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RESEARCH ARTICLE

A Blueprint for Initiating a Standardized Preliminary Point of Care Ultrasonography Training Curriculum in a combined MD and DO Internal Medicine Residency Program

Reddy Sneha DO[1], Khan Amit DO[2], Dhatt Ravinder MD[3], Rhodes Sarah DO[4], Ignatz Christopher DO[5], Avula Akshay MD[6], Ramesh Navitha MD[7]

[1]Internal Medicine, UPMC Community General Osteopathic Internal Medicine Residency, Harrisburg, PA 17109, USA
[2]Internal Medicine, UPMC Community General Osteopathic Internal Medicine Residency, Harrisburg, PA 17109, USA
[3]Internist and teaching faculty at UPMC Harrisburg Hospital Internal Medicine Residency Program, Harrisburg, PA 17109, USA
[4]Internist and Site Medical Director for UPMC Carlisle Hospital System, Carlisle, PA,17105
[5]Pulmonary critical care medicine at WellSpan York Hospital System. York, PA 17405, USA
[6]Pulmonary and critical care medicine, Associate program director for critical care fellowship program UPMC-Harrisburg, Harrisburg, PA 17109
[7]Pulmonary and Critical Medicine, Program Director for critical care medicine fellowship UPMC Harrisburg, Harrisburg, PA 17109

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ABSTRACT

Point of care ultrasonography (POCUS) is a limited yet effective bedside technique used to augment clinical decision making in patients with a multitude of medical conditions. This technique is taught and put into practice increasingly in emergency medicine residency curriculums. However, this technique does have increasing utility in an internal medicine residency curriculum as well and has shown to help guide clinical decision making with improved patient outcomes when used appropriately. Many papers outline the components needed to appropriately design a model program without taking into consideration the barriers that exist. Our initial question was to assess the feasibility of the implementation of a POCUS curriculum in to an already existing dual MD/DO internal medicine (IM) residency curriculum. This paper outlines the implementation of an IM POCUS curriculum while also attempting to navigate the barriers involved. The goal of our project is to serve as an initial building block for POCUS training curriculums in hopes to standardize its use in internal medicine residency programs across the nation.

Introduction

Point of Care Ultrasonography (POCUS) is an advanced diagnostic imaging modality that is utilized as part of a patient's bedside assessment. This real time dynamic imaging system can be used to visualize organ systems, assess fluid status, and help guide treatment decisions in real time without formal imaging techniques such as radiography or computed tomography, which also exposes patients to potentially unnecessary-radiation.

POCUS exams obtain imaging in real time to quickly aid in a differential diagnosis and guide focused assessments. The core concepts of non-procedure related POCUS are image acquisition, image interpretation, and clinical application. Many times, all these processes occur almost simultaneously or in very quick succession. A commonly utilized POCUS exam is the extended focused assessment with sonography for trauma (eFAST) which is indicated in patients with blunt/penetrating injury or undifferentiated shock[3]. The eFAST is a quick and effective evaluation of the pericardium and the peritoneal cavity for pathologic fluid accumulation in patients with known traumatic injury[4]. This simple and fast bedside POCUS assessment has shown to decrease time to operative intervention, patients' length of stay, and rates of complications[4]. A 2015 retrospective study showed that the utilization of POCUS led to fewer comprehensive diagnostic echocardiographic studies ordered overall and led to a 10.7% increase in formal comprehensive echocardiographs in flagged individuals[5]. Depending on the clinical setting, POCUS examinations provide a faster initial understanding of underlying pathology expediting focused guided treatment assessments.

A 2006 study showed that POCUS images and techniques were able to be interpreted by "high tech veterans" and "low-tech beginners" the same without any significant difference[6]. Studies have also shown that just a short 4-day course of POCUS training helped improve the POCUS median skill scores from 25% pre training to 50 % post training[7]. These studies and many more emphasize the low skillset needed to safely perform and interpret images with high clinical value. While the many benefits of POCUS are well documented, the barrier to its use seems to be inadequate training related to paucity of expertise at faculty level or limited availability of ultrasound machines. In this paper, we elaborate on how we developed our POCUS training program for our internal medicine residents in both our allopathic and osteopathic residency programs at UPMC Harrisburg. Here we outline in subsections the major components needed to successfully build a POCUS curriculum. Each subsection defines the importance within the POCUS curricula model, along with our tailored approach to overcoming the associated barriers. Overall, this manuscript outlines a preliminary blueprint that can be utilized for the successful implementation of POCUS curriculum in IM residences nationwide.

