Towards quality assurance: implementation of a POCUS image archiving system in a high-volume community emergency department

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Abstract

Background Quality assurance review is an integral part of point-of-care ultrasound (POCUS) programs but may not be routine practice in community hospitals. Lack of image acquisition and documentation can result in suboptimal patient care. In cases with an adverse outcome and no record of images, there is no mechanism for quality improvement.

Objectives Our goal was to implement a system of POCUS image archiving in a community hospital. Our SMART (Specific, Measurable, Actionable, Realistic, Timely) aim was to have > 50% of emergency department (ED) POCUS users archiving scans, and > 80% of all billed POCUS scans archived, measuring improvements bi-weekly over a period of 9 months.

Methods The study was conducted at a single-community ED between August 2020 and April 2021. The POCUS archiving workflow was developed and refined through multiple plan-do-study-act (PDSA) cycles. Surveys, stakeholder meetings, audits, and feedback were used to generate and re-evaluate the interventions. These included introduction of QPathE© software, streamlining of the workflow process, strategic machine placement, POCUS rounds, use of a website for POCUS workflow instructions, and dissemination of audit results. Scans were tracked biweekly, and indexed by the number of scans billed. The primary outcome measure was the number of POCUS scans archived per 100 scans billed.

Results Over a 9-month period, spanning 72,986 ED visits, 550 scans were archived. The percentage of POCUS users who changed practice to consistently archiving scans was 51%. The rate of POCUS scans archived per 100 scans billed was > 80%, compared to no archiving at baseline.

Conclusion We were able to transition from a system with entirely unarchived POCUS scanning, to one with > 80% of scans archived over a period of 9 months. This is the first published paper documenting implementation of a POCUS image archiving system in a Canadian Community ED.

Keywords Point-of-care ultrasound · Image archiving · Quality improvement · Quality assurance · Community emergency medicine

Résumé

Contexte L'examen de l'assurance qualité fait partie intégrante des programmes d'échographie au point d'intervention (POCUS), peut ne pas être une pratique courante dans les hôpitaux communautaires. L'absence d'acquisition et de

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documentation d'images peut entraîner des soins sous-optimaux pour le patient. Dans les cas où l'issue est défavorable et où il n'y a pas d'enregistrement des images, il n'existe aucun mécanisme d'amélioration de la qualité.

Objectifs Notre objectif était de mettre en place un système d'archivage des images POCUS dans un hôpital communautaire. Notre objectif SMART (Specific, Measurable, Actionable, Realistic, Timely) était de faire en sorte que > 50% des utilisateurs de POCUS aux urgences archivent les scans, et que > 80% de tous les scans POCUS facturés soient archivés, en mesurant les améliorations toutes les deux semaines sur une période de 9 mois.

Méthodes L'étude a été menée dans une seule urgence communautaire entre août 2020 et avril 2021. Le flux de travail de l'archivage POCUS a été développé et affiné à travers de multiples cycles Planification- Exécution—Étude—Action (PEEA) [en anglais *Plan-Do-Study-Act* (PDSA)]. Des sondages, des réunions de parties prenantes, des audits et des commentaires ont été utilisés pour générer et réévaluer les interventions. Il s'agit notamment de l'introduction du logiciel QPathE©, de la rationalisation du processus de flux de travail, de l'emplacement stratégique des machines, des tournées POCUS, de l'utilisation d'un site web pour les instructions de flux de travail POCUS et de la diffusion des résultats des audits. Les scans étaient suivis toutes les deux semaines et indexés en fonction du nombre de scans facturés. Le principal critère d'évaluation était le nombre de scans POCUS archivés pour 100 scans facturés.

Résultats Sur une période de 9 mois, couvrant 72 986 visites aux urgences, 550 scanners ont été archivés. Le pourcentage d'utilisateurs de POCUS qui ont changé de pratique pour archiver systématiquement les scans était de 51 %. Le taux de scanners POCUS archivés pour 100 scanners facturés était > 80%, par rapport à l'absence d'archivage au départ.

