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Impact of worklist selection on point-of-care ultrasound workflow – a quality improvement project

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Abstract

Background Research demonstrates that Point-of-care ultrasound (POCUS) improves clinical outcomes for patients. Improving clinician satisfaction with POCUS should promote utilization into everyday practice, leading to improved clinical outcomes. Despite this benefit, there are still barriers to use including POCUS workflow. This project was undertaken to improve the functionality of the existing POCUS workflow and move toward an "encounter-based" system by automating worklist generation. It aimed to streamline the POCUS workflow, primarily determine if there was improved clinician satisfaction with the new workflow, and secondarily determine the change in revenue generation from decreased errors in data entry.

Methods A new workflow was created which automatically populated every registered Emergency Department (ED) patient into the worklist upon patient registration. Clinician feedback on their use of the new workflow was sought via survey after implementation. The number of medical record number (MRN) entry errors prior to and following implementation was manually reviewed and calculated.

Results There was a strong preference for the new workflow, with 36 of 38 (94.7%) clinicians finding it to be more convenient and 37 of 38 (97.4%) finding it to be preferable to use compared to the old workflow. Implementation also resulted in a 36% reduction in database studies containing an MRN data entry error.

Conclusions An "encounter-based" workflow is strongly preferred over manual data entry for POCUS workflow among clinicians. Additionally, there was no cost to the intervention and the total data entry errors were significantly reduced, allowing for improved quality review and increased revenue.

Keywords Ultrasound, Point-of-care ultrasound, Workflow, Quality improvement, Clinician satisfaction

Background

Numerous stakeholders contribute to an efficient Point-of-Care Ultrasound (POCUS) program at a successful healthcare institution. These include patients, clinicians, medical directors, nurse managers, hospital administration, legal partners, biomedical engineering, information systems and technology, and coding and billing [1]. While a large multidisciplinary team is at play, the primary focus remains on patient-related outcomes and satisfaction. It has been shown repeatedly that POCUS can improve clinical outcomes through many different avenues, including increased safety and success of bedside procedures, individualized management of care, decreased length of Intensive Care Unit (ICU) stays, shortened time to initial treatment, return of spontaneous circulation (ROSC) after cardiac arrest, and increased overall survival [2–6]. Therefore, it stands to

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reason that improving clinician satisfaction with the use of POCUS should promote incorporation and utilization into everyday practice, which would likely result in further improved clinical outcomes for patients.

Though research demonstrates the positive impact POCUS has on patient outcomes, there are still several barriers to use. One of the main barriers includes POCUS workflow [1]. Many POCUS workflow systems involve manual data entry of patient information, which can be cumbersome and time-consuming for physicians to use. Previous studies have shown a connection between cognitive overload and increased time spent data gathering with increased medical errors [7]. New and improved clinical workflow systems that decrease cognitive load have shown evidence of improved clinician satisfaction and clinical outcomes [8]. Additionally, previous studies have demonstrated workflow compliance issues, specifically in documentation and billing [1, 9, 10]; when POCUS workflow is inconvenient, rates of documentation and billing are likely to decrease. With this in mind, this quality improvement (QI) project was undertaken to improve the functionality of the existing POCUS workflow and move toward a more "encounter-based" system by automating worklist generation. This project aimed to specifically, 1) streamline entering patient information into the ultrasound machines to improve efficiency and decrease errors in data entry, 2) allow images to be seen in the Electronic Medical Record (EMR) by all treating providers, 3) determine if there was improved clinician satisfaction with the new workflow system, and 4) determine change in revenue generation from decreased errors in data entry.

Methods

This QI project was performed at a tertiary, level 1 trauma, academic Emergency Department (ED). The annual ED volume is approximately 65,000 patients per year, and the average number of POCUS scans per year is 16,400. Thirty-seven attending physicians, fellows, and nurse practitioners are credentialed in POCUS. Resident physicians, while not credentialed, also perform POCUS under direct observation by attendings and fellows who are credentialed in POCUS. The original POCUS workflow included manually entering a patient's medical record number (MRN) into the touchscreen ultrasound machine, followed by manually entering the operator identification (ID). The clinician would then perform the appropriate scan of the patient and 'end' the scan to save the images and/or video clips. No manual EMR order was required. This system had been used for 20 years at this institution.

To create the modified POCUS workflow, the information technology (IT) department assisted in creating a method for automatically populating every registered ED patient into the worklist for all ED ultrasound machines. This was done by creating a temporary ED POCUS order, which was automatically generated by the EMR (EPIC, Epic Systems Corporation) once the patient was registered. This occurred instantaneously, including for resuscitation and trauma cases brought in by ambulance. Selecting a patient from the worklist allowed stored images to be automatically and appropriately archived within the patient's chart. Thus, the images could almost immediately be reviewed by anyone with EPIC access via the Picture Archiving and Communications System (PACS) (AGFA HealthCare, in this case), the same way an x-ray or computed tomography (CT) image would be viewed. Patient information would reside on the POCUS worklist until midnight when the list would reset for the new date.

