EMERGENCY ULTRASOUND:
Workflow White Paper

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OUTLINE

Front-end workflow

Begin Examination

#1 Place order in EMR, then select from DICOM modality worklist on the ultrasound machine to populate exam and patient information.

or

Using barcode reader, scan patient wristband barcode into the patient identifier field and sonographer barcode into the operator field.

#2 Designate ultrasound as a diagnostic, procedural, or educational study.

#3 Select examination preset and probe type to initiate ultrasound scan.

#4 Obtain ultrasound images and save to the ultrasound machine storage.

#5 (Enter ultrasound interpretation directly onto the ultrasound machine at the point-of-care.)*

End Examination

Back-end workflow

#6 Completed study transferred wirelessly from the ultrasound machine to the workflow system.

#7 (Hyperlink to the workflow system for entering ultrasound interpretation is sent to the EMR.)*

#8 Educational study images and interpretations remain within the workflow system only.

#9 Structured text or PDF report of ultrasound interpretation transferred from the workflow system to the EMR.

#10 Ultrasound images and interpretation transferred from the workflow system to the PACS.

or

Hyperlink to the workflow system for viewing ultrasound images is sent to the EMR.

* *Preferably workflow should proceed as described in #5. However, if this is not feasible on existing ultrasound machine models, an alternate workflow may be followed as described in #7.*

Key: Digital Imaging and Communications in Medicine (DICOM); Electronic Medical Record (EMR); Picture Archival and Communication System (PACS); Portable Document Format (PDF).

DISCUSSION

Utilizing standardized communication formats

Ultrasound machines, workflow systems, and the EMR (Electronic Medical Record) should communicate via standardized, non-proprietary formats. Development of a DICOM-SR (Digital Imaging and Communications in Medicine Structured Reporting) standard is recommended for ultrasound machine to workflow system communication, and an HL7 (Health Level 7) standard is recommended for workflow system to EMR communication.

Entering patient and sonographer information

Patient information should be populated onto the ultrasound machine either via DICOM (Digital Imaging and Communications in Medicine) modality worklists or using barcode scanners. With barcode scanning, the patient wristband barcode is scanned into the patient identifier field, and sonographer barcodes are scanned into the operator name fields. Personalized barcodes may be generated for individual sonographers and attached to hospital identification cards for ease of access. The ultrasound machine should provide 2 operator name fields to accommodate when both a trainee (non-credentialed) and a supervising (credentialed) sonographer participate in the study. After completed examinations have been transferred from the ultrasound machine to the workflow system, the workflow system uses the patient wristband identifier to populate the patient name, medical record number, and demographic information.

Diagnostic, procedural, and education study designation

Studies should be designated on the ultrasound machine as either diagnostic, procedural, or educational. Educational studies are performed by trainee (non-credentialed) sonographers for learning purposes, and ultrasound findings are not utilized in clinical decision making. Diagnostic and procedural studies are performed (or supervised) by credentialed sonographers, and ultrasound findings are incorporated into clinical decision making. After completed examinations have been transferred from the ultrasound machine to the workflow system, diagnostic and procedural studies are then sent to the EMR and PACS (Picture Archival and Communication System). Educational studies remain within the workflow system and are not sent to the EMR and PACS.

Wireless transfer of studies from the ultrasound machine

After scanning is finished, the ultrasound machine should allow easy review of all saved image stills and cine loops to facilitate deletion of unwanted images prior to transfer. All studies (diagnostic, procedural, and educational) should automatically transfer wirelessly from the ultrasound machine to the workflow system after the examination has been completed. It is especially important for ultrasound machine vendors to support all IEEE (Institute of Electrical and Electronics Engineers) 802.11 standards and security protocols commonly used in healthcare settings. Once successfully transferred from the ultrasound machine to the workflow system, studies should be delegated to temporary storage and deleted from the ultrasound machine after a designated period of time.

Integrated ultrasound interpretation worksheets

Interpretation worksheets should be integrated onto ultrasound machines so that they may be completed by the sonographer at the point-of-care. This may be accomplished either by incorporating interpretation worksheets into the ultrasound machine user interface or by accessing the workflow system directly on the ultrasound machine (e.g. via a web browser.) The implementation of integrated interpretation worksheets may not be feasible on some existing ultrasound machine models. As an alternate method, once a completed examination has been transferred from the ultrasound machine to the workflow system, a hyperlink is automatically sent

from the workflow system to the EMR. Upon activating the hyperlink within the EMR, the workflow system will open and automatically load the corresponding study images and interpretation worksheet for the user to complete.

