Journal of Digital Imaging (2023) 36:395–400
https://doi.org/10.1007/s10278-022-00742-4

ORIGINAL PAPER

Development and Implementation of a Semi-Automated Workflow for Point-of-Care Ultrasound Billing and Documentation Within an Electronic Health Record

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Received: 14 September 2022 / Revised: 9 November 2022 / Accepted: 9 November 2022 / Published online: 16 November 2022

Abstract
Point-of-care ultrasound (POCUS) is widely used for both diagnostic and therapeutic purposes. With its many advantages, including ease of use, real-time multisystem assessment, affordability, availability, and accuracy, it has been adopted by all medical specialties. Despite its advantages, the lack of standard workflow and automated billing solutions makes it difficult to launch a comprehensive POCUS program. In this work, we describe how we created and implemented an efficient standardized EHR-based workflow for POCUS that has been used across multiple division and settings within our organization.

Keywords POCUS · Billing · Enterprise imaging · Interoperability

Introduction

Point-of-care ultrasound (POCUS) is the use of ultrasound by a provider to answer a focused clinical question and assist in clinical decision making [1]. With the advancement of ultrasound devices from bulky machines to handheld devices, ultrasound has enviable portability that makes it the standard of care in many applications [2]. It is generally used both as an extension of the physical exam and to assist with procedures [3]. Since its advent in the early 1980s, it has evolved from being used primarily within the emergency room and critical care setting to a widespread adoption among all medical specialties [4]. The benefits of POCUS lie in its availability, affordability, and accuracy [4–7]. It is used by providers to obtain a real-time multisystem assessment [1, 8]. Because of its promise, ultrasound training is now included as part of the curriculum in 62% of medical schools as well is in many residencies and fellowships [9–11].

Despite its known advantages, it is still difficult to launch a comprehensive POCUS program due to the lack of standard workflow and automated billing solutions. The lack of a standard workflow leads to inefficient requirements for data entry; makes image storage, retrieval, and consumption more difficult; and prevents discovery of POCUS procedures within the electronic health record (EHR). The lack of a standard workflow makes billing more difficult as providers must determine which procedure best fits the study that they performed [12]. Prior studies have shown that standard workflows with automated billing have increased POCUS utilization and billing [13–15]. Furthermore, with the adoption of enterprise imaging principles at our institution, finding a solution for this problem a natural progression of our mission [16–18].

Over the past 5 years, multiple divisions at our institution have requested help from the enterprise imaging team in creating a POCUS workflow. The purpose of this manuscript is to describe how we created and implemented an efficient standardized EHR-based workflow for POCUS that has been used across multiple divisions and settings within our organization.

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Materials and Methods

Systems and Setting

This project took place at a large children's hospital with nearly 1.3 million encounters in fiscal year 2020. Providers care for patients in the ambulatory, inpatient, emergency room, and perioperative settings at 2 hospitals and 9 outpatient locations.

Our organization has a large enterprise imaging program that aims to build efficient workflows that enable users to "*capture, index, manage, store, distribute, view, exchange, and analyze all clinical imaging and multimedia content*" [16]. As part of the enterprise imaging program, we implemented an enterprise imaging archive (iConnect; IBM Watson Health Imaging, Cambridge, MA) in 2013. The archive serves as a single point of storage for all imaging studies including those obtained within radiology and cardiology. An enterprise viewer (iConnect Access; IBM Watson Health Imaging, Cambridge, MA) was launched in 2016. The enterprise viewer allows providers to view images obtained by any specialty [18]. Users can access the enterprise viewer via direct login or a link in the EHR (Epic Systems, Verona, WI).

We employ a multi-tiered governance model which differs from those described in the past [17]. Most of the day-to-day decisions are made by the operational governance team. This team is composed of a physician leader, imaging informatics professionals, and project manager. The operational governance team uses the clinical and technical governance bodies to inform larger, more impactful decisions. The clinical governance team includes physician leaders, compliance specialists, and health information management representatives. This team helps to make recommendations related to the prioritization of resources and the application and documentation of clinical care. The technical governance team is composed of information technology specialists. This team helps to make recommendations related to security, network or data center requirements, and integration with the EHR.

Requirements

A multidisciplinary project team was composed to build a standard workflow. The team consisted of an Associate Chief Medical Information Officer, the Director of Imaging Informatics, imaging informatics analyts, EHR analysts, a senior business director from the Department of Radiology, and a project manager. As POCUS expanded into a new division, representative clinical and business leaders were included.

