IHE Encounter-Based Imaging Workflow (EBIW)

Working DRAFT of PoCUS Update Proposals

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Introduction to this Document

Point-of-care ultrasound (POCUS) has become increasingly prevalent in the fields of emergency medicine, critical care, and anesthesia. This is due in part to advances in technology that have made ultrasound devices smaller, more portable, and more user-friendly, allowing for easy integration into clinical practice. Additionally, POCUS has been shown to provide several benefits, such as enabling rapid diagnosis and management of critically ill patients, reducing the need for more invasive procedures, and improving patient outcomes.

POCUS is non-invasive, safe, and cost-effective compared to other diagnostic imaging modalities. POCUS can be used to evaluate a variety of organ systems, including the heart, lungs, abdomen, and musculoskeletal system. As a result, POCUS has become a valuable tool in many different medical specialties and clinical settings, from primary care clinics to operating rooms and intensive care units.

In recent years, there has been a growing interest in POCUS education and training, with many medical schools and residency programs now offering POCUS training as part of their curricula. Professional organizations, such as the American College of Emergency Physicians (ACEP) and the Society of Critical Care Medicine (SCCM), have also developed guidelines and recommendations for the use of POCUS in clinical practice. All of these factors have contributed to the increasing popularity and adoption of POCUS in healthcare.

This document refines POCUS workflow Use Cases and Requirements with respect to ACEP guidelines and the real-world experience of ACEP members, and will likely result in one or more change proposals to the IHE EBIW, following the IHE CP process.

Items in *blue italics* are editorial comments.

References

1. ACEP Emergency Ultrasound Standard Reporting Guidelines
2. ASE/ACEP Focused Cardiac Ultrasound in the Emergent Setting

3. Ultrasound Guidelines: Emergency, Point-of-care, and Clinical Ultrasound Guidelines in Medicine
4. Use Cases for Encounter-Based Imaging Workflow (EBIW) *(IU Sharepoint)*
5. Advanced Point-of-Care Ultrasound Workflow: Best Practice Recommendations *(IU Sharepoint)*
6. Flannigan MJ, Adhikari S. *Point-of-Care Ultrasound Work Flow Innovation: Impact on Documentation and Billing.* J Ultrasound Med. 2017;36(12):2467-2474. doi:10.1002/jum.14284
7. Tayal, Vivek S, et al. *Ultrasound Program Management : A Comprehensive Resource for Administrating Point-of-Care, Emergency, and Clinical Ultrasound*. Cham, Springer International Publishing, 2018.
8. Best Practices in the Communication and Management of Actionable Incidental Findings in Emergency Department Imaging
9. EMERGENCY ULTRASOUND: Essential Machine Features
10. Consensus Terminology for Point of Care Ultrasound Studies with Incomplete Documentation and Workflow Elements

POCUS Concepts

IHE Profiles include a "Concepts" section to provide information that is not normative (i.e. Profile conformance "shall language") but would be important for those implementing the profile in products and those deploying the profile in care settings to understand and consider.

The following are POCUS concept material proposed by ACEP as likely useful to include in the Profile.

POCUS Information Model

See Section 47.4.1.1 of EBIW

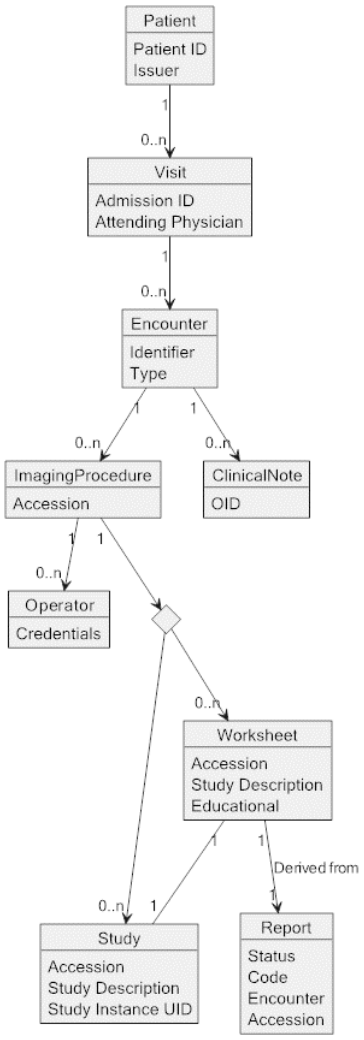


Figure X: POCUS Information Model

```
@startuml POCUSDataModel

object Encounter {
  Identifier
  Type
}
object Patient {
  Patient ID
  Issuer
}
object Visit {
  Admission ID
  Attending Physician
}
object ImagingProcedure {
  Accession
}
object Study {
  Accession
  Study Description
  Study Instance UID
```

Figure X: Diagram Pseudocode for POCUS Information Model

POCUS Credentialing and Privileging

Most professional medical organizations (i.e., American Medical Association) have affirmed that ultrasound imaging is within the scope of practice of appropriately trained physicians. Privileging is the process of granting a healthcare professional the authority to perform POCUS within a specific clinical setting or scope of practice. Credentialing is the process of verifying a healthcare professional's training and competency in performing POCUS. Credentialing ensures that healthcare professionals have the necessary skills and knowledge for safe and effective use of POCUS.

The American College of Emergency Physicians (ACEP) defines credentialing as the process of gathering information regarding a healthcare professional's qualifications for appointment to the medical staff.

POCUS credentialing is institution-specific and designed to ensure compliance with jurisdictional standards and specialty-specific policies. Credentialing typically involves a combination of formal training, hands-on experience, and standardized testing to assess the healthcare professional's knowledge and skill in performing POCUS exams. Physicians, nurse practitioners, physician's assistants and nurses may be privileged globally or on a per-application basis based on local POCUS credentialing policies.

To maintain credentials, the healthcare professional may be required to have ongoing education credits (e.g., CME) and/or perform a minimum number of ultrasounds per year. It is generally acknowledged that the intensity of training is significantly higher to obtain initial privileges compared to maintaining this skill, similar to other specialty-specific procedural skills. If quality issues develop providers might be required to undergo more intensive training and proctoring to restore privileges (focused professional practice evaluation (FPPE).

POCUS Education

[TODO] improve. This is a rough draft

Professional medical associations recommend POCUS as a core competency for medical students, residents, and fellows training in multiple specialties. There are varied pathways for clinicians in training to also obtain POCUS credentials. It is generally acknowledged that clinicians in training frequently acquire point-of-care ultrasound knowledge, technical skill, and documentation habits more readily than clinicians who've been in practice for significant amount of time or lack a structured mentoring and training environment afforded to them.

A typical clinician in training pathway includes:

- Completion of a formal POCUS curriculum, which covers various topics such as physics and instrumentation, artifacts, system setup, transducer positioning, and detailed discussions related to specific elements relevant to diagnostic and procedural studies within the specialty-specific application. This comprehensive curriculum ensures a thorough understanding of POCUS principles.
- Participation in supervised hands-on ultrasound scanning, conducted in either a simulated environment or a clinical setting. During these sessions, clinical exams are frequently performed, with real-time supervision and review by faculty members holding POCUS privileges. Additionally, POCUS experts provide in-depth reviews and constructive feedback to enhance proficiency.
- Demonstration of POCUS proficiency during a dedicated ultrasound rotation. This phase involves performing ultrasound studies primarily for educational purposes, focusing on technical adequacy, accurate interpretation, and appropriate documentation. Patients and co-learners often volunteer to participate as models for educational purposes, typically through verbal or written consent, depending on local expectations and policies. Depending on credentialing requirements, proficiency may necessitate a specific number of studies demonstrating disease.

