

Early Point of Care Ultrasound Training in Medical Education, Making the Case with a Case Report

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Abstract

Background: Point of Care Ultrasound (PoCUS) emerged in the early 1990's as a promising clinical and educational tool that allows for quicker diagnosis at the bedside. Our PoCUS program at Indiana University School of Medicine uniquely exposes students to training during their first weeks of medical school, with training continuing through all 4 years. Our paper demonstrates the portability and efficiency of PoCUS devices to benefit student run clinics, where vulnerable patients come to seek free medical care. **Case:** We report the case of a 48-year-old man presenting to our student run clinic with shortness of breath and cough. He recently immigrated from Nigeria, had no prior interaction with United States healthcare, and faced a significant language barrier. Physical examination conducted by the medical students revealed mild bibasilar crackles and 1+ pitting edema in the lower extremities. This prompted the students to suspect heart failure, and the first-year medical student used bedside ultrasound to reveal a reduced ejection fraction of approximately 15%, which resulted in expedited and escalated medical care. **Conclusion:** This case report demonstrates how incorporating PoCUS early into the undergraduate medical curriculum might improve patient care by expediting the diagnosis, while also enhancing student education. The use of bedside ultrasound rapidly updated the team to the severity and type of heart failure present. Therefore, the care team quickly escalated the appropriate treatment, and impressed the importance of follow up care to the patient.

Introduction

Point-of-Care Ultrasound (PoCUS) is a novel use of a tool that has been available for decades. With the invention of smaller and more portable units, physicians can deliver quicker diagnoses and guide management at the bedside. Several studies in Emergency Medicine and in Primary Care demonstrate the utility of ultrasound in bedside patient management.¹ As early as the 1990's, Emergency Medicine Departments in the United States started using PoCUS to assist with evaluation of trauma patients with the FAST exam.⁶ In 1990, a school in Hanover, Germany first introduced PoCUS in medical education as a pilot program, an adjunct to existing anatomy education.⁴ Since then, schools across the United States, and the world, started adopting and expanding on the utility of bedside ultrasound for medical education. However, only about 57% of medical schools across the United States offer PoCUS training as of 2020. Additionally, less than 10% of schools offer a 4-year longitudinal curriculum which includes clerkship POCUS training.⁵ The opportunity for improved patient care afforded with PoCUS still lies untouched in many medical schools.

At Indiana University School of Medicine, in Indianapolis, we implemented a comprehensive 4-year PoCUS curriculum in 2019.

Training in Point-of-Care Ultrasound started as early as the first week of school. Students received a mixture of online training and

Highlights:

- Use of bedside ultrasonography in a student run free clinic for underserved populations.
- Bedside ultrasonography allows identification and estimation of disease severity in clinics for underserved populations.
- Early integrated 4-year ultrasonography curriculum helped students identify use of ultrasound in clinical setting

in person practice sessions scattered throughout their pre-clinical and clinical training years. Alongside their education, students may volunteer to serve at the free Student Outreach Clinic based in the urban center of Indianapolis, Indiana. Each patient in the outpatient clinic gets a clinical care team of a junior medical student, senior medical student, resident, and attending physician, all providing quality care. Recently, students utilized bedside ultrasound, in large part due to the new PoCUS program, to aid in the diagnosis and management of vulnerable patients. This much needed imaging application saves time and impresses the importance of follow up care for the medical team and the patients themselves.⁸ We would like to present one such case to highlight the importance of teaching PoCUS early and comprehensively in medical education.