Conclusion Nous avons pu passer d'un système où les scanners POCUS n'étaient pas du tout archivés à un système où plus de 80% des scanners ont été archivés sur une période de 9 mois. Il s'agit du premier article publié sur la mise en œuvre d'un système d'archivage d'images POCUS dans une urgence communautaire canadienne.

Clinician's capsule

What is known about the topic?

Archiving POCUS scans is the first step towards quality assurance, but is not routinely done across Canadian community emergency departments.

What did this study ask?

Can we implement a POCUS image archiving system in a busy, fee-for-service, community emergency department?

What did this study find?

We transitioned from entirely unarchived POCUS scanning, to saving >80% of scans within one year.

Why does this study matter to clinicians?

Implementation of image archiving could lead to better and safer use of point-of-care ultrasound in community emergency departments.

Quality assurance programs for POCUS have a number of essential components including a mechanism to save all images, review images, provide feedback to end-users, and credential users. Archiving images is the first necessary step in any quality assurance program. Importantly, lack of image acquisition and documentation can result in suboptimal patient care. In cases with an adverse outcome and no record of images, there is no mechanism for quality improvement.

In a time-pressured, chaotic, and challenging environment such as the ED, taking time to archive POCUS scans may be perceived as delaying evaluation of the next patient. For users accustomed to scanning without saving images, physicians may feel uncomfortable with the workflow.

We engaged hospital stakeholders to support the introduction of the QpathE© archiving system in our community ED. To our knowledge, there is no literature available on how to successfully implement an image archiving system in a fee-for-service Canadian community emergency department.

Background

Point-of-care ultrasound (POCUS) has been demonstrated to improve diagnostic accuracy, increase patient safety, and decrease emergency department (ED) length of stay [1]. Despite clear guidelines, some users are not familiar with what constitutes appropriate image archiving [2, 3]. Tertiary academic centers have demonstrated the ability to implement robust quality assurance programs for ED physicians performing POCUS [4, 5]. These results have not been replicated in community EDs across Canada, where the majority of patients receive care.

Methods

Study setting and design

The study was conducted in a single community ED, which services a population of > 400,000. Forty-seven emergency physicians were on staff during the study period. Between August 2020 and April 2021, a series of plan-do-study-act cycles were conducted based on a survey of emergency physicians.

Intervention

Plan-do-study-act 1

Our first intervention was introduction of the QPathE© (Tel-exy Inc. Coquitlam, BC) software which provided an online database. Links to the software were highlighted on all computers in the ED. Hands-on educational sessions were done in tandem with an airway workshop to bolster attendance for the initial launch. Following the in-person session, a virtual educational video was disseminated to all staff and made available on our website.

Plan-do-study-act 2

The second cycle streamlined the process for physicians by (1) adding numbered labels on each ultrasound machine, (2) having department-wide availability of machines documented on maps and supported by RN colleagues to decrease time spent looking for hardware (3) implementation of a digital work list to eliminate manual entry of patient's demographic information.

Plan-do-study-act 3

The third cycle focused on appropriate billing for POCUS. We disseminated information on key billing codes and their indications. We provided audit and feedback to physicians who billed for POCUS without archiving scans.

Plan-do-study-act 4

A final cycle focused on cultural shift through POCUS rounds and digests showcasing cases where archived images changed management.

Outcome measures

With our goal of reducing the number of scans without archived images, the primary outcome measure was the number of POCUS scans archived per 100 scans billed. Our process measures were (1) the total number of scans archived and (2) the total number of QpathE users, both measured bi-weekly. "QPathE User" was defined as saving at least one scan per month over multiple months.

Our fidelity measures included random audits to see that machines were being returned to designated locations, and being plugged in. Our balancing measure was observing for any decline in the number of staff performing POCUS due to new requirements to save scans.