Compliance

Note: this is a works in progress

It is imperative that point-of-care ultrasound exams maintain compliance with departmental documentation standards for patient and provider identification, as well as exam indication and interpretation. Although standards may vary from department to department, this section introduces common pitfalls and presents best practices to ensure that patient medical, educational, and billing records for POCUS studies are accurate and complete.

The table below summarizes data errors that can lead to compliance issues.

Issue	Definition	Significance	Resolution

Unclaimed Study	Study does not contain information an Operator	No one has ownership/accountability for the study. This is needed to: • verify privileging • complete the report, • send to EMR to incorporate in the patient medical record, and • initiate billing.	Claimed by the operator or supervising clinician on the POCUS Manager.
Unreported Study	Study does not have a report in the EMR.	This a very common scenario. Patient demographics and Operator identification are present, however, there is no signed report.	Complete and sign a worksheet
Blind Study	Study does not contain any POCUS images. It may or may not have a signed report in the EMR. Note: this is different from a study that is missing an expected, or complete set of images	Images were never saved, or deleted from the Modality and not sent to the Image Archive. Results in missing information in the patient medical record; the study cannot be billed.	Cannot be resolved, however, the risk could be mitigated through the use of Storage Commitment.
Nameless Study	The study contains images without identifiers that can be reconciled in the VNA or EMR, however the patient identity is known within the department.	The study was initiated before the patient was registered The Operator knows the identity of the patient and manually enters a pseudonym at the Modality when the scan is initiated.	Because the Operator knows the identity of the patient, he/she can reconcile demographics in POCUS Manager or the Modality once the patient is registered. See Unidentified patient Alternate Case #2 below.
Orphan Study	The study contains images without identifiers that can be reconciled in the VNA or EMR, however, the patient identity is <u>not</u> known within the department	This is similar to the Nameless Study; however, the patient cannot be positively identified during an audit of Nameless Studies.	Cannot be resolved

Phantom Scan	A study that was performed without patient identifiers and without images.	There is evidence that an ultrasound was performed, however, the patient cannot be positively identified during an audit	Cannot be resolved

Compliance begins with entering data into the POCUS modality, which includes identifying the operator(s), patient and supervising physician. These are critical data and should be prominently displayed on the user interface, free from unnecessary clutter.

Operator Identification

Accurate operator identification is crucial in determining if the operator is privileged to conduct a specific study type and authorized to sign the report. In cases where the operator lacks necessary privileges for a given study type, a credentialed user must perform an overread and sign off on the report to ensure accurate diagnosis, billing, and regulatory compliance. Furthermore, operator identification plays a crucial role in ensuring that POCUS learners, who are completing exams as part of their credentialing process, receive:

- credit for performing the study,
- timely feedback regarding the completeness of an exam protocol, and
- feedback pertaining to technical aspects of image acquisition (gain, depth, measurements, demonstration of essential structures, etc.).

Due to the specificity of privileges for point-of-care ultrasound (POCUS) within healthcare delivery organizations (HDOs), an operator's authorization to sign certain exams may vary. Therefore, ensuring precise operator identification involves two essential aspects: accurately selecting the operator and correctly identifying the worksheets the operator is permitted to sign, based on their POCUS privileges. While the use cases for operator identification may differ based on local policies and IT infrastructure, it is crucial for POCUS device manufacturers to prioritize measures that promote accurate operator identification. Some recommended measures include:

- avoiding manual entry by utilizing barcode scanners, RFID, or QR codes,
- allowing entry of multiple operators to support multiple POCUS learners,
- allowing operators to “tap in” or “tap out” for participating in the acquisition of a given series,
- implementing system authentication credentials (e.g., ITI-9),
- implementing poke-yoke controls to prevent scanning or transmission of images without identifying the operator,
- requiring the operator to identify themselves at the start of each study (e.g., operator is logged out when the study ends), and
- setup options that automatically end exams if there's been no machine activity (button pushes or image / video capture) for a defined period of time.

Although this document does not provide a specific profile for enterprise user authentication (e.g., LDAP, AD, OAuth, SAML, Kerberos), it is important for manufacturers to prioritize measures that promote accurate operator identification, ensuring that operators utilize enterprise identity credentials (vs. an entry that requires a verification step to reconcile improperly entered information).

Patient Identification

Accurate and efficient patient identification at the modality promotes patient safety, avoids medical record errors, facilitates billing and regulatory compliance, and increases efficiency. As in operator identification, manufacturers should implement measures for streamlined accurate patient identification:

- avoiding manual entry by utilizing barcode scanners, RFID, or QR codes at the Modality,
- configurable policies for the Encounter Manager to remove unnecessary entries from the Modality Worklist,
- support Patient Update/Merge on the Image Manager (POCUS Manager) for patients whose images are captured before they are registered
- prompts or reminders to add patient information at the beginning and/or end of a POCUS exam
- automated closure of exams after a pre-determined period of time to prevent inadvertent addition of images to an exam that was previously performed on the modality, but not closed

Supervising Physician

Also known as attending physician, staff physician, "attending", or in the UK as "consultant", the supervising physician is responsible for all care in which interns, residents, or fellows are involved, and has ultimate responsibility for the patient encounter and associated POCUS reports. A supervising physician may also review procedures and encounters, and provide feedback after care is delivered. The EBIW Profile acknowledges the importance of identifying the Attending Physician, however it is not profiled.

The supervising or attending physician role in clinically-indicated point-of-care ultrasound exams is paramount. These physicians are typically required to supervise key components of procedures that are performed by POCUS learners and required to determine if the exam images are diagnostic quality to aid in medical decision-making, and therefore billable.

While HL7 PV-1.7 contains attending physician information, it does not map to DICOM MWL, which currently offers Requesting Physician (0032,1032) and Referring Physician's Name (0008,0090). *Editorial Note: do we map it to one of these, or submit a CP to add it to DICOM? Note: the General Study Module includes Consulting Physician's Name (0008,009C) and the Consulting Physician Identification Sequence (0008,009D).*

For compliance purposes, the Encounter Manager should attempt to pre-populate the Referring Physician's Name (0008,0090) based on departmental preferences during the pocus manager setup, such as:

- the current patient encounter (PV1-7)

- the operator
- departmental schedule
- history

Reporting

For reporting and billing compliance, HDO has the option to create specific requirements for mandatory information in the worksheet. This includes important details such as MRN/CSN/FIN, accession number, views, indications, interpretation, as well as flags differentiating between clinically indicated and educational cases. The POCUS Manager is responsible for determining the appropriate worksheet based on the Study Description and automatically populating it with values obtained from DICOM metadata. Certain organizations may also prepopulate CPT codes, although the reporting healthcare professional (HCP) retains the ability to modify them, if necessary.

> Note: IHE EBIW RAD-132 is an HL7v2 ORU^R01 message specified to include information necessary for the Results Aggregator (typically the EMR) to create an order for billable studies, as well as financial transactions necessary for charging.

A hanging reports is a worksheet in the POCUS Manager that has not been signed by a credential HCP. The POCUS Manager is responsible for sending a notification to the Attending Physician of record (either named on the worksheet, or the Encounter.