Our guiding principle was to create a standard process that enabled providers to efficiently perform, document, store, and bill POCUS studies across multiple specialties and within multiple settings. To achieve this goal, we had requirements for each POCUS modality and for the EHR build. First, our enterprise imaging governance team decided that POCUS devices must be able meet hospital security requirements, create Digital Imaging and Communications in Medicine (DICOM) standard images, and use a DICOM modality worklist (MWL). The team believed that DICOM standard images would enable the routine storage and consumption of obtained images. The use of a DICOM MWL would allow providers to efficiently apply standard patient demographic metadata to the images. In addition to these requirements, the governance team recommended that divisions purchase devices or software packages with the DICOM modality perform procedure step (MPPS) to enable greater levels of automation [19].

The team worked with clinical providers to identify requirements of the EHR build. Ideally, the POCUS workflow should be initiated within standard clinical or procedural workflow appropriate to the context of care. The number of workflow steps was expected to be minimal and would ideally result in a decrease in the number of mouse-click or keystrokes as compared to the pre-existing workflow. Clinical documentation should be automated and associated with the images via a link in the EHR, no matter the imaging setting. Finally, image storage and procedure billing should be automated based on standard workflow steps.

Interventions

Discovery

Each new division added to the POCUS program is treated as a mini project. The first phase is discovery. At the outset, the enterprise imaging implementation team asks the division to provide access to their ultrasound machines. This allows the implementation team to assess the POCUS modality's WIFI connectivity, DICOM capabilities, and ability to meet the security requirements of the organization. If the modality did not meet these requirements, recommendations for new equipment are made.

Next, the division is asked to create lists detailing the procedures and billing codes utilized as well as the names and roles of employees who perform or support POCUS procedures. Any standard, structured diagnostic or procedural notes are provided. After these lists are obtained, the enterprise imaging physician leader works with divisional physicians to create a list of potential POCUS procedures. The new list of procedures follows the organizational naming schema recommended by the clinical governance team: <SPECIALTY>ULT<BODY PART or PROCEDURE>. The business leaders then review the list and assign the appropriate technical and professional Current Procedural Terminology (CPT) codes.

Workflow

The POCUS workflow is outlined in Fig. 1. This workflow is available to all user roles identified during the discovery phase. Initially, the provider clicks the POCUS tab within the already opened patient chart. The provider then selects the appropriate procedure from a drop-down list. This list is specialty specific and includes all the procedures identified during the discovery phase. Providers, such as residents, who work in multiple areas, have access to multiple drop-down lists.

Once the provider selects the procedure, it is automatically scheduled and begun in the background. The provider moves to the POCUS modality where he or she selects the patient from the DICOM MWL. Selecting the patient from the MWL automatically applies all of the patient and study metadata to the images. The provider then performs the imaging study. As images are acquired, they are automatically sent to the radiology picture archiving and communication system (PACS) and enterprise imaging archive. Once the imaging study or procedure is complete, the provider returns to the EHR to complete documentation.

The POCUS workflow includes the ability to write a note for the imaging study. If a standard structured note was identified during the discovery phase, it can automatically be applied for the specified procedure. In this instance, the provider would have to add unique relevant information to complete the note. POCUS notes are filed on the imaging tab of our EHR, grouped by the specialty performing the examination. Once the note is filed, a link to launch the images via the enterprise viewer is created. The notes created for ultrasound-guided procedures are slightly different. We employ a separate workflow for these studies due to the requirement for a procedure note. In these instances, a note is automatically created within the POCUS workflow instructing users to look to the procedure note created on the same date for details.

There are some divisional differences in note creation. Most notably, anesthesia POCUS is integrated into their standard workflow. Anesthesia providers can create a standard note using button clicks describing specific variables.

Assessment

The POCUS workflow was assessed to determine efficiency, use, and impact. Using a standard patient, an observer (AD) measured the time and counted the number of clicks and keystrokes required to complete imaging and documentation. For this assessment, the standard patient's name was Mary Smith. Her medical record number was 12345678, the study accession number was 12345678, and her date of birth was 1/1/2000. Counts were obtained both for the pre-existing imaging workflow and the new EHR-based workflow.

