

Opinion

The Future of Ultrasound Education: A Medical Student's Perspective

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Ultrasound has been described as the stethoscope of the future, both excitedly by admirers and jokingly by detractors (1-2). While I cannot see the stethoscope ever being fully replaced by the probe, ultrasound is quickly becoming a tool that contemporary medical students and residents are almost as familiar with as they are the bell and diaphragm. However, this is a relatively new development with focused ultrasound education only recently becoming part of some medical school curricula (3-4). This is in sharp contrast with the fact that ultrasound is a well-established, safe, and rapid diagnostic tool that dramatically improves both patient care and satisfaction (5).

Ultrasound was once the exclusive domain of imaging specialists and for a few focused applications in primarily the obstetrical and cardiology fields; however, this is no longer the case as point of care ultrasound (POCUS) is now used in numerous fields with a variety of applications. It is also no longer a skill reserved for clinicians or residents in the later stages of their training. Ultrasound has been taught successfully to medical students, nurses, and emergency medical services (EMS) personnel (3, 6-7). Despite the increasing availability of ultrasound and

the ease of its use, dedicated medical school curriculum teaching POCUS is still uncommon, with many medical professionals not receiving any training until they have entered their third year of medical school (4). This may be due to barriers preventing the adoption of a required ultrasound education including cost, space, lack of trained faculty educators, and limited time in an already full curriculum (8).

My own experiences with ultrasound over my four years as a medical student have been overwhelmingly positive. The skills I acquired early in my education have greatly enhanced how I diagnose, treat and interact with patients and have become a fundamental part of how I practice medicine. These skills have immediate clinical utility and can play a role in every aspect of medical education including basic anatomy and physiology, clinical skills, interacting with patients and colleagues, research, and even teaching skills.

My first experience with ultrasound was during my first-year gross anatomy course. Each segment of anatomy was paired with ultrasound lectures and skills labs, where we practiced scanning. We were only the second class at West Virginia University to have ultrasound as a formal part of our curriculum. I

can remember being excited, but somewhat confused. I knew ultrasound could evaluate the heart and pregnancies, but little else. I initially thought that we would be shown the machine, given a lecture on how clinicians could use this technology, and unless pursuing cardiology or obstetrics, would memorize for an exam and then forget. I was surprised when the first skills lab was in the musculoskeletal system. This application introduced me to ultrasound as a tool with uses beyond what I had previously considered. After learning musculoskeletal ultrasound, we began reviewing basic echocardiograms. Cardiac physiology and pathology were arguably one of the most difficult concepts in medical school. Using ultrasound to view the motion of the heart in real-time was invaluable. Learning echocardiograms and how to interpret basic pathology as first-year students made me realize that ultrasound was not a skill for advanced clinicians, but had applications at every point in training.

During head and neck anatomy, I learned the application that solidified ultrasound as a keystone to my medical education: procedures. We discussed the numerous vital structures that all track closely together in the neck. It was incredibly difficult