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The Case

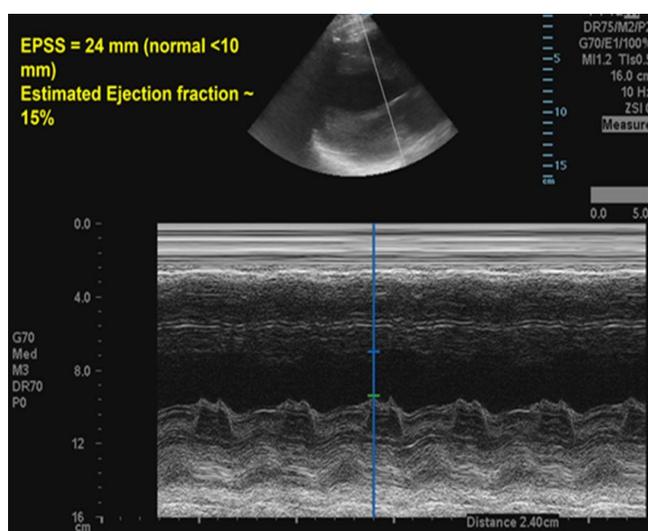
The CARE guidelines were used for reporting our case. Consent from our patient was obtained verbally via a trained Yoruba interpreter. A 48-year-old man who recently immigrated from Nigeria presented to the student-run free clinic in Indianapolis with the complaint of shortness of breath and cough. The shortness of breath was reported at his work and was relieved by drinking water. The language barrier made history taking difficult; however, he was able to communicate that he had dyspnea on exertion for the last 7 months. He denied any past medical history and took no medication as he had not had the financial resources to interact with healthcare since immigrating. Family history was unremarkable. He denied use of tobacco, alcohol, and illicit substances. The physical exam performed by the medical students identified mild bibasilar crackles and 1+ pitting edema in the bilateral lower extremities. The students, concerned for heart failure, initiated an EKG which revealed evidence of atrial overload and left ventricular hypertrophy. The first-year medical student had received training on cardiac ultrasound the week prior, allowing the students to perform point of care ultrasound. Hypokinetic left ventricular walls were visualized with bedside ultrasound and the cardiac PoCUS trained attending physician assisted with estimating the ejection fraction at 15% (normal 50%-70%), seen in [Figure 1](#). The patient was diagnosed with heart failure with reduced ejection fraction, labs were drawn, appropriate medication was started, and urgent cardiology consultation was scheduled. At the outreach clinic, he was started on furosemide, lisinopril and metoprolol. Furosemide was subsequently discontinued due to elevation in serum creatinine and hypokalemia during follow-up visits at the outreach clinic. The patient followed up with the attending physician at his primary clinic 4 months later, where a formal echocardiogram confirmed the diagnosis of heart failure with reduced ejection fraction. After 7 months of medical treatment at the student outreach clinic, his systolic ejection fraction improved to 49% on formal transthoracic echocardiogram. At the county hospital, he met with a cardiologist who adjusted his medication and scheduled him for a stress test to be completed. His symptoms improved, and his prognosis from congestive heart failure improved significantly.

On reflection with his primary care provider, using a Yoruba interpreter, he expressed gratitude for the student outreach clinic and staff accurately diagnosing his condition, and connecting him with specialist care. He was unable to afford medical care and was grateful for the assistance at the free clinic. The first-year medical student reflected, "I was especially impressed with how ultrasound in this context could rapidly correlate our patients' clinical status with an anatomical picture of heart failure. It felt empowering to have a tool readily accessible to deliver quality care to an underserved patient. Our free clinic is limited in resources and time, but I felt that the use of ultrasound exceeded this barrier and allowed us to rapidly and accurately diagnose our patient and guide in their management."

Discussion

In our case, we highlighted how Point-of-Care Ultrasound afforded rapid diagnosis of a patient with characteristics indicative of heart failure. Bedside ultrasound confirmed the diagnosis of heart failure and further characterized the type of heart failure, so that appropriate medical management could be initiated promptly; the formal echocardiogram was scheduled 4 months later due to staffing shortages. Findings of heart failure can be supported by x-ray imaging, but this also often requires the patient to leave the initial clinical space to obtain the x-ray, whereas Point-of Care Ultrasound is performed at the bedside. Student staffed clinics allow both clinical and pre-clinical students to hone their medical skills. In our case, the use of bedside ultrasound by the first-year medical student allowed for the students and staff to escalate the urgency of the care for this patient.