Methods

CURRICULUM DESIGN & TEACHING METHODS

This is an observational descriptive study detailing our novel POCUS curriculum and how we overcame the associated barriers.

Our POCUS longitudinal curriculum is developed in 3 main parts:

A. Introduction and basics of POCUS for first year residents within 2 months of their residency: This includes a 2 day intense hands on and lecture based educational workshop

B. Advanced POCUS training: one day work shop on advanced concepts of POCUS for our second and third year residents

C. A 2- 4 week POCUS elective with 50/50 split between internal medicine teaching service and critical care medicine service for senior residents, with completion of a research project, POCUS portfolio and opportunity to receive a POCUS certificate of completion.

Our system detailed below, combines shortened robust in-person informational sessions multiple times throughout training years to provide the benefit of

high retention rates without the burden of prolonged excess workload. This system allows for a longitudinal training environment that is supported by the Alliance of the Academic Internal Medicine (AAIM) without overworking our residents leading to increased satisfaction rates.

In their first year bootcamp, our residents start by learning the basic physics behind utilization of ultrasound sonography, the variety of probes and appropriate usage of each, along with appropriate probe selection. These "basics" of training are not only important to the overall understanding of POCUS but are often overlooked. Short didactic sessions are introduced to discuss common pathologies that can be assessed with POCUS; emphasis in their first year is placed on cardiac views, lung pathologies, and liver pathologies. These lecture seminars are then paired with hands on practice with standardized patients. All hands-on learning is performed on standardized patients versus simulators to help our residents become comfortable with variation in anatomy amongst patients. Day two of POCUS training during their first-year course, focuses on becoming proficient in cardiac window views of parasternal long axis, parasternal short axis, subcostal, and apical four chamber views. Our residents also learn to perform basic thoracic ultrasonography to assess lung sliding, pneumothoraxes, pleural effusions, and pleural lines. Finally, we complete our first-year training session with multidisciplinary case studies. These case studies weld together the practical knowledge of the techniques learned with the skill used to acquire and interpret appropriate images to help guide treatment. Once our first-year residents have successfully completed this mandatory training they are encouraged and expected to utilize these skills on their medicine, ICU, and emergency medicine rotations. Handheld ultrasound devices are stationed on internal medicine teaching service teams for our residents to utilize. While in the ICU and emergency departments it is expected that our residents will be able to utilize the larger more sensitive ultrasound machines.

In year two of our residents training, we provide a one-day bootcamp that is centered around mastering the skills they learned previously with the addition of valvular assessment for cardiac views and imaging of the gallbladder, kidneys, and lower extremities. These skills are again combined with case studies to help integrate a multidisciplinary approach to their learning.

Our third-year residents are given the opportunity to participate in our POCUS Elective. The POCUS elective is a partially self-directed course that establishes the expectation of building a POCUS portfolio. The POCUS portfolio consists of obtaining 10 or more images of common cardiac, thoracic, vascular, and abdominal structures. By the end of the rotation, our residents are expected to be proficient in performing a basic bedside echocardiograph, assess volume status, perform thoracic ultrasound, identify important abdominal structures, and identify vascular thrombi in large veins in the lower extremities. Our residents begin their POCUS elective by reviewing pre-work videos of mastering techniques and assessing pathologies. For their 2–4-week rotation they alternate between ICU and internal medicine teaching services paired with an ICU attending or POCUS trained internal medicine faculty. Each week they are expected to participate in rounds, obtain ultrasound images on each patient, present their findings to the designated faculty member on service. They then are expected to collect and review images with our faculty in real time at the end of each day. If the faculty is unable to review the images on the same day, they then must upload their images to our de-identified HIPPA compliant software to have each of their images reviewed by faculty for quality assurance. Throughout their rotation they are expected to participate in "Ultrasound Conference", where they present interesting POCUS patient findings or new POCUS literature. By the end of their rotation our residents are tested on both their technical acquisition and interpretive POCUS skills in an in-person practical and multiple-choice examination to receive a POCUS certification of completion.