After this was implemented throughout the department, clinicians using POCUS were able to select the appropriate patient from the dropdown patient worklist, leaving only the operator ID to be manually entered. After the images were obtained and saved, this new system automatically linked the saved POCUS images to the patient's chart in the EMR, allowing the images to be seen by all treating providers both during that encounter and in future encounters. This required no additional cost from department administration, did not require any middleware software, and took only three months from initial email to implementation. The clinician's interpretation of the scan was documented in a separate procedure note.

Clinician feedback related to their use of the new POCUS workflow, as well as their overall satisfaction with the change, was the primary outcome. A short survey (Appendix A) was developed specifically for this study and was performed via electronic survey (Google Forms) four months after implementation of the system. A reminder email was sent three days after the initial email, a second reminder email was sent one week later, and a third and final reminder email was sent after one month. Participation in this survey was voluntary and anonymous. The survey included six questions, took an estimated 2 min or less, and respondents were given the opportunity to provide feedback using a free response comment box. Secondary outcomes included the number of MRN data entry errors prior to and following implementation, which was manually reviewed and calculated.

Results

A total of 50 out of 69 (72.5%) clinicians completed the survey. Respondents were made up of 23 resident physicians years 1–3 (46%), 15 attending physicians (30%),

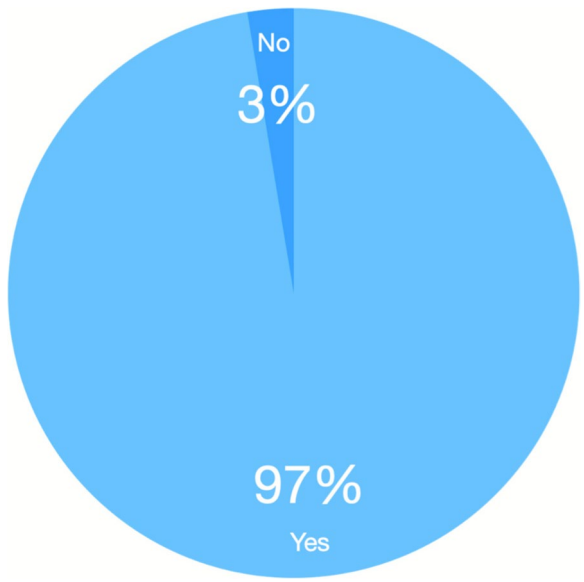

Fig. 1 Clinician preference for new workflow

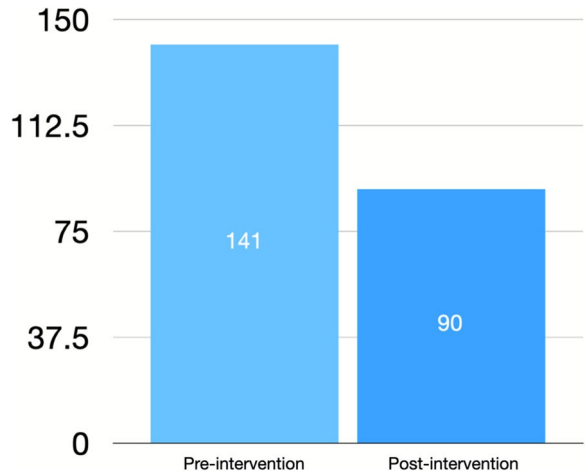

Fig. 2 MRN data entry errors pre- and post-intervention resulting in studies not billed for

7 fellows (14%), and 5 nurse practitioners (10%). Thirty-eight of the 50 (76%) clinicians who completed the survey had tried using the new workflow during the four-month period of implementation. Among these users, there was a strong preference for the new workflow, with 36 of 38 (94.7%) finding it to be more convenient to use than the old workflow, and 37 of 38 (97.4%) finding it to be preferable to use compared to the old workflow (Fig. 1). The clinician who found the new workflow to be less convenient though still preferable had the following comment: *"The old [workflow] is easier because you type [the MRN] in, and sometimes scrolling through the list [with the new workflow] is annoying – but having the images saved to the patient's chart is worth the annoyance."*

Nine of the 38 users commented that the worklist did not function consistently, prompting them to revert to manually entering the patient's information. Two of the 38 users commented that the automated worklist was too long to scroll through.

Through manual review, there were 141 studies that had MRN data entry errors in the 138-day period before implementation of the new POCUS workflow. These errors included adding additional numbers to the 7-digit MRN, not including enough numbers, or using the incorrect number. Due to the data entry errors, the studies were unable to be linked to a patient encounter and, therefore, were not billed for and were not assessed during the quality review process. In the 138-day period following implementation, there were only 90 MRN data entry errors (Fig. 2).[1] This resulted in a relative 36% reduction in database studies containing an MRN data entry error, which led to a revenue gain of approximately $1,800 in professional charges and $5,600 in technical charges. In theory, with ongoing and streamlined use of automated worklist generation, there should eventually be very few data entry errors resulting in successful billing and quality review of nearly all studies performed.