Types of notifications include:

- email reminders
- "EHR" in basket (Provider Notifications)
- Popup on app
- FHIR Communication Resource

QA

[TODO] Describe the QA process at a high level to allow for local policy differences:

1. *Processes vary site to site, however, the primary concern at SCUF 2023 the desire to get QA completed.*
2. *Consider/debate potentially two different use cases for QA.*
    a. *Clinical exam QA*
        i. *Variable percentage that needs QA*
        ii. *How to reconcile errors and misses*
            1. *Potential to addend studies*
            2. *Local policy for notification/documentation*
        iii. *Report and metrics that should be generated*
    b. *Educational exam review and feedback*
        i. *All exams undergo review: QA is to evaluate the study, provides comments on the study, and issue credit*
        ii. *Tracking and portfolio generation is central to the process*
        iii. *Reconciling "misses" that have clinical significance*
3. *Other Considerations*
    a. *When does QA end (on the POCUS Manager)?*
    b. *Profile attributes for encoding QA comments*
    c. *QA status in the POCUS Manager*
    d. *Context sharing: EHR launch from POCUS Manager.*

e. QA status
i. QA ready
ii. QA In process
iii. QA complete
iv. Referring notified
f. QA reports, tracking, portfolio management by user type

POCUS Use Cases

IHE Profiles include "Use Cases" which demonstrate typical patterns of use and show how Profile transactions would go together, and sometimes interact with real-world actions, to achieve effective integration.

The following are additions and clarifications from ACEP of typical POCUS workflows and variants.

As education plays a fundamental and continuous role in POCUS workflows, this document outlines various educational and non-educational use cases, as summarized below:

Use Case #	Provider	Clinically Indicated	Setting	Image Destination	Report Destination	Notes
Diagnostic POCUS						
1	Privileged	Yes	Clinical	VNA	EHR	Typical "happy path"
2	Learner	Yes	Clinical	VNA	EHR	• Study must be finalized by a privileged in POCUS manager prior to transfer to VNA and EHR. • Local policy my desire preliminary report
3	Learner	No	Clinical or Educational lab	POCUS Manager	POCUS Manager	• Training only • Local policy may optionally dictate VNA archive of all POCUS studies
Procedural POCUS						
4	Any	Yes	Clinical	VNA	EHR	Local policy dictates the need to render a dedicated imaging report (vs. procedural report in the EHR)
5	Learner	No	Educational lab	POCUS Manager	POCUS Manager	

Use Case #1 Diagnostic Point of Care Ultrasound

The most typical ("normal") case involves a diagnostic study performed and reported by a privileged HCP for a registered patient.

A diagnostic study is performed to evaluate a specific medical condition (shock), or to evaluate a patient's anatomy or physiology (left ventricle chamber size and function). This could be an initial evaluation or a reassessment/serial study. The Diagnostic POCUS Use Case is intended to generalize the following scenarios:

1. The patient is registered for an inpatient or outpatient encounter in a healthcare facility (e.g., emergency department, critical care unit, cardiology office, obstetrics and gynecology suite, or operating room).
2. The HCP enters their ID in the POCUS device (i.e., with a barcode scanner, RFID, QR code or manual entry)
3. The HCP enters the patient ID in the POCUS device (i.e., with a barcode scanner, RFID, QR code or manual entry)

   Note: depending on the EMR system, the patient ID could also be a medical record number or billing number known. Examples include: CSN (Contact Serial Number), FIN (Financial Identification Number) or ASN (Appointment Serial Number). See the Compliance section for more information.

4. The POCUS device displays a MWL entry specific to the patient. The HCP confirms the patient demographic information (name, date of birth, gender, etc.). and selects the patient prior to initiating exam specific image capture.
5. The HCP performs a focused POCUS exam (e.g., biliary scan for cholelithiasis). Images are transferred to the POCUS Manager.
6. The HCP accesses the POCUS Manager system (through a client application on a handheld device, client web browser or PC workstation) and searches for the study completed in the previous step.
7. The HCP views the images. The POCUS Manager proposes an interpretation worksheet based on the Study Description. The HCP confirms the worksheet, and completes it, entering the views obtained, indications, findings, and interpretation. The HCP selects a flag indicating that the study is clinically indicated (vs. educational).

   Note: See the Compliance section for more information.

8. The HCP applies their electronic signature to the worksheet. This signature is typically generated using a unique identifier tied to the provider's identity within the POCUS Manager.

   Notes:

   1. Technical requirements for electronic signatures are determined by jurisdiction, institution or payors, and out of scope of this document.
   2. The HCP may apply a Confidentiality Code to indicate the degree to which special confidentiality protection should be applied to the report. This does not encode site policy, but rather describes the nature of the study which would facilitate the implementation and invocation of such site policies.

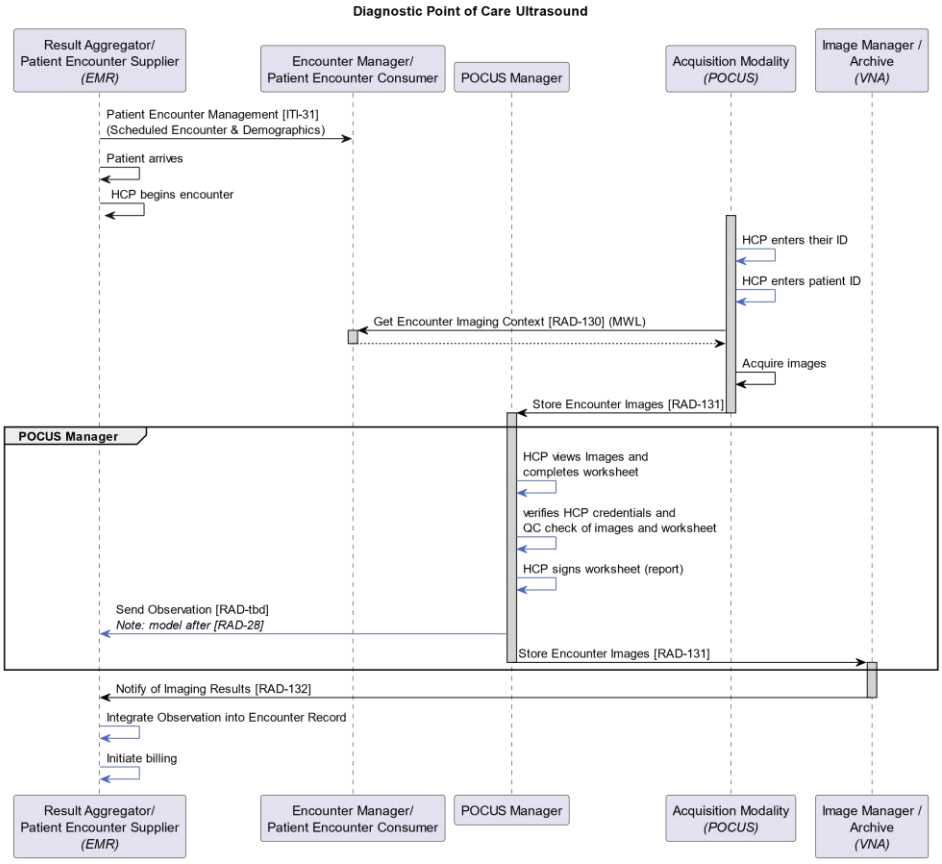
9. The POCUS Manager verifies the HCP credentials, as well as required worksheet elements (i.e., a valid MRN, CSN/FIN, a valid patient name, views, indications, interpretation views, indications, and interpretation).
10. The POCUS Manager also validates that the study contains at least one image, and that all images contain a valid MRN/CSN/FIN, patient name and accession number issued from either the Encounter Manager namespace, or the POCUS Manager namespace.
11. Because the HCP is credentialed, and both the worksheet and images meet validation criteria, the POCUS Manager sends the report (i.e., the signed worksheet) as an

unsolicited observation to the EMR, and transfers DICOM images to an Image Manager/Archive (a.k.a. VNA).