Results

Our POCUS Internal Medicine curriculum largely focuses on competency around acquisition and interpretation of cardiac, thoracic, abdominal, and vascular pathologies. While there is no standardized curriculum in place; literature has found the skillset to obtain and interpret images around these organ systems to be the most vital in IM residency training. While building our curricula we noted the need for standardization and competency through repetition. Modeled after the ACGME implemented "case log" system, the need for a POCUS specific portfolio (figure A) and nuanced schedule (figure B) seemed essential to track the progress of our residents and keep them accountable. We largely based our POCUS portfolio on a paired down version of the Society of Hospital Medicine's "Ultrasound certificate of completion." These systems put into place served to guide our standard for quality assessment.

POCUS PORTFOLIO CHECKLIST

Have pocus attending initial (sign) any images you review, and they deem to be adequate. This can be subtracted from the portfolio requirement. Upload what is not evaluated here to portfolio and email portfolio link and this form to Dr. Dhatt for review.

RESIDENT NAME _____

CARDIAC										
PLAX										
PSAX										
Apical 4										
Subxiphoid										

LUNG					
B-Lines					
A-lines					
Effusion					
Pneumonia					
Lung sliding with m-mode					

VASCULAR					
IVC (long axis)					
Aorta (transverse)					
Effusion					
Pneumonia					
DVT Right (CFA/CFV--peanut)					
DVT Right (Take off GSV—mickey mouse)					
DVT Right(FA/FV-vein on bottom)					
DVT Right (popliteal- pop vein on top)					
DVT Left (CFA/CFV--peanut)					
DVT Left(Take off GSV—mickey mouse)					
DVT Left(SFA/FV- vein on bottom)					
DVT Left (popliteal-pop vein on top)					

Abdo			
Gallbladder (subcostal)			
Hepatorenal Space			
Splenorenal Space			
Diaphragm			

Other					
Renal (fan through both orientations)					
Bladder (both longitudinal and transverse)					
Opthalmic					

Figure A: showcasing our standardized POCUS elective portfolio. Expected Acquisition of Cardiac views including (Parasternal long axis, parasternal short axis, apical 4 chamber view, and subxiphoid views) Lung view, Vascular, and Abdominal Imaging.

	TIME	MONDAY	TUESDAY	TUESDAY	WEDNESDAY	THURSDAY
IM WEEK	0700-0930	AM Education/ New Admit POCUS Scan Pts pending studies that day scan	AM Education/ New Admit POCUS Scan Pts pending studies that day scan	AM Education/ New Admit POCUS Scan Pts pending studies that day scan	AM Education/ New Admit POCUS Scan Pts pending studies that day scan	AM Education/ New Admit POCUS Scan Pts pending studies that day scan
	0930-1200	IM Rounds with POCUS	IM Rounds with POCUS	IM Rounds with POCUS	IM Rounds with POCUS	IM Rounds with POCUS
	1300-1700	Portfolio Build/ Scan new	Portfolio Build/ Scan new	Portfolio Build/ Scan new	Portfolio Build/ Scan new	Portfolio Build/ Scan new
	1300-1700	Core Ultrasound Videos*	Shadow/Scan with Echo Tech	ICU Patient POCUS and Procedures	Shadow/Scan with US Tech	ICU Patient POCUS and Procedures

	TIME	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
ICU WEEK	0700-0900	AM Education/ New Admit POCUS Scan Pts pending studies that day scan	AM Education/ New Admit POCUS Scan Pts pending studies that day scan	AM Education/ New Admit POCUS Scan Pts pending studies that day scan	AM Education/ New Admit POCUS Scan Pts pending studies that day scan	AM Education/ New Admit POCUS Scan Pts pending studies that day scan
	0900-1200	ICU Rounds with POCUS	ICU Rounds with POCUS	ICU Rounds with POCUS	ICU Rounds with POCUS	ICU Rounds with POCUS
	1200-1300	Noon Education	Noon Education	ICU Rounds with POCUS	Noon Education	Noon Education
	1300-1700	Portfolio Build/ Scan new	Shadow/Scan with Echo Tech	ICU Rounds with POCUS	Shadow/Scan with US Tech	Portfolio Build/ Scan new

Figure B: showcasing the model schedule that was developed for POCUS Elective; alternating between ICU and IM service weeks.