To assess the impact of the POCUS workflow, the number and type of POCUS studies were tabulated, and the United States dollars (USD) billed was reported from the start of POCUS in our hospital through the end of 2021. Because images were not stored prior to the implementation of the new POCUS workflow, the study volumes and USD billed are only reported after the implementation of the new workflow.

Results

Currently, 7 divisions have implemented a POCUS workflow: anesthesia, rheumatology, emergency medicine, pediatric ICU, neonatology, cardiology ICU (not cardiac echoes), and physical medicine and rehabilitation. Currently, it takes approximately 6 months to move a division from the discovery phase through clinical go-live. Most of the time spent is in the creation of the billing codes within the EHR.

During review of the historical process, 47 keystrokes were used to perform and document the POCUS procedure from start to finish. The procedure took 56 s to complete (not including the time for imaging). The new standard POCUS process required 32 keystrokes to complete and took 42 s to complete. Notably for the new process, 20 s of the 42 s was background scheduling and advancement of the study. Detailed information comparing the two workflows is included in Table 1.

A total of 6387 POCUS studies have been performed on 18 POCUS machines between January 1, 2016, and December 31, 2021. Overall, by the end of 2021, we were able to bill $2.4 million dollars of new services billed.

Discussion

There has been widespread adoption of POCUS [3, 7, 8, 11]. While providers are able to use POCUS to care for patients, many hospitals still have difficulty implementing

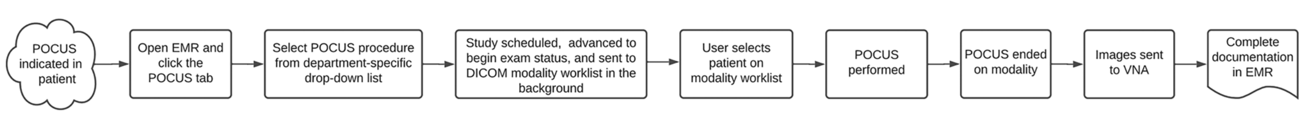

Fig. 1 POCUS workflow

Table 1 List of steps for prior vs new procedure with clicks

Prior = 47 clicks/keystrokes	New = 32 clicks/keystrokes
Press Power Button on machine	Click patient name
Click patient	Click orders tab
Enter MRN; 8 characters	Click Pocus Tab
Enter Last Name: Smith; 5 characters	Click procedure; drop down; 2 clicks
First name: Mary; 4 characters	**Press power button on machine**
Enter DOB; 3 clicks	**Click patient**
Enter Age; 3 clicks	Click worklist
Enter Gender; drop down; 2 clicks	Click query
Enter Exam Type; drop down; 2 clicks	Click patient from list
Enter operator; drop down; 2 clicks	Click done
Click Done button	**Collect images**
Collect images	**Click Save Image**
Click Save image	**Repeat as needed**
Repeat as needed	Click Review
Click End Exam	Click Select all
Click Yes to end it	Click send to
Enter dot phrase;.POCUSPROC, 10 characters	Click DICOM tab
Complete procedure note on EPIC	Click Send
	Click End Exam
	Click Yes to End it
	Enter dot phrase;.POCUSPROC, 10 characters
	Click Sign
	Complete procedure note on EHR

Bolded items are common steps and are not counted. This assumes the use of our specific ultrasound device and that the faculty member is already logged into EHR

comprehensive POCUS programs due to an inability to adequately store images and document results [12, 20–23]. To meet United States Medicaid rules, complete documentation must include the following six components: indication, operator, study performed, and findings, and interpretation [12, 24, 25]. This documentation can reside within a relevant note including procedure notes, operative notes, progress notes, or standard imaging reports [12, 20, 26].

It is important to state that just authoring a note is not enough to be able to bill for a POCUS. An image or series of images is required to be stored for each billed imaging study [12]. This has been described as a significant limitation for many divisions due to the reluctance of adding non-radiology images to a hospital PACS. We have not faced this challenge at our hospital. Our radiology department has encouraged us to send POCUS studies to the PACS so that they are available for radiologists to view and to compare to other radiologic imaging studies. Even if our radiology department resisted this idea, POCUS images could be sent to our enterprise imaging archive, the repository containing all of the images obtained in the hospital.

