according to DICOM PS3.4 Section B.5 for the appropriate DICOM SOP Class.

Table 3.108.4.1.2.1-1 identifies recommended SOP Classes for commonly captured single-frame image types. DICOM defines more specific SOP Classes that may be used if applicable (see DICOM PS3.3).

Table 3.108.4.1.2.1-1: Recommended SOP Classes for Single-frame Images

Captured Image Type	SOP Class Name	SOP Class UID	IOD Specification defined in DICOM PS3.3
Photographs	VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	VL Photographic Image IOD
Screenshots	Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Secondary Capture Image IOD

The Image Pixel Module is mandatory according to DICOM PS3.3. However, due to the limitation to obtain the image pixel information by certain mobile SDK or mobile clients (e.g., zero footprint browser client), this transaction relaxes the requirement for the Sender such that

the type of the following attributes is changed from Type 1 to Type 2, meaning that the Sender shall include these attributes, but the values can be empty.

Table 3.108.4.1.2.1-2: Image Pixel Macros Attributes

Attribute Name	Tag
Samples per Pixel	(0028,0002)
Photometric Interpretation	(0028,0004)
Rows	(0028,0010)
Columns	(0028,0011)
Bits Allocated	(0028,0100)
Bits Stored	(0028,0101)
High Bit	(0028,0102)
Pixel Representation	(0028,0103)

3.108.4.1.2.1.1 JPEG Storage Option

A Sender that supports the JPEG Storage Option shall be capable of sending images that are created using JPEG compression.

If the Sender knows the Transfer Syntax of the JPEG image, the Sender shall encode the compressed pixel data using single-frame Media Types described in Media Type Mapping to Transfer Syntax in DICOM PS3.18 Table 6.5-1.

If the Sender does not know the Transfer Syntax of the JPEG image, the Sender shall use media type of image/jpeg.

~~**Note: Sending images with Media Type image/jpeg is currently not supported in DICOM PS3.18. This is pending DICOM CP 1509 and CP 1582.**~~

3.108.4.1.2.1.2 PNG Storage Option

A Sender that claims the PNG Storage Option shall be capable of creating images using lossless PNG compression with 8-bit per channel.

The Sender shall use a media type of image/png.

~~**Note: Sending images with Media Type image/png is currently not supported in DICOM PS3.18. This is pending DICOM CP 1509 and CP 1582.**~~

3.108.4.1.2.2 Multi-frame Video

The Sender shall encode compressed multi-frame video pixel data elements in one message part per instance.

The Sender shall include all required attributes in the Native DICOM Model or DICOM JSON Model Object according to DICOM PS3.4 Section B.5 for the appropriate DICOM SOP Class.

Table 3.108.4.1.2.2-1 identifies recommended SOP Classes for commonly captured multi-frame video types. DICOM defines more specific SOP Classes that may be used if applicable (see DICOM PS3.3).

Table 3.108.4.1.2.2-1: Recommended SOP Classes for Multi-frame Videos

Captured Video Type	SOP Class Name	SOP Class UID	IOD Specification defined in DICOM PS3.3
Video Photographs	Video Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4.1	Video Photographic Image IOD

The Image Pixel Module is mandatory according to DICOM PS3.3. However, due to the limitation to obtain the image pixel information by certain mobile SDK or mobile clients (e.g., zero footprint browser client), this transaction relaxes the requirement for the Sender such that the types of the following attributes are changed from Type 1 to Type 2, meaning that the Sender shall include these attributes, but the values can be empty.

Table 3.108.4.1.2.2-2: Image Pixel Macro Attributes

Element Name	Tag
Samples per Pixel	(0028,0002)
Photometric Interpretation	(0028,0004)
Rows	(0028,0010)
Columns	(0028,0011)
Bits Allocated	(0028,0100)
Bits Stored	(0028,0101)
High Bit	(0028,0102)
Pixel Representation	(0028,0103)

3.108.4.1.2.2.1 MPEG4 Storage Option

A Sender that supports the MPEG4 Storage Option shall be capable of sending videos that are encoded using AVC/H.264.

If the Sender knows the Transfer Syntax of the created video, the Sender shall encode the compressed video stream using a multi-frame Media Types described in Media Type Mapping to Transfer Syntax as defined in DICOM PS3.18 Table 6.5-1.