Discussion

There are not many internal medical residency programs that have a dedicated POCUS curriculum. A large barrier to POCUS implementation is making the time for the addition of so much information/ training on top of an already robust residency curriculum[8]. It was found that dedicated in-person lectures along with live model patient practice superseded online POCUS courses even if self-paced[9]. While many studies have shown that "bolus training" does not allow for the retention that longitudinal training delivers; one study showed improved subjective and objective assessment of POCUS knowledge and skills after only a 30-hour introductory course delivered over 5 days during intern year[10]. The important barriers that we were faced with and our methods for overcoming them throughout our curriculum building process are outlined below in their own subsection.

FACULTY RECRUITMENT

A large barrier to building a POCUS IM program is obtaining a large enough faculty that is POCUS trained but is also interested in teaching residents with standardized methods. Possible solutions to obtaining POCUS trained faculty us sponsoring faculty to go through Society of Hospital Medicine(SHM) like training programs to obtain a certificate of POCUS completion. While this is time and cost endeavor, it can provide standardization across faculty when training residents. Hospitals can also sponsor POCUS "crash course" certification training sessions to help build a larger group of faculty to be drawn from. Otherwise, recruitment of POCUS trained faculty across multidisciplinary specialties such as

Emergency medicine, ICU, Cardiology and etc. is another solution. This method also helps build interprofessional collaboration and exposes trainees to a wider range of pathology that can be taught and seen. We overcame this barrier by first appointing a POCUS faculty leader, who led development, recruitment, and maintenance of the program. Assigning a POCUS faculty leader has shown to have improved outcomes when building a POCUS curriculum. We then compiled faculty that were a mix between all avenues aforementioned. In conjunction with our POCUS faculty leader all our POCUS recruited faculty did closely participate in developing our POCUS curriculum, so standardization of teaching methods and quality analysis were honored.

EQUIPMENT ACQUISITION

Finances are often a limitation to acquisition of ultrasound devices which can be a large barrier to POCUS curriculum development[8]. Without the appropriate number of devices, the implementation of POCUS training is essentially mute. While multi-probe ultrasound machines are extremely sensitive and diagnostic, they can often be extremely expensive to procure in bulk. However, with the development of technology, lower portable hand-held units are becoming more affordable and are sensitive enough for IM training.[8] Our program provided each IM department with one hand-held ultrasound device to be used on IM teaching service rounds. It was expected that our residents would be able to utilize the large ultrasound machines that were stationed in the emergency department and ICU while on those rotations respectively. Funding for the hand-held POCUS devices were requested through a split of education, grant funding, and non-profit and hospital device funding to make it more affordable.

QUALITY ANALYSIS

Our quality assessment of resident image procurement is assessed only by our POCUS elected and trained faculty. Our residents are expected to review their images with our POCUS faculty at the end of each academic day and receive feedback. If this is unable to be done, then our residents are expected to upload de-identified HIPPA compliant images to a free image sharing domain that is utilized. Images were then pulled from the domain and reviewed weekly by our POCUS faculty and feedback was given in person to the respective resident. Quality assessment can pose a large barrier to implementing a POCUS curriculum. If there is not a large enough faculty to review images in real time at the end of each day, the implementation of a HIPPA compliant image sharing domain public or private remains a good option.

Conclusion

To help promote multidisciplinary collaboration in medicine; calls for a need for standardized training in advancements in medical technologies. POCUS training has shown to be revolutionary in bedside assessments of patients in real time. POCUS has shown to decrease time to diagnosis and reduce overall costs by decreasing the need for formal imaging modalities. With these well established benefits, the need for standardized mandatory POCUS curriculum needs to be established for IM residency training programs. POCUS training is no longer just an emergency medicine or ICU specific skillset. While the American College of Physicians has formally made a statement for their support of POCUS, the barrier to its use by internal medicine physicians remains to be inadequate training. Overall, this manuscript outlines a preliminary blueprint that can be utilized for the successful implementation of POCUS curriculum in IM residences nationwide. A further novel aspect of our POCUS program is the establishment of POCUS trained faculty that are a mix of both allopathic and osteopathic trained. This allows for a larger clinical interpretation that can be established from the acquisition of POCUS images. Not only can our residents make clinical decisions to treat with medications based off the image procurement but can also utilize osteopathic manipulative techniques when appropriate.

Conflict of Interest:

The authors have no conflict of interest to declare

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