12. The Image Manager/Archive sends a notification to the EMR using Notify of Imaging Results [RAD-132].
13. The POCUS report along with hyperlinks to review the study image data in PACS are associated with the patient encounter in the EMR.

    Note: Based on local policy, the EMR may also create an order for billable studies, as well as financial transactions necessary for charging.

Use Case #1 Process Flow



Blue arrows: new transactions

Black arrows: existing EBIW transactions

Figure 1-1: Diagnostic Point of Care Ultrasound Use Case Process Flow

The text in below was used to generate the diagram above. Readers will find the diagram more informative. The text is included here to facilitate editing.

```
@startuml
title Diagnostic Point of Care Ultrasound


participant "Result Aggregator/\nPatient Encounter Supplier\n//(EMR)//" as RA
participant "Encounter Manager/\nPatient Encounter Consumer" as EM
participant "POCUS Manager" as US
participant "Acquisition Modality\n//(POCUS)//" as Modality
participant "Image Manager /\nArchive\n//(VNA)//" as VNA


RA->EM: Patient Encounter Management [ITI-31]\n(Scheduled Encounter & Demographics)
RA->RA: Patient arrives
RA->RA: HCP begins encounter
skinparam sequence {
   ArrowColor RoyalBlue
  }
activate Modality #D3D3D3
Modality -> Modality: HCP enters their ID
Modality -> Modality: HCP enters patient ID
 skinparam sequence {
   ArrowColor Black
```

Figure 1-2: Diagram Pseudocode for Diagnostic POCUS Process Flow

Use Case #2 Non-privileged Operator Clinical and Training POCUS

Training and education is integral in many POCUS workflows. Within each patient evaluation stud(y/ies) may be clinically indicated and/or performed for training.

For example, a pregnant woman might come in with vaginal bleeding and concerned about her baby. A pelvic ultrasound is clinically indicated, yet the provider also obtains permission to image her heart, lungs, and kidneys for credentialing purposes (educational).

In this case, a non-privileged operator (POCUS Learner) performs multiple studies upon a registered patient within a clinical environment.

From Use Case #1

Step #1-4: No change.

Notes:

1. If the Modality supports selecting a supervising physician (e.g., attending physician or staff physician), it may be chosen in Step #3.
2. Multiple operators may be entered in case of multiple POCUS Learners.

Steps #5: The POCUS Learner simultaneously acquires multiple studies, including Obstetrical Pelvic, Renal, and Thoracic, all having the same Accession Number, Study Description and Study Instance UID.

Discuss: Alternatively, the Modality could allow the operator to start a new study without ending the first one (i.e. the Modality does not require the operator to perform Steps #1-4 after the complete the Obstetrical Pelvic study)

Step #6: No change.

Step #7a: During the image review, if not previously selected in Step #3, the POCUS Learner designates the supervising physician.

Step #7b: The POCUS Learner applies the educational identifier to the Renal and Thoracic worksheets and performs a hard split, resulting in the creation of three separate studies: Obstetrical Pelvic, Renal, and Thoracic.

Note: The order of worksheet selection and hard split is irrelevant and can be determined by the implementer.

The POCUS manager creates three new studies associated with each worksheet, with unique Accession Numbers, Study Descriptions, and Study Instance UIDs.

Note: This may result in images being duplicated in multiple studies.

Step #8-10: The POCUS manager may also check for the presence of a supervising physician.

Step #10a: Since the POCUS Learner is not credentialed for the Obstetrical Pelvic study, the worksheet signed by the POCUS Learner becomes a preliminary report, and the POCUS Manager withholds it overread by the supervising physician.

Note: Some local policies may require the POCUS manager to send preliminary reports to the EMR (e.g., in cases where POCUS Learners are unsupervised). In this case, the POCUS Manager will send an addended report once the overread is signed by the supervising physician.

Step #10b: Based on the education identifier, the POCUS Manager withholds the Renal and Thoracic studies and identifies them as ready for QA.

Note: In the case of a Partially Privileged Operator, the POCUS Manager proceeds to Step #11 for study types for which the POCUS learner **is** credentialed.

Step #10c: The supervising physician accesses POCUS Manager and evaluates the study. If necessary, they amend the report, and sign worksheets withheld for overread.

Step #10d: The QA reviewer accesses POCUS Manager, evaluates the study, provides comments on the study, and issues credit, using the POCUS Manager QA functionality.

Notes:

1. The QA reviewer could be a: supervising physician, lab supervisor, clinical instructor, faculty member, etc..
2. The QA reviewer does not counter-sign the worksheet

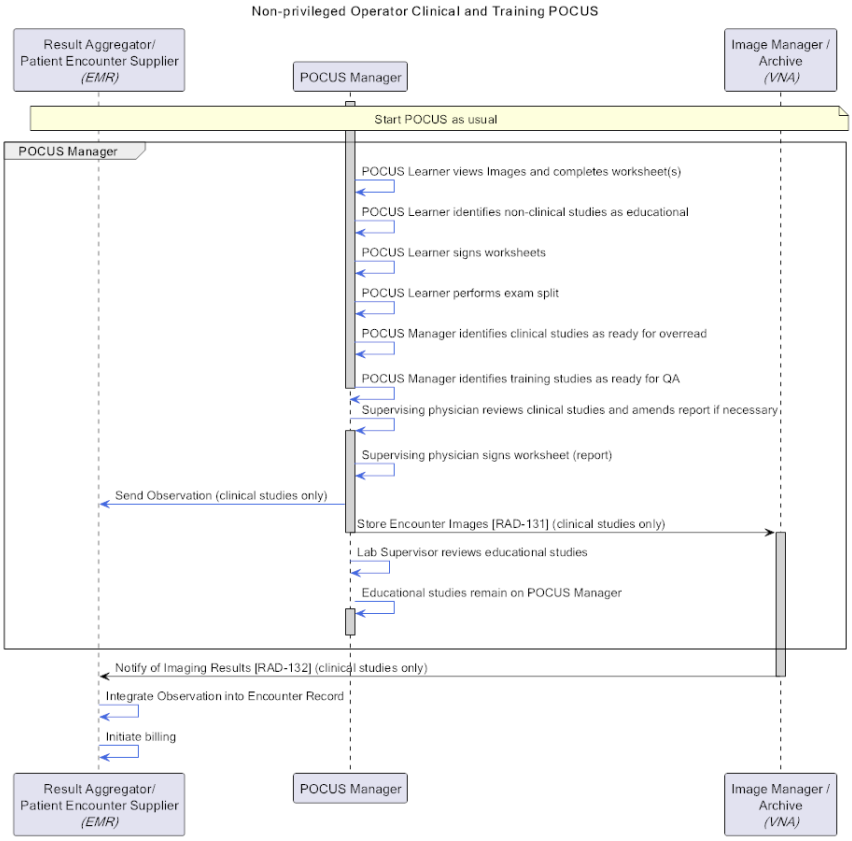
In the event of a medical finding, the QA reviewer adheres to local policies for incidental findings. This process may involve reaching out to the volunteer or their provider to guide them into a clinical care pathway, which necessitates patient registration and the formal initiation of patient care.

Steps #11-13: No change for the Obstetrical Pelvic study. The POCUS Manager sends the report (i.e., the signed worksheet) as an unsolicited observation to the EMR, and transfers DICOM images to an Image Manager/Archive (a.k.a. VNA).

Using the educational identifier, the POCUS Manager segregates the Renal and Thoracic (educational) worksheets and images from clinical data. The worksheet and images are not added to any patient record and are not sent to the EMR/VNA.

