Closing the gap: creating a focused transthoracic echocardiography training curriculum for advanced practice providers

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In the United States, ultrasound examinations can be carried out by non-medically qualified personnel such as nurse practitioners and physisican assistants, collectively known as Advanced Practice Providers (APPs). This article summarizes a recently published study describing a training curriculum on Focussed Transthoracic Echocardiography (FoTE) and created for critical care APPs. It is shown that, with training, APP's can successfully achieve echocardiogram images equivalent to their physician counterparts.

The utilization of advanced practice providers (APPs) in the intensive care unit (ICU) has become an increasingly popular model to offset the shortage of intensivists and meet the demands of critical care [1, 2]. Currently, there are more than 248,000 nurse practitioners (NPs) and 123,000 physician assistants (PAs) practicing in the United States with predicted growth of more than 30% each by 2026 [3-6]. Safety and efficacy of APP-staffed ICUs is well documented with comparable measurable outcomes, such as mortality and length of stay, to non-APP staffed units [1,7].

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One gap that still exists is that ultrasound training has been integrated into medical school and residency training programs but not into most APP programs. Point-of-care ultrasound is no longer reserved in the United States for sonographers to perform and radiologists to interpret. In fact, ultrasound technology has become essential to the critical care provider, as clinical decisions are made by consideration of self-obtained and interpreted data. In order for APPs to perform in both a complementary and at times, as an independent provider from their physician counterparts, training modalities and competency standards for APPs in ultrasound assessment of the critically ill patient are needed.

Focused transthoracic echocardiography (FoTE) has emerged as an efficient and powerful resource for clinicians to improve diagnostic accuracy and guide management of life threatening conditions, such as shock [8]. Both the Society of PAs in Clinical Ultrasound and the American Association of Colleges of Nursing have recommended incorporation of ultrasound assessment into APP curriculum, as it is currently not required and is rarely provided [9,10]. This article summarizes a recently published study by Diaz-Gomez *et al* [11] describing a FoTE curriculum created for critical care APPs in four ICUs in a single institution (Mayo Clinic Florida, USA). As a result of this training and in response to the current inter-professional gap between practitioners who have mastered echocardiography such as cardiothoracic intensivists and APPs who have been more recently exposed to critical care ultrasound in their scope of practice, APPs from this group subsequently developed and directed their own ultrasound course for local APP ultrasound novices [12]. As the role and practice of critical care medicine continues to grow, technical and procedural skill requirements have advanced [13]. In order to keep up with this expansion, the APPs within critical care medicine workforce need to be proficient in all technical aspects, including FoTE.

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METHODS AND RESULTS

A 6 phase curriculum is described, based on the American Society of Echocardiography and Society of Critical Care Medicine (SCCM), with a primary outcome comparing FoTE diagnostic concordance between APP's and critical care physicians. The APP group included 10 NPs and 2 PAs with no formal or significant FoTE training, while the control group included 3 critical care physicians certified in Special Competencies in Adult Echocardiography, actively involved in critical care ultrasound education within the SCCM, and also greater than 5 years' experience in FoTE. Education methods included didactic in-classroom training on ultrasound machine technology and cardiac views followed by wet lab interaction with porcine hearts. Porcine heart manipulation improved learners understanding of the imaging planes pertinent to each cardiac view. Unique to this article was the use of a registered diagnostic cardiac sonographer (RDCS) who spent a mean time of 48.5 hours and roughly 20 studies with each APP to provide 1:1 instruction in the clinical setting. Evaluation of technical skills followed 6 months of training and utilized the Vimedix Cardiac ultrasound simulator to identify types of shock common in critically ill patients. Specific parameters were measured including image acquisition, time to diagnosis, and accuracy of diagnosis. Blinded evaluations included APP and physician comparison in the time it took for image acquisition and accurate diagnosis of shock in an ICU patient identified by the RDCS. Image quality was also scored based on a measurement defined by the RDCS and control group. Finally a 30- question written exam was utilized to evaluate recall and content understanding.

The study reports better image quality, quicker image acquisition, and time to diagnosis of shock in the intensivist group compared to APP, all statistically significant. However, despite the statistical significance of the speed at which intensivists performed, the median time difference of 83 seconds was not clinically relevant. The APP group achieved the correct diagnosis of shock in 83.33% of cases, which was also statistically significant, and the mean test score on the final evaluation was 24.6 out of 30.

The impact of this investigation is evident in a second study by Santos *et al* [12], which described and evaluated the effect of a 1-day APP-developed and directed course designed to provide fellow APPs with the skills to procure basic echocardiographic views as well as image interpretation. The course consisted of an 8-hour day with didactic content and an emphasis on hands-on instruction, delivered at a faculty: student ratio of 1:3. This study demonstrated that an APP proctorship utilizing hands-on and didactic approach is an effective method as an entry point for FoTE in ultrasound-novice APPs. Indeed, it has been the only course where both the learners and instructors were solely APPs.