If the Sender does not know the Transfer Syntax of the created video and the created video is using a MPEG or MPEG4 container, then the Sender shall use one of the following media types:

Table 3.108.4.1.2.2.1-1: Generic Video Media Type Support by the Receiver

Media Type	Required in Named Option
video/mpeg ~~(Note 1)~~	MPEG4 Storage
video/mp4 ~~(Note 1)~~	MPEG4 Storage

~~Notes: 1. These video media types are commonly used for encoding videos in mobile devices. Sending videos with Media Type video/mpeg or video/mp4 is currently not supported in DICOM PS3.18 STOW-RS. This is pending DICOM CP 1509 and CP 1582.~~

The Sender shall support at least one of video/mpeg or video/mp4 media types. When using the video/mp4 media type, MPEG-4 video stream shall be encoded using AVC/H.264 encoding scheme and stored in MP4 container format (ISO/IEC 14496-14:2003).

~~3.108.4.1.2.2.2 QuickTime Storage Option~~

~~A Sender that supports the QuickTime Storage Option shall be capable of creating video stream encoded using AVC/H.264 encoding scheme and stored in QuickTime container format.~~

~~The Sender shall use media type of video/quicktime.~~

~~Notes: 1. Sending videos with Media Type video/quicktime is currently not supported in DICOM PS3.18 STOW-RS. This is pending DICOM CP 1509 and CP 1582.~~

~~3.108.4.1.2.2.3 3GPP Storage Option~~

~~A Sender that supports the 3GPP Storage Option shall be capable of creating video stream encoded using AVC/H.264 encoding scheme and stored in 3GPP container format.~~

~~The Sender shall use media type of video/3gpp.~~

~~Notes: 1. Sending videos with Media Type video/3gpp is currently not supported in DICOM PS3.18 STOW-RS. This is pending DICOM CP 1509 and CP 1582.~~

3.108.4.1.2.3 Evidence Document Storage Option

The Sender shall encode the complete evidence document metadata in the first part of the multipart request.

The Sender shall include all required attributes in the Native DICOM Model or DICOM JSON Model Object according to DICOM PS3.4 Section B.5 for the appropriate DICOM SOP Class that is used for the evidence document.

Table 3.108.4.1.2.3-1 identifies recommended SOP Classes for commonly created evidence documents. DICOM defines more specific SOP Classes that may be used if applicable (see DICOM PS3.3).

Table 3.108.4.1.2.3-1: Recommended SOP Classes for Evidence Document

Captured Evidence Document Type	SOP Class Name	SOP Class UID	IOD Specification defined in DICOM PS3.3
Presentation State	Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1	Grayscale Softcopy Presentation State IOD
	Color Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.2	Color Softcopy Presentation State IOD
	Pseudo-Color Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.3	Pseudo-color Softcopy Presentation State IOD
Structured Report	Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	Basic Text SR IOD
	Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	Enhanced SR IOD
	Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	Comprehensive SR IOD
	Comprehensive 3D SR	1.2.840.10008.5.1.4.1.1.88.34	Comprehensive 3D SR IOD
Key Object Selection	Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59	Key Object Selection Document IOD
Encapsulated Document	Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Encapsulated PDF IOD
	Encapsulated CDA Storage	1.2.840.10008.5.1.4.1.1.104.2	Encapsulated CDA IOD

The Sender shall include each encapsulated document in its own separate message part in the DICOM Request Message Body with the following HTTP headers:

Encapsulated PDF document

Content-Type: application/pdf

Content-Location: {BulkDataURI}

Encapsulated CDA document

Content-Type: text/xml

Content-Location: {BulkDataURI}

Other encapsulated document

Content-Type: application/octet-stream

Content-Location: {BulkDataURI}

~~**Note: Sending encapsulated document such as PDF or CDA are currently not supported in DICOM PS3.18 STOW-RS. This is pending DICOM CP 1509 and CP 1582.**~~

The expected endpoint for DICOM Encapsulated PDF / CDA documents is a DICOM server. For transmission of plain PDF or CDA documents that are not intended to be DICOM encapsulated and stored to a DICOM server, ITI Mobile Access to Health Document (MHD) provides a more appropriate mechanism for uploading electronic health records.

3.108.4.1.2.4 DICOM Instance Storage Option

The Image Capturer shall encode each DICOM instance as a separate message part.

The Image Capturer shall send the DICOM instances using DICOM binary format.

3.108.4.1.3 Expected Actions

The Receiver shall accept and process the message payload.

The Receiver shall accept metadata and bulk data encoded in either Native DICOM Model or DICOM JSON Model Object. The Receiver shall at least support the SOP Classes defined in Tables 3.108.4.1.2.1-1, 3.108.4.1.2.2-1 and 3.108.4.1.2.3-1.

If the message contents are not binary DICOM instances, the Receiver shall convert the DICOM metadata and bulk data into DICOM binary instances according to the SOP Class UID specified in the metadata.