Note: Local policy may optionally dictate VNA archive of non-clinical POCUS studies (RAD-131), however, there is Notification of Results for these images (RAD-132).

Use Case #2 Process Flow



Blue arrows: new transactions

Black arrows: existing EBIW transactions

Figure 2-1: Non-privileged Operator Clinical and Training POCUS Process Flow

The text in below was used to generate the diagram above. Readers will find the diagram more informative. The text is included here to facilitate editing.

```
@startuml
title Non-privileged Operator Clinical and Training POCUS

participant "Result Aggregator/\nPatient Encounter Supplier\n//(EMR)//" as RA
participant "POCUS Manager" as US
participant "Image Manager /\nArchive\n//(VNA)//" as VNA

note over RA,VNA
Start POCUS as usual
end note

activate US #D3D3D3
skinparam sequence {
  ArrowColor RoyalBlue
}
group POCUS Manager
  US->US: POCUS Learner views Images and completes worksheet(s)
  US->US: POCUS Learner identifies non-clinical studies as educational
  US->US: POCUS Learner signs worksheets
  US->US: POCUS Learner performs exam split
  US->US: POCUS Manager identifies clinical studies as ready for overread
```

Figure 2-2: Non-privileged Operator Clinical POCUS Process Flow

Use Case #3 Non-privileged Operator Training Point of Care Ultrasound

Removed

Use Case #4 Training-only Point of Care Ultrasound

In this case, a non-privileged operator (POCUS learner) conducts an ultrasound study with no clinical intent. This subject can be a non-patient volunteer model, an anatomical phantom, or a procedural phantom, such as a gel phantom or a trans-esophageal simulator.

As in all training scenarios, the primary objective is to impart ultrasound technique, diagnosis skills, and the importance of proper documentation. This includes not only documenting findings in the report but also emphasizing the significance of accurate demographic data entry into the ultrasound system.

From Use Case #1

Step #1: Volunteer (e.g., simulated patient) is not a registered patient.

Step #2: The modality allows entry of multiple operators in case of multiple POCUS learners (e.g., lab partners).

Step #3: No change, however, the POCUS learner operator could, (in order of preference):

- scan an ID band with a fictitious ID,
- enter a fictitious patient ID based on local policy,
- enter a pseudonym based on local policy, or
- use the modality to generate a fictitious patient ID

Step #3a: The POCUS learner also enters the supervising physician (i.e., attending physician, staff physician, or attending). This could be:

- an educational lab supervisor, or
- a fictitious supervising physician

Note: Some programs may not require entry of a supervising physician during lab-based training, and the systems may be configured to skip this step.

Step #4: Depending on departmental policy:

- There may be a standing admission for educational studies,
- the MWL server may be required to generate, or access fictitious patients in the EMR,
- the modality may hold a local cache of MWL responses (see CARD Vol1: 4.3.2), or
- a fictitious patient may be entered manually based on local naming conventions.

Note: The school of medicine or educational lab may be organizationally separated from the clinical environment, and the POCUS device may be required to switch between multiple Modality Worklists, i.e., a production (clinical) and non-production (non-clinical) MWL.

Step #5: Images are sent to a sequestered destination and kept out of the patient care domain. This could be a multi-tenant POCUS manager (i.e. system with clinical and educational organizational tenants), a dedicated POCUS manager, VNA, workstation, or some other DICOM Service Class Provider SCP.

Step #6: No change.

Step #7: When completing the worksheet, the POCUS learner identifies the study as "educational", and not intended for clinical diagnosis

Using the educational identifier, the POCUS Manager segregates the worksheet, along with any related images (if they haven't been already), from clinical data. This separated report and its associated images are not added to any patient record and are not sent to the EMR/VNA.

Notes:

1. The educational identifier differentiates learning purposes vs. clinical diagnosis (which is the default pathway).
2. Although educational images and reports are segregated, they are not excluded from operator analytics provided by the POCUS manager.
3. Segregation aims to preventing the introduction of educational studies into the clinical pathway. The means of segregation is not specified in this profile; however, standardized metadata is provided to facilitate segregation.

Step #8-10: No change.

Step #10a: The POCUS Manager withholds educational studies and identifies them as ready for QA.

Step #10b: The QA reviewer accesses POCUS Manager, evaluates the study, provides comments on the study, and issues credit, using the POCUS Manager QA functionality.

Notes:

1. The QA reviewer could be a: supervising physician, lab supervisor, clinical instructor, faculty member, etc..
2. The QA reviewer does not counter-sign the worksheet

In the event of a medical finding, the QA reviewer adheres to local policies for incidental findings. This process may involve reaching out to the volunteer or their provider to guide them into a clinical care pathway, which necessitates patient registration and the formal initiation of patient care.

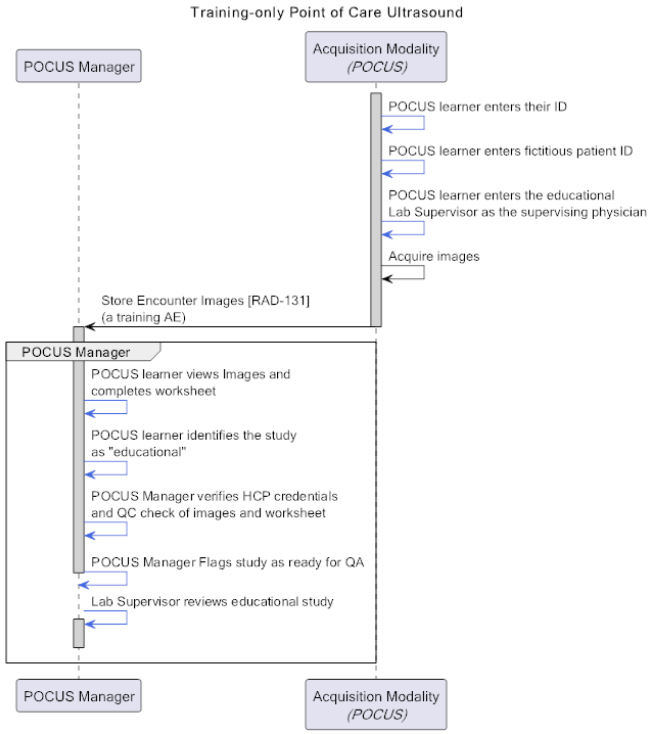
Steps #11-13: Not applicable.

Note: Local policy may optionally dictate VNA archive of non-clinical POCUS studies (RAD-131), however, there is Notification of Results for these images (RAD-132).

Use Case #4 Process Flow

The figure below depicts a typical POCUS training process flow in a training lab depicting:

1. Manual Entry of Fictitious Patient ID based on local naming conventions. This step allows trainees to practice entering patient demographics.
2. Image Acquisition: Trainees acquire ultrasound images following the designated training protocols. These images are typically captured on phantoms, simulators, or volunteer models in a controlled environment.
3. Sending Images to POCUS Manager: This step mimics the real-world process of transferring images to a responsible party for review and documentation.
4. Lab Supervisor Review: The ultrasound studies are made available for review by the lab supervisor or instructor. This allows the supervisor to assess the quality of the images and the accuracy of the documentation.