Discussion

Automatic worklist generation and selection, or "encounter-based" workflow, is strongly preferred over manual data entry for POCUS workflow among clinicians. Similar studies performed have demonstrated the positive effects of implementing an automated POCUS workflow, such as increased POCUS utilization [11] and significant increases in compliance with POCUS documentation and image archiving, thus leading to increased billing and revenue generation [11–13]. Our study differs in that clinician satisfaction was the primary outcome of this study. A strong majority found the new workflow to be more convenient to use and preferable over the old workflow. It is reasonable to expect that increased clinician satisfaction with POCUS use should lead to increased utilization and, therefore, improved clinical outcomes. Additionally, using the new workflow allowed the images to be viewed in real-time in the EMR by all treating providers, promoting expeditious multi-disciplinary management of emergent pathology such as ruptured ectopic pregnancies.

[1] Following implementation, there was a transition period in which many clinicians were still manually entering data rather than using the new workflow. Additionally, if the new workflow failed for any reason (for example, failure of machine Wi-Fi), it was advised to revert to the old workflow and manually enter patient data.

Finally, the total number of data entry errors related to patient MRN was significantly reduced using an automated worklist. Such errors limit our ability to enter the patient's chart for quality review of the acquired POCUS images, and therefore a reduction in errors allowed for improved quality review. In addition, these errors limit our ability to appropriately bill for these studies, resulting in a loss of revenue; the reduction in errors using the new workflow allowed for over $7,000 in increased revenue generation during the examined post-implementation period.

The 90 MRN data entry errors seen post-implementation of the new workflow were all due to manual data entry errors. There are several reasons why some users continued to enter patient information manually rather than use the automated worklist. The ultrasound machines are only able to display the worklist for a single date; providers using the ultrasound machines shortly after midnight had to manually change the worklist date to find patients that had checked in prior to 12:00 am. If the date had been manually changed on the machine by a previous provider, then patients checking in after 12:00 am were not viewable on the automated worklist unless the date was manually changed again. Therefore, providers using the machines overnight may have had difficulty finding their patients due to the date change. Additionally, the machines were used throughout a large, 50 + bed ED; on occasion, the machines would lose connectivity to the Wi-Fi when being transported, making the automated worklist no longer viewable. Many users were unaware of how to reconnect the machines to the Wi-Fi. Furthermore, each patient only populated to the worklist a single time; when a study was 'ended' after performing a scan, the patient no longer appeared on the worklist as the infrastructure was not set up to complete subsequent exams. Therefore, if a repeat scan was performed, the patient could not be selected from the worklist. Lastly, one of the two users who commented on the length of the worklist requested that the worklist be automatically alphabetized. The worklist was organized by patient arrival time; however, it could be sorted by last name, which required an extra 'click' on the ultrasound touchscreen. It may be that some users were unaware of this extra step required to sort the list alphabetically; therefore, rather than scrolling through the list, manual data entry was used.

There are several limitations to this study. This QI project examined the effects of a single method of streamlining POCUS workflow. There are other methods that could additionally be examined and compared, such as order-based workflows (versus our encounter-based workflow) or using barcode scanners to attach saved POCUS images to patient charts. Our department at the time of implementation of the new workflow did not use any middleware software, however this workflow option should still suffice for other departments that do utilize a middleware solution, and some middleware options may further streamline the workflow process. While there was no additional cost to implement our automated workflow, this may also vary depending on the EMR and on the capabilities of the individual IT department. Additionally, documentation and billing are separate processes from the new workflow; our study did not examine the effects of this change in workflow on compliance with documentation, nor did it examine rates of POCUS use prior to and following implementation. Lastly, this study looked at the relative immediate effects of the implementation of a new workflow after several months; however, it did not examine the long-term effects on clinician satisfaction and data entry errors.

Conclusion

Based on this study, we suggest moving toward an encounter-based workflow and eliminating manual data entry in POCUS workflow. Benefits include happier clinician users, no cost for implementation, improved billing/revenue, improved quality review, and the technical flexibility to easily communicate with the EMR when the data is appropriately and fully connected, which was preferred among our IT department. Future studies should consider measuring changes in efficiency as well as objective effects on clinical outcomes following implementation of workflow optimization.

Supplementary Information

The online version contains supplementary material available at https://doi.org/10.1186/s12913-025-12234-6.

Supplementary Material 1.

Supplementary Material 2.

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Authors' contributions

J.R., S.S., and J.C.F. designed the research study. J.R. and N.D. collected the data. S.S. performed the data analysis. J.B., N.D., and M.W. drafted the original manuscript. All authors reviewed and substantially edited the manuscript.

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Data availability

All data generated or analyzed during this study are included in this published article and its supplementary information files.

Declarations

Ethics approval and consent to participate
All methods were carried out in accordance with relevant guidelines and regulations. The protocol was approved by the UC Irvine Institutional Review Board (IRB) under exempt status. Informed consent was obtained from all participants in the study.

Consent for publication
Not applicable.

Competing interests
The authors declare no competing interests.

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