If the received object includes empty Image Pixel Macro Attributes (see Table 3.108.4.1.2-1), the Receiver shall populate them according to the Image Pixel Attribute Descriptions specified in DICOM PS3.3 Section C.7.6.3.1.

The Receiver shall store the DICOM binary instances (either received or converted) such that they can be later queried or retrieved in a fashion meeting the requirements defined for a DICOM Level 2 Storage SCP (refer to DICOM PS3.4 Section B.4.1).

If the received object includes the Transfer Syntax in the media type parameter, then the Receiver shall use the same Transfer Syntax when converting the DICOM metadata and bulk data into DICOM binary instances.

If the media type of the received object is image/jpeg, then the Receiver shall use the Transfer Syntax 1.2.840.10008.1.2.4.50 when converting the DICOM metadata and bulk data into DICOM binary instances.

If the media type of the received object is video/mpeg or video/mp4, then the Receiver shall use the appropriate Transfer Syntax for the received object as defined in the following table:

Table 3.108.4.1.3-1: Transfer Syntaxes for Video

Media Type	Eligible Transfer Syntax	Description
video/mpeg	1.2.840.10008.1.2.4.100	MPEG2 Main Profile @ Main Level
	1.2.840.10008.1.2.4.101	MPEG2 Main Profile @ High Level
video/mp4	1.2.840.10008.1.2.4.102	MPEG-4 AVC/H.264 High Profile / Level 4.1

Media Type	Eligible Transfer Syntax	Description
	1.2.840.10008.1.2.4.103	MPEG-4 AVC/H.264 BD-compatible High Profile / Level 4.1
	1.2.840.10008.1.2.4.104	MPEG-4 AVC/H.264 High Profile / Level 4.2 for 2D Video
	1.2.840.10008.1.2.4.105	MPEG-4 AVC/H.264 High Profile / Level 4.2 for 3D Video
	1.2.840.10008.1.2.4.106	MPEG-4 AVC/H.264 Stereo High Profile / Level 4.2

3.108.4.1.3.1 PNG Storage Option

A Receiver that supports the PNG Storage Option shall convert the encoded lossless PNG image into DICOM binary format with an appropriate standard uncompressed or lossless (reversible) compressed Transfer Syntax.

Table 3.108.4.1.3.1-1: Eligible Transfer Syntaxes for PNG Storage

Media Type	Eligible Transfer Syntax	Description
image/png	1.2.840.10008.1.2	Implicit VR Little Endian: Default Transfer Syntax for DICOM
	1.2.840.10008.1.2.1	Explicit VR Little Endian
	1.2.840.10008.1.2.1.99	Deflated Explicit VR Little Endian
	1.2.840.10008.1.2.4.57	JPEG Lossless, Non-Hierarchical (Process 14)
	1.2.840.10008.1.2.4.70	JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1]): Default Transfer Syntax for Lossless JPEG Image Compression
	1.2.840.10008.1.2.4.80	JPEG-LS Lossless Image Compression
	1.2.840.10008.1.2.4.90	JPEG 2000 Image Compression (Lossless Only)
	1.2.840.10008.1.2.4.92	JPEG 2000 Part 2 Multi-component Image Compression (Lossless Only)
	1.2.840.10008.1.2.5	RLE Lossless

~~#### 3.108.4.1.3.2 QuickTime Storage Option~~

~~A Receiver that supports this QuickTime Storage Option shall convert the encoded QuickTime video into DICOM binary format with the pixel data encoding using appropriate Transfer Syntax defined in Table 3.108.4.1.3-1.~~

Commented [OK3]: FYI These are being dropped for lack of current relevancy. "Industry has moved on".

~~#### 3.108.4.1.3.3 3GPP Storage Option~~

~~A Receiver that supports this 3GPP Storage Option shall convert the encoded 3GPP video into DICOM binary format with the pixel data encoding using appropriate Transfer Syntax defined in Table 3.108.4.1.3-1.~~

3.108.4.2 Return Status Message

The Receiver reports the outcome of the Store Instances Message.

3.108.4.2.1 Trigger Events

The Receiver receives a Store Instances Message.

3.108.4.2.2 Message Semantics

This message is a DICOM STOW-RS response. The Sender is the User-Agent. The Receiver is the Origin-Server.

The Receiver shall return a response to the Sender according to DICOM PS3.18 Section 6.6.1.3.

Note: The Receiver may return a response before all processing is complete for the received object; for example, performing required image conversion asynchronously after sending the response. Sender implementers should be aware that such post-response processing may fail.

Note: The Receiver will honor the HTTP Accept header field for encoding of the response message. However, if the Sender accepts both XML and JSON, then the Receiver can choose either format for the response message.