Blue arrows: new transactions

Black arrows: existing EBIW transactions

Figure 4-1: Training-only Point of Care Ultrasound Use Case Process Flow

The text in below was used to generate the diagram above. Readers will find the diagram more informative. The text is included here to facilitate editing.

```
@startuml
title Training-only Point of Care Ultrasound

participant "POCUS Manager" as US
participant "Acquisition Modality\n//(POCUS)//" as Modality

skinparam sequence {
   ArrowColor RoyalBlue
  }
activate Modality #D3D3D3
Modality -> Modality: POCUS learner enters their ID
Modality -> Modality: POCUS learner enters fictitious patient ID
Modality -> Modality: POCUS learner enters the educational\nLab Supervisor as the supervising physician
 skinparam sequence {
   ArrowColor Black
  }
Modality->Modality: Acquire images
Modality->US: Store Encounter Images [RAD-131]\n(a training AE)
deactivate Modality
activate US #D3D3D3
skinparam sequence {
```

Figure 4-2: Diagram Pseudocode for Training-only POCUS Process Flow

Use Case *nn* Procedural Adjunct Point of Care Ultrasound

Procedural guidance and confirmation. Images are acquired and use of POCUS is documented in a procedure report. Static (e.g., pre, mid, post single image) and dynamic (e.g., continuous guidance) images may be obtained.

Discussion from SCUF:

- *Option 1: "pass through" is desirable, but could be problematic.*
  Any pass through option would need to:
  - *Link to the procedure note generated natively in the EMR,*
  - *Support a unique CPT code that would enable POCUS billing.*
    A procedure specific string/value (e.g., Reason for Performed Procedure Code Sequence (0040,1012)) could be selected on the Modality and used by the POCUS Manager to send an unsolicited result to the EHR. The EHR can then use that value to generate and link the correct order.
    Could the POCUS Manager send a "canned" observation with procedure to initiate billing as in Step #13?
- *Option 2: Manage like a diagnostic study (images + specific worksheet tied to a CPT code)?*
  - *We don't want a provider to need to complete a worksheet in the pocus manager and then also write a procedure note in the EHR. If the entire procedure can be documented in the POCUS Manager and that is the only documentation required then I think this can work.*
  - *Avoiding variation in how the EHR stores and displays information about the same procedure done with/without ultrasound. In other words if a doc places a central line w/US*

and they complete their documentation on the pocus manager and it goes one place in the EHR; then if the doc does a central line w/o US on the same patient and completes the documentation solely in the EHR – those two procedure notes should end up in the same place and someone who later looks for central line placement notes should find both.

- *Option 3: Can an orders-based workflow be used? Conceivably, the Encounter Manager could generate a MWL comprised of encounter data from the ADT and orders from the Order Placer*

Use Case *nn* Discontinued

Guiding principal, discontinue up until images are captured.

After images captured.

_____

Quiet discontinue vs lazy non-compliance

Start study (no Images), then discontinued →

Images captured, then discontinued →

Images captured, sent to POCUS Manager, then discontinued →

Time-out for compliance (in general) 24h

Use Case *nn* Study Merge

Interrupted study. Examples:

- *perform echo and FAST end exam, come back and scan a kidney*

Breakout topics:

- *One (interrupted) study could be performed on 2 different US devices*

Use Case *nn* Research

TODO: look at … could be a concept section

IHE Consent

IHE Teaching and clinical export

IHE (Forms)

Segregate research (timestamp studies)

DICOM De-identification profiles

What are actor capabilities that may be useful (functionality)

Research worksheet capability

DICOM Clinical Trial Attributes

Use Case *nn* Inadvertent Capture of Images under Wrong ID

This includes 2 sub cases

- *Demographics are wrong because 1st patient did not end*

- *Demographics wrong – incorrect ID entered*

This should also consider errors identified before and after study is sent to VNA

Editorial note: POCUS manager, could act as an IOCM Change Requestor to store a Rejection Note and Replacement Instances

Use Case *nn* Unidentified Patient

Registered, but unidentified patient (e.g., trauma) who is assigned a "John Doe" identifier. Patient information updates are introduced into the system at various stages of the normal process flow.

- *Before the scan is complete (rare)*
- *After the scan is complete but before the report is signed (common)*
- *After the report is signed (common)*

Note: aligns with IHE PIR, should this be supported by the POCUS Manager (with an ADT feed)?

Use Case *nn* Unregistered Patient

This case covers an unregistered patient, who may or may not be identified (e.g., arrival of an acute patient that requires immediate evaluation). The patient is assigned a temporary name and ID at the POCUS Modality, and like the Unidentified Patient, patient information updates are introduced into the system at various stages of the normal process flow.

Use Case *nn* Addend a Report

POCUS manager sends an addended report to EHR

Use Case *nn* Multiple Operators

Is this only educational? (one operate probe, one operates console)

Use Case *nn* Modality Based Worksheet

The HCP completes the worksheet(s) on the modality in a FHIR Questionnaire. The Questionnaire Response is transferred to the POCUS Manager.

Use Case *nn* Different POCUS Studies During an Encounter

From EBIW closed items Q7. Should we include a case to filter out completed work and return active and pending encounters in the MWL?

Appendix xx – POCUS Definitions

[Editorial note: These terms may be incorporated into the Concepts section, removed, or incorporated into the IHE Glossary, here https://profiles.ihe.net/GeneralIntro/ch-D.html*. During the drafting of this work-item they are here for reference in order to provide consistency]*

Attending Physician

A fully licensed independent (vs. educationally licensed) medical doctor who has completed all necessary residency training and is board-certified. Also known as staff physicians or supervising physicians, Attending physicians hold faculty positions at medical schools or teaching hospitals and are responsible for the overall care of a patient in a hospital or clinic setting. Attending physicians have the capability of obtaining application-specific POCUS privileges. Also known as supervising physician, staff physician, or attending.

Advanced Practice Provider

An Advanced Practice Provider (APP) is a health care provider who is not a physician but who performs medical activities typically performed by a physician. APPs can be awarded POCUS privileges based on state licensure rules and facility privileging policies.

Compliance

Encoding to ensure that medical (and billing) records for POCUS studies are accurate, complete, and traceable across the enterprise.

Credentialing

The process of verifying a healthcare professional's training and competency for a specific clinical application. Clinical applications are typically based on POCUS acquisition and facility department. Successful completion of the credentialing process results in POCUS privileges.

Educational POCUS study

A POCUS study obtained for teaching purposes and not intended for clinical diagnosis or research.

Operator

One or more healthcare practitioners performing a POCUS study.

Partially Privileged Operator

Users that have completed credentialing to obtain privileges in some applications, but not all.

- If credentialed for a given application, they are considered a Privileged User.
- If not credentialed for a given application, they are considered a POCUS learner.

Operators' privileging should be considered in the context of a given POCUS application (i.e. study).

POCUS Learner

An operator without privileges, who is in process of obtaining them. This person could be any type of a teaching/learning situation.

Privileged User

A POCUS operator who has obtained (and continues to maintain) POCUS privileges (see "Privileging"). A Privileged User can sign worksheets and export signed reports (within the scope of their POCUS privileges) to the EHR without supervision.

POCUS privileging for a given HCP is constrained by their professional credentials and departmental scope of practice (i.e., an emergency physician typically performs POCUS in the ED).

The POCUS manager should distinguish POCUS operators based on their privileges.

Privileging

The process of authorizing an HCP to independently conduct POCUS for designated applications, within the defined scope of practice for their department, within the healthcare facility where the provider works. Privilege policies are established by the facility privileging committee, and typically:

- facility-specific (e.g., hospital),
- department/unit/service-specific (e.g., ED, or ICU), and
- application-specific (e.g., abdominal, lung, musculoskeletal).

Different departments may determine applications and type of privileging.

There may not be privileging reciprocity amongst facilities in the same network.

The POCUS manager should distinguish application-specific POCUS studies in order to facilitate enforcement of local privileging policies.