Our SMART (Specific, Measurable, Actionable, Realistic, Timely) aim was to have > 50% of ED POCUS users archiving scans, and > 80% of all billed POCUS scans

archived, measuring improvements bi-weekly over a period of 12 months.

Stakeholder engagement

Achieving change in a community hospital requires alignment of priorities at both the hospital and department level. We were fortunate to have support from our Chief Information Officer and Chief of Radiology. A project manager from information services was assigned to help with implementation and streamlining of workflow. At the department level, key stakeholders included nursing management and our ED equipment manager.

Data analysis

We calculated the outcome measure by tabulating the number of scans archived bi-weekly, combined with billing submissions bi-weekly. These calculations were made possible given that our site uses a single billing agent.

Results

Over the 9-month study period, there were 72,986 ED visits and 550 POCUS scans archived. Thirty-nine (83%) of physicians completed the survey. Five study participants had no level of POCUS training, 20 had completed Emergency Department Echo level 1 (EDE1), and 25% had some advanced POCUS training. The majority of physicians reported using POCUS at least once per week (54%). Approximately 25% were regular users who self-reported scanning on every shift. Overall, we classified 37 of our physicians as "POCUS users" based on self-report of performing at least one scan per month. The eight physicians that did not complete the survey were largely untrained in POCUS, with 6 having no previous ultrasound training.

Barriers to archiving POCUS scans included difficulty locating an ultrasound machine in our large department, feeling time-pressured with high patient volumes, the machine not being plugged in and being slow to turn on.

At baseline, we had no physicians using the QpathE software to archive scans and correspondingly zero percent of POCUS scans being archived (Fig. 1). After initial introduction and educational interventions, we had 21% of all physicians begin archiving scans (Fig. 1). We observed the greatest initial increase in physicians performing scans after completion of a hands-on workshop (Fig. 1).

Audit and feedback [5] at month 6 of the intervention identified five POCUS billers who consistently were not documenting scans. The physicians were approached in person to obtain feedback on how the workflow could be improved to decrease barriers to use.

Fig. 1 Number of POCUS scans archived by ED physicians per 100 scans billed bi-weekly

Our SMART aim (> 50% MDs archiving images and > 80% billed scans archived) was achieved after a period of 9 months and multiple PDSA cycles. The percentage of POCUS users who changed practice to consistently archiving scans was 51%. For the final two bi-weekly study periods, 45/50 scans and 70/70 scans billed were archived (Fig. 1). Physicians reported satisfaction with having a mechanism for archiving POCUS scans.

Discussion

We were able to transition from a system with no archiving, to one with > 80% of scans saved to the patients' medical record over 9 months using multiple plan-do-study-act cycles.

There are no published studies on the introduction of a POCUS image archiving system in a community ED. The only other published plan-do-study-act study was with respect to POCUS documentation in an academic center in the UK where they were able to achieve 80% compliance with the demographic information they requested physicians to input [6]. In another study evaluating barriers to compliance POCUS documentation, recommendations were integration with the current electronic medical record, better upkeep of US machines, and simplification of workflow [7].

In our study, we attribute our success to these previously recommended factors, including integration of QpathE

with our single sign on provider, targeted machine location, workflow simplification, and adherence to a strong quality improvement approach.

Strengths and limitations

The major strength of our study is documentation of the introduction of POCUS archiving in a high-volume community ED. This has implications for other community sites who are in the process of improving the quality of their POCUS programs.

The second strength is that we were able to capture a close proxy for actual POCUS use through our single billing agent, which may not be the case at other fee-for-service sites. We cannot know the true number of scans being performed on a daily basis. We chose billing as a proxy representing what is happening in practice. There are undoubtedly scans not captured using this metric.

Our intervention was performed in only one community ED, limiting generalizability. Factors that may differ at other sites include our practice setting being a large metropolitan area, the high-volume patient census, the large number of physicians on staff, and geographical layout of our ED.