Ultrasound interpretation worksheet customization

Interpretation worksheets should be fully configurable, so that they may be modified according to the specific preferences and needs of individual hospital sites. While worksheets templates (e.g. based upon the ACEP (American College of Emergency Physicians) Standard Reporting Guidelines) may be provided, it is essential that worksheet fields are completely user customizable. A worksheet editor and building tool should be provided and easily accessible by the hospital site ultrasound director. It is especially important for ultrasound machine vendors to provide this functionality if interpretation worksheets are incorporated into the ultrasound machine user interface.

Assigning multiple worksheets to individual studies

Users should be able to assign multiple different worksheet types to individual ultrasound studies, since not infrequently a sonographer will obtain images corresponding to several different ultrasound applications as part of a single patient examination. For example, a sonographer may perform both focused cardiac and thoracic ultrasound during the evaluation of a patient with undifferentiated shortness of breath, and both corresponding worksheet interpretations would need to be completed for this single study.

Core versus advanced interpretation worksheet fields

Interpretation worksheets should accommodate both core (required) and advanced (optional) ultrasound views and findings. Core ultrasound views and findings constitute the minimal requirements for a complete ultrasound examination. Worksheet fields corresponding to core views and findings should always be visible to the user when entering the ultrasound interpretation. Advanced ultrasound views and findings are optional and not required as part of a complete ultrasound examination. Worksheet fields corresponding to advanced views and findings should as a default remain hidden but may easily be revealed by selecting an advanced tab or setting.

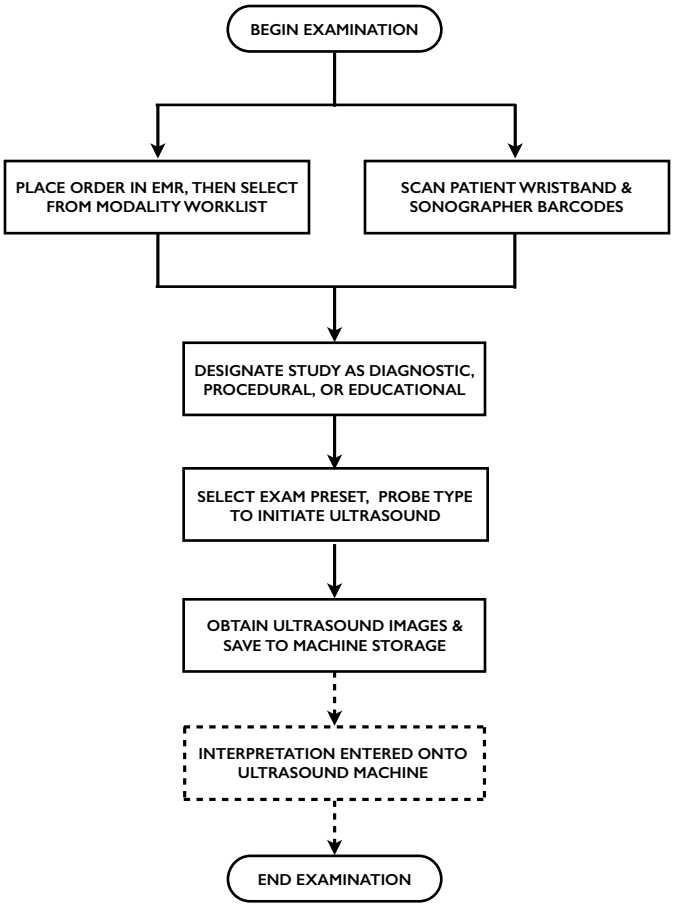
Ultrasound interpretation reports in the EMR

Ultrasound interpretations should be sent from the workflow system to the EMR as structured text or PDF (Portable Document Format) reports. For diagnostic and procedural studies, once an ultrasound interpretation has been completed in the workflow system, the workflow system should automatically send an interpretation report to the EMR. Interpretation reports should be sent either as structured text or in PDF format so that they may be easily viewed within the patient chart. Interpretation reports should not be sent to the EMR for educational studies.

Ultrasound image archival and viewing

Ultrasound images must be easily accessible to all healthcare providers participating in the care of the patient. Many sites prefer that ultrasound images (and interpretation reports) reside within the hospital PACS. For diagnostic and procedural studies, after completed examinations have been transferred from the ultrasound machine to the workflow system, study images should automatically be transferred to the PACS. However, some sites may prefer not to utilize the hospital PACS. As an alternate method, after a completed examination has been transferred from the ultrasound machine to the workflow system, a hyperlink is automatically sent from the workflow system to the EMR. Upon activating the hyperlink within the EMR, the workflow system will open and automatically load the corresponding study images. Ultrasound images should not be sent to the PACS and EMR for educational studies.

Front-end workflow



Back-end workflow