Quality Assurance

Quality management activity focused on providing confidence that quality requirements of a POCUS program (i.e. a review of technical proficiency, interpretive accuracy, and appropriate clinical indications) can be fulfilled (see https://asq.org/quality-resources/quality-assurance-vs-control)

Quality Control

Quality management activity focused on ongoing monitoring and correction of compliance issues of individual POCUS studies (see https://asq.org/quality-resources/quality-assurance-vs-control)

Report

A document elaborating on the study worksheet, offering an interpretation and analysis of a POCUS study. It is signed by a privileged POCUS practitioner and submitted to the EMR as an unsolicited observation.

Worksheet

A standardized form or template used by healthcare practitioners to record the findings and results of a point-of-care ultrasound examination. It helps ensure systematic data collection and provides a structured guide for operators during the ultrasound procedure.

Appendix xy – Use Case Mapping to Data Elements

Use Case #1 Diagnostic Point of Care Ultrasound

<This is another pass at the data/metadata collection sequence, and possible exceptions, from the completed diagnostic use case. I followed Kevin's convention of putting metadata items in [square brackets] for now to distinguish the Patient (human) from the [Patient] (metadata), and terms in italics, to see if that is helpful. The text is ***not complete*** *here. Wanted to test the format. Some of the statements likely need factual fixing>*

The most typical ("normal") case involves a diagnostic study performed and reported by a privileged HCP for a registered patient.

A diagnostic study is performed to evaluate a specific medical condition (shock), or to evaluate a patient's anatomy or physiology (left ventricle chamber size and function). This could be an initial evaluation or a reassessment/serial study. The Diagnostic POCUS Use Case is intended to generalize the following scenarios:

1. The patient is registered for an inpatient or outpatient encounter in a healthcare facility (e.g., emergency department, critical care unit, cardiology office, obstetrics and gynecology suite, or operating room).[Encounter]
2. The HCP enters their ID in the POCUS device (i.e., with a barcode scanner, RFID, QR code or manual entry) [Operator Identification Sequence] [Referring Physician Identification Sequence]
3. The HCP enters the patient ID in the POCUS device (i.e., with a barcode scanner, RFID, QR code or manual entry) [Patient Demographics]
4. The POCUS device displays a MWL entry specific to the patient. The HCP confirms the patient demographic information (name, date of birth, gender, etc.). and selects the patient prior to initiating exam specific image capture.[Get Encounter Imaging Context (RAD-130)]
5. The HCP performs a focused POCUS exam (e.g., biliary scan for cholelithiasis). Images are transferred to the POCUS Manager. [Store Encounter Images (RAD-131)] [Performed Procedure Step Description]
6. The HCP accesses the POCUS Manager system (through a client application on a handheld device, client web browser or PC workstation) and searches for the study completed in the previous step.
7. The HCP views the images. The POCUS Manager proposes an interpretation worksheet based on the Study Description. The HCP confirms the worksheet, and completes it, entering the views obtained, indications, findings, and interpretation. The HCP selects a flag that indicating that the study is clinically indicated (vs. educational). [Worksheet] [Patient Demographics][Encounter][Referring Physician Identification Sequence][Performed Procedure Step Description] [Educational flag]
8. The HCP provider applies their electronic signature to the worksheet. This signature is typically generated using a unique identifier tied to the provider's identity within the POCUS Manager. [Confidentiality Code]

9. The POCUS Manager verifies the HCP credentials, as well as required worksheet elements (i.e., a valid MRN, CSN/FIN, a valid patient name, views, indications, interpretation views, indications, and interpretation). [Patient Demographics][Encounter] [Referring Physician Identification Sequence][Performed Procedure Step Description][Operator Identification Sequence][Accession Number][Issuer of Accession Number Sequence]
10. The POCUS Manager also validates that the study contains at least one image, and that all images contain a valid MRN/CSN/FIN, patient name and accession number issued from either the Encounter Manager namespace, or the POCUS Manager namespace. [Patient Demographics] [Encounter] [Referring Physician Identification Sequence][Performed Procedure Step Description][Operator Identification Sequence][Accession Number][Issuer of Accession Number Sequence]
11. Because the HCP is credentialed, and both the worksheet and images meet validation criteria, the POCUS Manager sends the report (i.e., the signed worksheet) as an unsolicited observation to the EMR, and transfers DICOM images to an Image Manager/Archive (a.k.a. VNA). [RAD-131][ORU]
12. The Image Manager/Archive sends a notification to the EMR using Notify of Imaging Results [Notify of Imaging Results (RAD-132)].
13. The POCUS report along with hyperlinks to review the study image data in PACS are associated with the patient encounter in the EMR.

    Note: Based on local policy, the EMR may also create an order for billable studies, as well as financial transactions necessary for charging.

Open Issues from ACEP

This table contains open issues raised by the ACEP workgroup:

Q:How should a "hanging report"(i.e. a report that has not been signed) be addressed by the POCUS Manager?

A: The attending named on the report should be notified. If there is no attending named, the attending of record based on the Encounter should be notified. Types of notifications include:

- *email reminders*
- *"EHR" in basket (Provider Notifications)*
- *Popup on app*
- *FHIR Communication*

Q: Is it sufficient to encode confidentiality codes in the report, or should DICOM images contain confidentiality codes as well?

Certain study findings may require tighter controls. OM1-30 (Confidentiality Code) applies to an observation, however there is no corresponding attribute in DICOM. Both the Confidentiality Constraint on Patient Data Description (0040,3001) and Requested Procedure Module Attributes Confidentiality Code (0040,1008) are intended to indicate confidentiality constraints from the Order Filler in an order-based workflow. DICOM cp1982 was created to address confidentiality constraints on visible light images.

Q: Should any "roles" be encoded on the Modality (i.e. Referring Physician's Name or Name of Physician(s) Reading Study)?

In POCUS it is important to identify: who saved images and who is responsible for signing.

The Operator Identification Sequence (0008,1072) in the General Series Module can encode multiple Operators (i.e., who saved images). For example:(1093745721,99NPI,"Ferre, Robinson"). This is ideal for POCUS workflows in which it is common to have 1-3 operators

Knowing the role of the Operator up front can be valuable for report sign-off accountability.

On the other hand, the person signing the report may not be one of the operators.

Referring Physician's Name could be included in the incoming MWL, however, Name of Physician(s) Reading Study potentially adds UI interactions and typographical errors on the modality.

A: No, operator mapping should be performed on the POCUS Manager

Q: Should educational studies be identified on the modality or on the POCUS Manager?

Instead of solely relying on the Operator to determine clinical vs educational intent of a study, the Procedure Code Sequence (0040,1012) could include coded entries, such as

Coding Scheme Designator	Code Value	Code Meaning
UMLS	C0007836	Certification
DCM	129012	Educational Intent

DCM	113009	For Research

Selection could be added to the UI with little overhead (i.e. check box or pulldown on the Modality) and facilitate routing of images.

Q: Where should HCP credentials be verified (e.g., should the modality verify credentials, or should credentialing be verified on the POCUS Manager)?

A: Credentialing/privileging should be managed by the POCUS Manager. Operator credentials do not need to be validated on the modality. The operator must identify themselves to determine if a privileged provider is required to sign (i.e. overread) the report.

Q: Should a transaction to "obtain credentials" be profiled on the POCUS Manager? If so, is there a preference for a standard? The HPD data model includes credentials. Likewise, practitioner.qualifications in FHIR could be profiled.

A: No, paperless credentialing are closed and do not provide standardized interfaces (for regulatory reasons) to query provide credentials.