3.108.4.2.3 Expected Actions

The Sender has no expected actions.

3.108.5 Security Considerations

3.108.5.1 Security Audit Considerations

The Radiology Audit Trail Option in the IHE ITI Audit Trail and Node Authentication Profile (ITI TF-1:9) defines audit requirements for IHE Radiology transactions. See RAD TF-3:5.1.

Table 3.108.5.1-1: Audit Message for Store Instances over the Web [RAD-108]

IHE Radiology Transaction	ATNA Trigger Event(s)	Actor(s) that shall be able to record audit event
Store Instances over the Web [RAD-108]	Instances-stored	Receiver: Image Manager

3.108.5.2 Transport Security

In order to avoid unauthorized interception of private health information, the communication over HTTP may be secured by using HTTPS.

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

[The IHE Radiology Technical Committee is exploring a transaction to obtain Encounter Imaging Context using a series of FHIR Queries but it was not possible to resolve all the issues

in time to include it in this document for Public Comment. The FHIR Queries Document will be circulated later using the same channels as this document.]

Add the following rows to RAD TF-3: Table 5.1-2

5.1 ITI-20 Record Audit Event

…

Table 5.1-2: IHE Radiology transactions and resulting ATNA trigger events

IHE Radiology Transaction	ATNA Trigger Event(s)	Actor(s) that shall be able to record audit event
Patient Registration [RAD-1]	Patient-record-event	ADT Order Placer, DSS/OF – when PHI is presented
…		
Get Encounter Imaging Context [RAD-130]	**Query Information**	**Responder: Encounter Manager**
Store Encounter Images [RAD-131]	**Begin-storing-instances**	**Sender: Acquisition Modality**
	Instances-Stored	**Receiver: Image Manager/Image Archive**
Notify of Imaging Results [RAD-132]	**Procedure-record-event**	**Sender: Image Manager/Image Archive**
Store Instances over the Web [RAD-108]	**Begin-storing-instances**	**Sender: Lightweight Modality**
	Instances-Stored	**Receiver: Image Manager/Image Archive**

Add the following Appendix to RAD TF-3

Appendix Z – Reason for Procedure Codesets (Informative)

This appendix provides codesets for consideration when populating the Reason for Performed Procedure Code Sequence (0040,1012).

Table Z-1: Point-of-Care Ultrasound Procedure Reasons

Coding Scheme Designator	Code Value	Code Meaning
LN	69280-6	Evaluate State of Urinary Bladder with US
LN	39415-5	Evaluate Gastrointestinal Tract with US
LN	80871-7	Detect/Evaluate Ovary for Torsion with US
LN	80877-4	Detect/Evaluate Scrotum and Testicle for Torsion with US
SCT	401186003	Detect/Evaluate Deep Venous Thrombosis
LN	39527-7	Detect/Evaluate Unspecified Body Region for Foreign Body with US
SCT	710241003	Guide Removal of Retained Foreign Body with US
LN	87162-4	Guide Placement of Needle
LN	38032-9	Determine/Evaluate Localization of Needle with US
LN	25059-7	Guide Biopsy with US
LN	30643-1	Guide Placement of CV catheter in Vein with US
LN	87144-2	Guide Placement of PICC Line
LN	87019-6	Guide Drainage
LN	87017-0	Evaluate Drainage Catheter for Abscess
SCT	431805002	Guide Embolization with US
SCT	61593002	Guide Procedure with US
SCT	439864002	FAST (Focused Assessment with Sonography in Trauma) (See http://pubs.rsna.org/doi/full/10.1148/radiol.2017160107)

Some other reasons of interest for which codes were not found include:

- Evaluate Breast Lump
- Evaluate Reduction of Fracture or Dislocation
- Localize/Evaluate Fluid or Abscess
- Detect/Evaluate Detached Retina
- Detect/Evaluate Gallstones

- Detect/Evaluate Internal Bleeding
- Determine/Evaluate Position of Line (Arterial, central venous)
- Determine/Evaluate Position of PICC Line
- Guide Fluid Collection
- Guide Placement of Airway Tube
- Determine/Evaluate Position of Airway Tube
- Collect Procedural Evidence
- Evaluate Success of Procedure

Table Z-2: Digital Photography Procedure Reasons

Coding Scheme Designator	Code Value	Code Meaning
LN	46212-7	Pre-operative Photo
LN	46211-9	Post-operative Photo
LN	29112-0	Photo documentation Left eye
LN	29111-2	Photo documentation Right eye
SCT	446080005	Photography of wound
SCT	252983000	Skin Lesion Photography