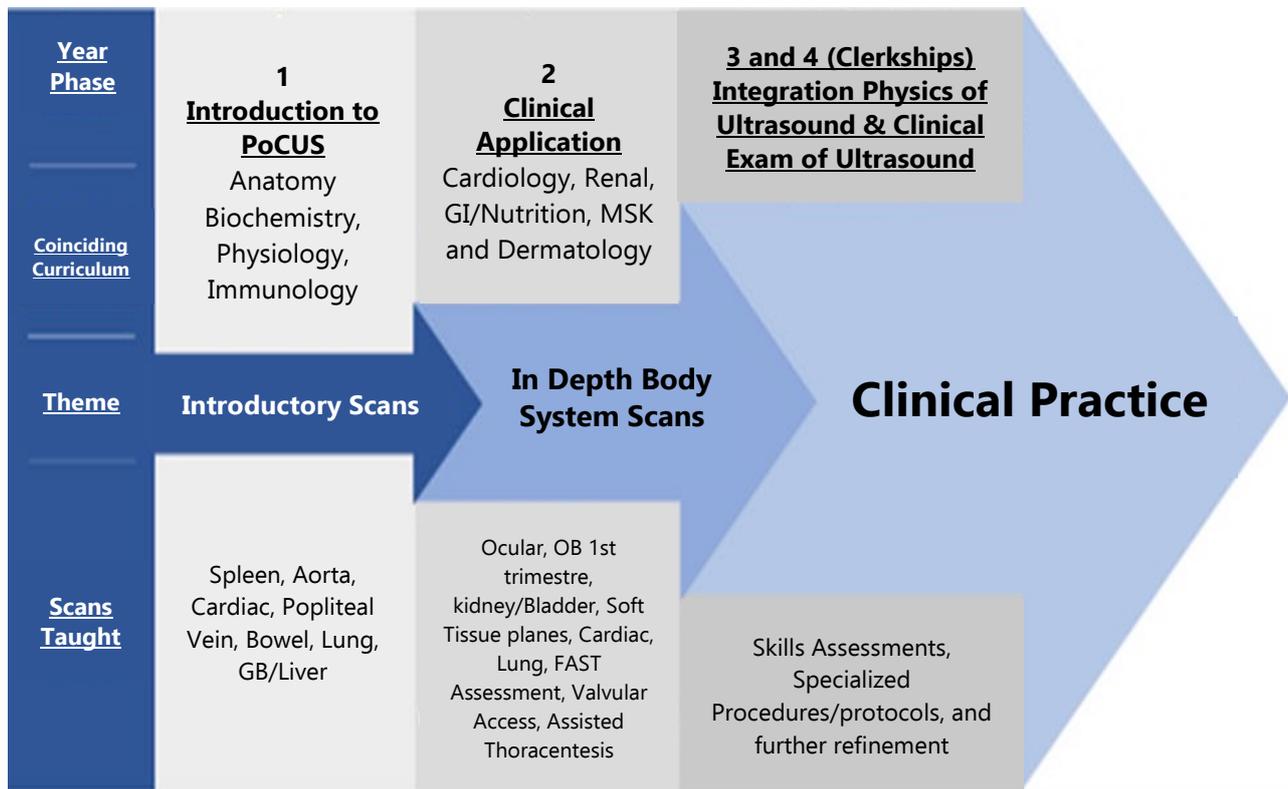
Figure 1. End Point Septal Separation (EPSS) Calculation: Distance Between the end Point Excursion of the Mitral Valve and the Interventricular Septum on m-mode Imaging in Parasternal Long Axis View.



Legend: The distance in millimeters is included in a formula ($EF = 75 - [EPSS \times 2.5]$), y and gives an estimate of the left ventricular ejection fraction.

With our comprehensive PoCUS training curriculum, seen in [Figure 2](#) our student was able to perform a bedside limited echocardiogram to evaluate the left ventricular function for our patient in the underserved clinic. With this added information, we were not only able to direct management but also impress the severity of his situation to him during his consultation. The limitations to our case report include that, although the student performed the ultrasound, the images were reviewed and interpreted by the staffing physician present. However, this should encourage support for staffing physicians to have protected time to train in PoCUS for improved patient care and medical student education.

Figure 2. Indiana University School of Medicine Point of Care Ultrasound Curriculum.



PoCUS training has rapidly spread in undergraduate medical education across the country with more than half of programs now instituting this training. Other papers demonstrate that student-performed PoCUS improves patient care at the bedside.⁷ However, our case demonstrates the benefit for patients when we train our medical students in clinical ultrasound early in their education. Our first-year student accurately identified the abnormal heart on his initial ultrasound scan and discussed treatment options promptly with the attending. This case highlights the importance of initiating early PoCUS training for medical students, and how PoCUS education can help students better treat patients even while still in training.

Summary – Accelerating Translation

Ultrasound use at the bedside by medical clinicians, called Point of Care Ultrasound (PoCUS), emerged in the early 1990's as a promising clinical and educational tool that allows for quicker diagnosis of medical problems. However, only a little more than half of medical schools in the United States teach PoCUS to their medical students; barely a tenth of schools teach this important tool over all four years of medical education. Our paper, Point of Care Ultrasound Early and Consistent in Medical Education, Making the Case with a Case Report highlights the need for medical schools to teach students clinical ultrasound early and

consistently throughout education. The PoCUS program at our local university uniquely exposes students to training during their first weeks of medical school, and training continues through all 4 years.

The portability and efficiency of PoCUS devices benefit free student-run clinics, where vulnerable patients come to seek free medical care while giving students the opportunity to practice hands-on clinical skills. We report the case of a 48-year-old man presenting to our student-run clinic with shortness of breath and cough. He recently immigrated from Nigeria, had no prior interaction with United States healthcare, and faced a significant language barrier. Physical examination conducted by the medical students revealed abnormal lung sounds and swelling in the lower legs. This prompted the students to suspect heart failure, and the first-year medical student accurately used bedside ultrasound to reveal reduced cardiac function of approximately 15% (normal 50%-70%), which prompted expedited and escalated medical care.

We demonstrate in our paper how incorporating PoCUS early into the undergraduate medical curriculum improves patient care while enhancing student education. The use of bedside ultrasound rapidly updated the team to the severity and type of heart failure present. Therefore, the care team quickly escalated the appropriate treatment, and impressed the importance of follow up care to the patient. This case highlights the importance of initiating early PoCUS training for medical students, and how PoCUS education can help students better treat patients in training and beyond graduation.

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