Clinical implications

Continuity of care, both for those who are admitted, or who have repeat ED visits are among the strongest arguments for

image archiving [8]. Presentations such as possible ectopic pregnancies and pericardial effusions benefit greatly from allowing clinicians to follow results over time, make disposition decisions, and provide images to consultants for review [9].

Finally, there are implications for community hospitals as it comes to advocating for urgent transfer where indicated [8, 9]. The ability to eventually have POCUS images transmitted to PACS, and these images sent in real-time to accepting hospitals, will represent a true improvement to the care for patients in community hospitals.

Conclusion

Our study demonstrates how archiving software can be introduced into a fee-for-service environment. Strategies we found effective included use of a single sign-on, labelling all machines with necessary steps for archiving images, promotion of culture change through POCUS rounds and digests, and audit and feedback around billing practices.

A system to archive POCUS images improves patient outcomes by providing continuity of care and ensures images are reviewable for quality assurance. We believe advocating for POCUS archiving systems will transform care in Canadian community emergency departments.

Author contributions AA, AW and SC were involved in the design and execution of the study, as well as data collection and analysis. RM and PH assisted with manuscript writing and data analysis. All co-authors have had the opportunity to review the final manuscript and have provided their permission to publish the manuscript.

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Data availability Aggregated data are available on request for review.

Code availability Not applicable.

Declarations

Conflict of interest None of the authors report any conflicts of interest related to this project.

References

1. Adhikari A, Amini R, Stolz LA, Blaivas M. Impact of point-of-care ultrasound on quality of care in clinical practice. *Rep Med Imaging*. 2014;7:81–93.
2. Wong MKY, Olszynski P, Cheung WJ, Pageau P, Lewis D, Kwan C, et al. Position statement: minimum archiving requirements for emergency medicine point-of-care ultrasound-a modified Delphi-derived national consensus. *Can J Emerg Med*. 2021;23:450–4.
3. Lewis D, Rang L, Kim D, Robichaud L, Kwan C, Pham C, Shefrin A, Ritcey B, Atkinson P, Woo M, Jelic T, Dallaire G, Henneberry R, Turner J, Andani R, Demsey R. Recommendations for the use of point-of-care ultrasound (POCUS) by emergency physicians in Canada. *Can J Emerg Med*. 2019;21(6):721–6.
4. Bellamkonda VR, Shokoohi H, Alsaawi A, Ding R, Campbell RL, Liu YT, et al. Ultrasound credentialing in North American emergency department systems with ultrasound fellowships: a cross-sectional survey. *Emerg Med J*. 2015;32(10):804–8.
5. Thomas-Mohtat R, Breslin K, Cohen JS. Quality assurance for point-of-care ultrasound in north American pediatric emergency medicine fellowships. *Pediatr Emerg Care*. 2019. <https://doi.org/10.1097/PEC.0000000000001871>.
6. Dowling SK, Mondoux S, Bond CM, Cheng AHY, Kwok E, Lang E. Audit and feedback for individual practitioners in the emergency department: an evidence-based and practical approach. *Can J Emerg Med*. 2020;22(4):528.
7. Aziz S, Bottomley J, Mohandas V, Ahmad A, Morelli G, Thenabadu S. Improving the documentation quality of point-of-care ultrasound scans in the emergency department. *BMJ Open Qual*. 2020;9:e000636.
8. Saul T, Siadecki SD, Rose G, Berkowitz R. A survey evaluation of barriers to provider compliance with point-of-care ultrasound documentation. *Ann Emerg Med*. 2016;68(4S):S141.
9. Olszynski P, Kim DJ, Ma IWY, Clunie M, Lambos P, Guzowski T, et al. The development of a provincial multidisciplinary framework of consensus-based standards for point of care ultrasound at the University of Saskatchewan. *Ultrasound J*. 2019;11(1):28.