Several hospitals have implemented programs automating workflow and billing [13–15]. These sites have shown that a standard workflow and automated billing can increase POCUS utilization and generate revenue [13–15]. Many of the previously described workflows require an additional middleware software to implement POCUS workflow, and drive documentation and billing [14, 15, 27]. Our system differs from these in that the workflow is driven entirely by the EHR. We believe that an EHR-driven workflow is more efficient as providers do not have to learn or use an additional system. Our data shows that this process is efficient, requiring 32 keystrokes or mouse clicks to perform a POCUS.

Only one other report of EHR-driven POCUS workflow has been published [13]. In this work, the authors created a complex solution that incorporated more detailed structured reporting [13]. While the authors did not report the number of keystrokes or mouse clicks, based on the description of their workflow, we believe that our design is more elegant while maintaining the same benefits of automated billing and reporting [13].

We tried to make our workflow as efficient as possible leveraging automation. Key automation steps included ad-hoc order creation through the selection of a study from a predetermined list of orders, automated scheduling of procedures, automated begin and end exam steps, use of a DICOM MWL to populate patient demographic information, and the use of pre-populated auto-text options for procedures. These automation steps helped us to reduce the number of mouse clicks and keystrokes and achieve our goal of implementing a workflow with fewer steps than the pre-existing work. We believe that reducing workflow steps is important. Studies have shown that higher numbers of mouse clicks and keystrokes with resultant increasing EHR time may be associated with burnout among physicians [28–30]. Besides being more efficient, we believe that our standard workflow provides for better data consistency. The use of DICOM MWL allows for automatic assignment of patient and study demographics and preventing manual data entry errors.

While the POCUS program enabled divisions to bill for work being performed, it is important to note that billing does not directly correlate with revenue. Because of the convoluted mix of payers and negotiated payment rates, it is not possible to determine the amount collected. If we conservatively assume that we collected 40% of what was billed, we can estimate that our POCUS program has generated approximately $1,000,000 in revenue [21]. Assuming that each of our 18 POCUS machines were purchased at approximately $50,000 per unit, our POCUS program has generated a positive return on investment [net revenue = $1,000,000 revenue collected – $900,000 cost = $100,000 net revenue] [21, 31]. This net revenue would grow significantly if low-cost handheld devices were selected.

There are several limitations of this workflow. While we tried to create a simple workflow, it still requires training. Most providers are not familiar with this type of workflow and expect to start on the POCUS machine, not the EHR. If they go out of order, images can still be sent to the enterprise imaging archive; however, some of the workflow efficiency is lost. Additionally, while we tried to create a simple method for creating a document, the POCUS note does not always fit in the location expected by the provider. For example, during procedures, providers prefer to document the POCUS study in the same location as the remainder of the procedure. To accommodate this, we had to create a referential note describing the location of the full note. While this keeps the workflow simple, it makes it difficult to associate the images with the correct note in the EHR and within the enterprise viewer. We believe that there is still room to improve this component of the workflow. Finally, while we believe that every study sent to the imaging archive utilized the correct workflow, we have no way to measure studies that were performed using an incorrect workflow. Because many steps of the workflow are automated, if a POCUS was performed using an incorrect workflow, there would be no way to create a link in the EHR or generate a bill for services rendered.

In conclusion, we have created a standard and efficient EHR-driven POCUS workflow. This workflow has enabled providers to perform POCUS studies, document their results, store images, and bill for their work. We have implemented the workflow across 7 different divisions within our hospital and continue to expand it to others. Although the process is specifically tied to our EHR, we believe that the principles are generalizable and can be applied across many different systems.

Author Contributions Project conception and design: Perry, Ulland, Slavik, OConnor, Towbin. Material preparation: Dhamija, Perry, Ulland, Slavik, OConnor, Towbin. First draft: Dhamija, Towbin. Manuscript editing: Dhamija, Perry, Ulland, Slavik, OConnor, Towbin. Manuscript approval: Dhamija, Perry, Ulland, Slavik, OConnor, Towbin.

Declarations

Ethics Approval This manuscript represents a systems implementation. No ethics approval is required.

Competing Interests The following authors have no relevant financial or non-financial interests to disclose: Akhil Dhamija, Laurie A. Perry, Jennifer Regan, Tim OConnor, Lisa Ulland, Evan Slavik. Alexander J. Towbin declares the following: Elsevier — author royalties; Applied Radiology — consultant; Cystic Fibrosis Foundation — grant funding.

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