DISCUSSION

The research described by Diaz-Gomez and colleagues is one of few studies describing ultrasound curriculums and establishment of ultrasound proficiency for APPs. Guidelines for the training and evaluation of competency are clearly established for residents and fellows; however, no such guidelines exist for APPs. The American College of Chest Physicians (ACCP) has proposed 10 hours of general critical care ultrasound and 10 hours of critical care echocardiography, divided between didactic and hands-on modalities.14,15 In Diaz-Gomez *et al*'s study [11], participants went through approximately 60 hours of training, divided between didactic and hands-on. In contrast, cardiology fellows have established levels of competency, with Level I being considered introductory level of proficiency and is achieved after 3 months training and 75 transthoracic echocardiograms (TTE) performed and 150 interpreted.16

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Further research is needed to determine the ideal number of training hours and cases to establish proficiency. Additionally, research should be conducted to standardize the evaluation of competency. If there is continued research and publication regarding the expanding role of APPs and necessity of ultrasound mastery in critical care, there could be consideration of APP eligibility to sit for national certification.

Santos *et al*'s [12] investigation could be used as a foundation for large-scale courses for both APP and physician learners and demonstrate that APPs can be trusted as inter-professional and multidisciplinary critical care ultrasound faculty. The SCCM has already involved APPs in their fundamental ultrasound courses which are held bi-annually in the United States (US). It is possible that APPs can be involved in international courses organized by the SCCM in the near future.

We are in the infancy of point-of-care ultrasonography as, so far, we do not have the studies available to develop consistent standards. Thus, Diaz-Gomez and Santos investigations are ready to bring our inter-professional collaboration to the next level, generating knowledge and seeing the educational and potential impact in our patients-the most important step in any healthcare process. Future enhanced educational interventions for competence assessment in echocardiography include utilization of computer-based simulators able to provide immediate feedback to the learner and metrics for assessment of technical skills that are based on transducer tracking data [17,18]. Simulator-based competency testing in diagnostic ultrasound is likely to contribute to the paradigm change in medical ultrasound education. Moreover, Sheehan *et al* [18] developed a simulator-based, self-taught curriculum for focused cardiac ultrasound that provides immediate feedback for rapid performance improvement in residents. Average error in image acquisition and cognitive skills improved with utilization of this simulator-based curriculum instead of expert oversight curriculum. We can speculate that APPs can have similar training and still achieve appropriate competence in FoTE. Nevertheless, accuracy of diagnosis utilizing echocardiography is critically dependent on the skill of the examiner so this latest advancement in simulation education deserves to be explored by APPs as we move forward.

CONCLUSION

Ultrasound proficiency has become an expected skill for critical care providers. The majority of literature focuses on physicians as critical care providers; though APPs are increasingly demonstrating their value across the majority of ICUs in the US. Ultrasound is a mandatory component of physicians training but has not yet being included in physicians assistants or nurse practitioners curricula. The curriculum described by Diaz-Gomez and Mayo Clinic colleagues demonstrates that with training, APP's can successfully achieve echocardiogram images equivalent to their physician counterparts. The study also demonstrated that beyond image acquisition, APPs were able to successfully come to the correct diagnosis of shock, albeit in slightly more time than physicians. The investment in the training and development of APPs is necessary to promote safe and independent practice.

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Book Review

Medical Imaging for Health Professionals: Technologies and Clinical Applications

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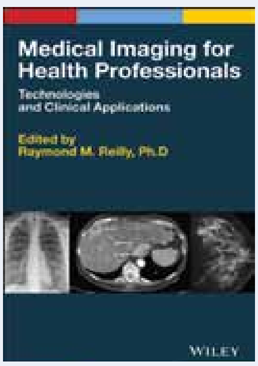

Describes the most common imaging technologies and their diagnostic applications so that pharmacists and other health professionals, as well as imaging researchers, can understand and interpret medical imaging science This book guides health professionals and researchers to understand and interpret medical imaging.

Divided into two sections, it covers both fundamental principles and clinical applications. It describes the most common imaging technologies and their use to diagnose diseases. In addition, the authors introduce the emerging role of molecular imaging including PET in the diagnosis of cancer and to assess the effectiveness of cancer treatments. The book features many illustrations and discusses many patient case examples.

The book offers in-depth chapters explaining the basic principles of: X-Ray, CT, and Mammography Technology; Nuclear Medicine Imaging Technology; Radionuclide Production and Radiopharmaceuticals; Magnetic Resonance Imaging (MRI) Technology; and Ultrasound Imaging Technology.

It also provides chapters written by expert radiologists in well-explained terminology discussing clinical applications including: Cardiac Imaging; Lung Imaging; Breast Imaging; Endocrine Gland Imaging; Abdominal Imaging; Genitourinary Tract Imaging; Imaging of the Head, Neck, Spine and Brain;