Q: Should all studies undergo QA? Not all care areas have the resources or time to perform QA every study

QA is defined as: a review of technical proficiency, interpretive accuracy, and appropriate clinical indications.

A: No,

1. *QA for clinical POCUS is not currently required by accrediting bodies (e.g. JACHO) however, most institutions implement QA programs for continuous improvement of patient care.*
2. *QA occurs for all educational studies by definition*

This profile does not profile QA Use Cases; however, many POCUS Managers provide may be used for QA, or provide QA functions.

Q: Should all studies be routed to the POCUS Manager?

A: No, cases such as peripheral IV placement, could be stored directly to an Image Archive, or be routed to an Image Archive (i.e. pass-through) by the POCUS Manager.

However, some departments may opt for a workflow that routes all POCUS images through the POCUS Manager

Q: LDAP is included in the Best Practice Recommendations and commonly implemented in other domains (imaging, bedside monitors, EKG, etc..). Authentication is recommended in FDA cybersecurity guidance(s) and required by VA/DoD, as well as several institutions. On the other hand, not all ultrasound devices have LDAP capabilities, nor do they require log-in.

Whether on dedicated equipment, or a mobile application, user IDs should be input easily, using methods such as barcode scanning. IN POCUS one or more operators need to be associated with enterprise user accounts, permissions and NPIs for downstream workflow activities.

Should user authentication be profiled? If so, how?

A: There is no one-size fits all authentication standard, however user identification is important for determining POCUS Privileges (see "Compliance" section)

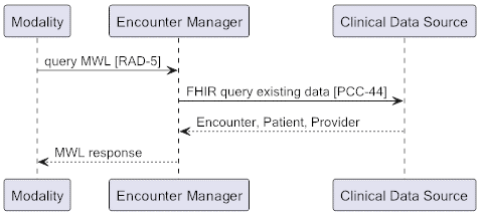
Q: EBIW mentions barcode, but did not specify transactions in order to offer flexibility.

As mentioned above, barcode is a desired user function. Wristbands may include a multitude of identifiers that could be mapped to Admission ID, which is already R+ in EBIW. Should a specific barcode transaction be avoided?

How to handle barcode scan of an operator? DICOM attributes for operator, physician, etc.. have VR PN (patient name). How does an employee barcode decode?

A: This document takes the same approach as EBIW. There is no one-size fits all standard in practice, however user identification is important (see "Compliance" section)

Q: Building a worklist based on filtered ADTs is common (i.e., patients registered, previously registered, transferred in/out, or discharged from a specific department or predetermined areas of care). There is an opportunity to add specificity to ADT based worklists. IHE CP-RAD-480 has been opened to add ADT mapping to EBIW; workgroup input is sought for this CP.
Are there other methods that should be profiled (see EBIW 47.4.1.5 Obtaining Encounter Metadata)?
Should there be a named option for FHIR Context? IHE drafted "FHIR Query for Imaging Context." The Encounter Manager could function as a MWL proxy and perform a FHIR query after receiving a MWL request e.g.,



Is this prone to issues with MWL request timeouts?

Q: Where should the report be signed?
A: The worksheet is electronically signed by the privileged user in the POCUS Manager. An un-privileged user may sign a worksheet (i.e. preliminary, or "interpreted by"); however the worksheet must be countersigned signed by a privileged user (i.e., verified by)
Technical requirements for electronic signatures are determined by jurisdiction, institution or payors, for example:

- *CMS*
- *AHMIA (American Health Information Management Association)*
- *Michigan Uniform Electronic Transaction Act*

Also see IHE DSG
Requirements for electronic signatures are out of scope of this document.

Q: Should this Use Case profile DICOM Storage Commitment
A: No: Storage Commitment is not required in EBIW

Q: Does the order creation on the EMR need to be profiled?
A: No, this process is locally defined and EMR -specific. RAD-132 is an HL7v2 ORU^R01 message specified to include information necessary for the Results Aggregator (typically the EMR) to create an order for billable studies, as well as financial transactions necessary for charging

Q: How can the modality communicate when the study is complete? (either the operator ends the exam or there is a time-out without saving an image). MPPS is used to achieve such behavior in scheduled workflow, should we consider profiling something based on the Unidentified Patient or Unscheduled Patient in SWF?

Q: For legacy reasons, some modality vendors provide Secondary Capture of the patient demographics UI to record additional patient history typed in by the operator. Should this be Encoded in DICOM for display on the POCUS Manager?
A: Yes one of the following should be profiled:

Module	*Element Name*	*Tag*	*VR*	*Type*
Patient	*Patient Comments*	*(0010,4000)*	*LT*	*3*
Patient Study	*Additional Patient History*	*(0010,21B0)*	*LT*	*3*

Q: Should preliminary reports form a POCUS Learner be sent to the EMR before they are overread by a supervising physician?
A: No. Preliminary reports should remain on the POCUS Manager until overread. A note has been added to explain the exception case in which POCUS Learners are unsupervised, and preliminary reports may be sent to the EMR, and addended after the overread.

Closed Issues from EBIW

This table contains issues that were closed during IHE Rad Tech committee preparation of the IHE EBIW Profile for Trial Implementation. IHE records closed issues so that if/when new considerations come to light, the issues can be revisited. A selected set of closed issues are listed here that may be worth a second review from the ACEP workgroup:

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.

Comment: ACEP WG should confirm the use of Encounter ID

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.)

Comment: ACEP WG should review use of accession number based on billing requirements. US Management systems currently incorporate elements of Group Case and PGP

Accession number is implicitly decoupled from billing in EBIW, do EMR systems automatically associate an accession number with a billable encounter?

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

For outpatient, encounter ID is unique for each department.

Comment: ACEP WG should confirm the use of Encounter ID

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.

Comment: Could be managed by a US Management systems in the same way Image Manager/Archive addresses in SWF.b

Q. Where, if anywhere, should configuration of procedure lists be required?

A. Don't require.

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. Could also make use of the Shared Value Sets (SVS) Profile or FHIR codeset services when they're ready.

Neither of the above are required, leaving it up to users and their set of vendors to work something out.

Comment: ACEP WG should confirm

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.

Comment: ACEP WG should confirm (especially sub-encounters)

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.

Comment: ACEP WG should confirm this approach

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.

Comment: ACEP WG should discuss, as this was noted as an issue during SCUF22

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.

Comment: ACEP WG should confirm this approach

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.

Commented [1]: I believe we were able to develop a process to do this at Spectrum Health (Corewell Health-West)

Commented [2]: It was my understanding that FHIR queries the MWL (patients in the department < 100) and returns one patient. That patient might be scanned at time 0 and time +180 minutes + 24 hours for example if they're a patient that requires admission but stuck in the ED.

Commented [3]: Yes, agree. Particularly for admitted patients— volume status assessments, fetal heart rate, repeat iv access, bladder volume assessments

Commented [4]: This is a nice feature that allows a health system to archive clinically indicated studies in VNA / EMR independent of billing status (sometimes contractual obligations that prevent a speciality from seeking billing for example)

Commented [5]: Let's discuss

- 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

Comment: ACEP WG should discuss. Some facilities require MPPS for POCUS (i.e. SWF unscheduled case)

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 Section 4.132.4.1.1 Trigger Events.

If implemented, Issuer of Accession Number might also help to identify those from the Encounter Manager, or if a prefix-suffix-known range 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).

Comment: ACEP WG should confirm

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

Comment: Does the POCUS reporting/billing apply to photography?

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?)

Comment: ACEP WG should discuss: Options are outlined in EBIW 47.4.1.4 Obtaining Patient Metadata. Is this sufficient, or should one or more named options be added?

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