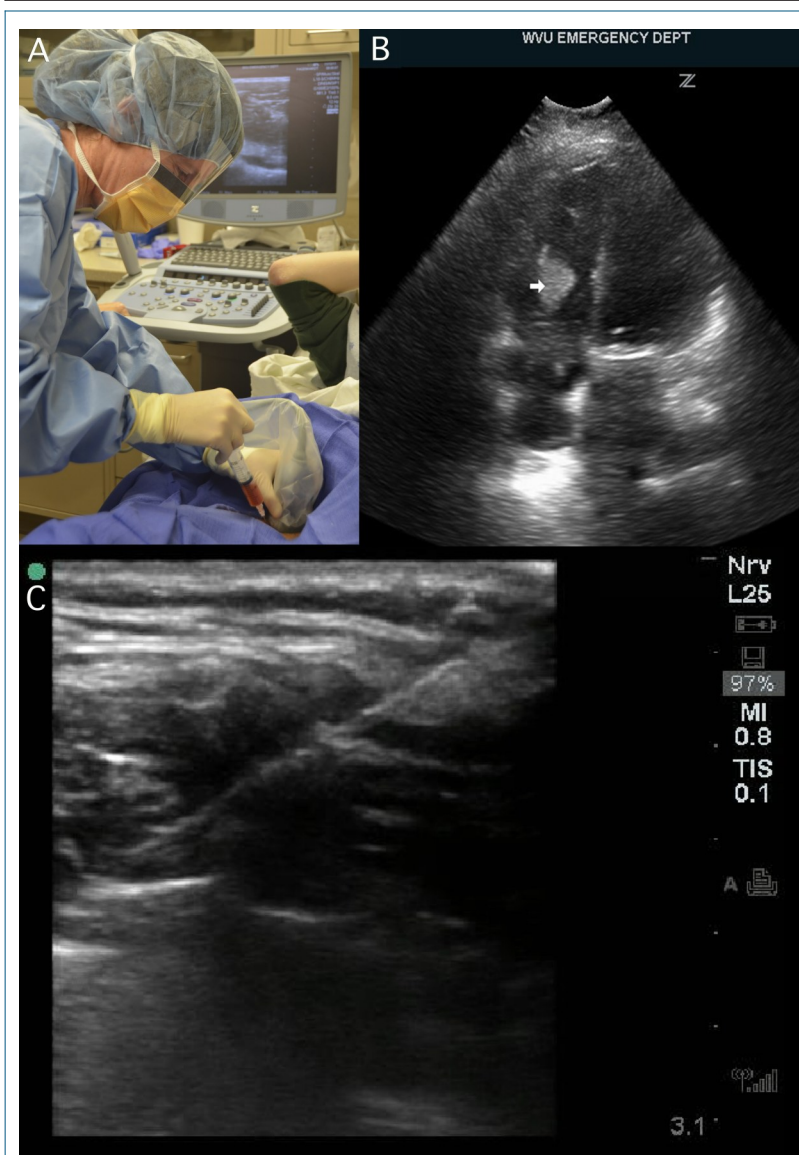


Figure. Expanding Ultrasound Training Gives Patients Broader Access to Specialized Care.

Panel A: An emergency physician performing ultrasound guided hip arthrocentesis, a procedure that traditionally required the sub-specialty referral. Wider access to training in ultrasound-guided procedures makes more specialized procedures more accessible to patients. Panel B: A needle seen in-plane injecting the brachial plexus at the supraclavicular location by an emergency physician. Again, this procedure is traditionally performed only by a narrow group of specialists, but wider access to ultrasound training allows broader access for patients. Panel C: A case of pacemaker associated endocarditis. The arrow indicates the vegetation associated with the pacemaker lead. This finding was first identified by a medical student on our ultrasound elective in a patient suspected to have uncomplicated pneumonia.

to separate the jugular from the carotid in a cadaver, let alone a living person. It seemed impossible that central lines were placed using anatomical landmarks and were a skill that would take years to learn. However, we were shown how ultrasound could help not only to diagnose but to treat. Procedures that were seemingly beyond my skillset as a medical student suddenly became feasible with ultrasound (Figure). It became clear that ultrasound was a skill that would become crucial to my future practice. Ultrasound was a fundamental part of how I learned during my first year in medical school, and shaped how I view physiology and anatomy by correlating the various functions and diseases with what I learned in ultrasound.

My second year of medical school ultrasound education was focused on refining skills I had learned as a first year, and putting them to use in specific ways. We were given the opportunity to use handheld ultrasounds, and encouraged to take them home to practice. This was particularly fun, as my father and brother are also physicians. When I showed them the various ways ultrasound could be used, they were impressed. Neither had received any ultrasound education during their time in medical school, and they had little idea that it could be used to diagnose deep vein thrombosis (DVT), inject joints, or diagnose abdominal aneurysms. I got a chance to demonstrate some of the more advanced techniques I had been learning, including looking for a sternal fracture in my sister. Below is a brief overview of the longitudinal ultra-

sound curriculum at West Virginia University:

MS1 (1st year student) – Didactic lectures and small group hands-on lab sessions, with written and practical assessment, integrated with Human Structure Course. Topics include introductory ultrasound, upper extremity, lower extremity, chest/heart, abdomen, retroperitoneum/pelvis, and sonographic anatomy for medical procedures.

MS2 (2nd year student) – Required video tutorials and practical sessions, with written and practical assessment, integrated with MS2 curriculum focused on important pathologic findings. Practical sessions include lower extremity DVT, echocardiography, abdominal, and female pelvis.

MS3 (3rd year student) – Case-based videos with required scans for rotations as well as numerous scanning opportunities, assessed with brief written quizzes.

MS4 (4th year student) – Multiple scanning opportunities as well as electives in Radiology and Emergency Ultrasound. Required assessment prior to graduation.

Unfamiliarity with ultrasound was something I saw again during my second-year clinical preceptorship. During this time, I was paired with an upper-level resident, and we were assigned monthly ultrasounds. When we went to scan, we found that it was as much a learning process for our preceptor as it was us. Although she had some exposure during residency, she had none as a medical student. We were able to use the skills we had learned, and apply it to a scan with which we were less familiar. Ultrasound was wonderful in this sense, as it was very forgiving of

making mistakes. We felt comfortable experimenting with our skills and learning how to produce the best images. With no radiation exposure or preparation needed, we could be directly involved and contribute to patient care without fear that we were delaying or causing discomfort.

The third and fourth years of medical school were a chance to truly apply my ultrasound skills to real patients on a regular basis. My rotations in obstetrics and vascular surgery gave me ample opportunity to put my skills to use. I became more involved with assessing pregnancies and guiding instruments on obstetrics. During my vascular surgery rotation, I was able to assist with procedures, Doppler limbs, and trace blood vessels.

I was also able to further develop my ultrasound interests during my emergency medicine rotations and a clinical ultrasound elective. During these rotations, I was able to perform various scans ranging from focused assessment with sonography in trauma (FAST) exams on trauma patients to biliary scans on patients with abdominal pain, all in an emergency setting where my images directly affected patient care. While ultrasound was common in my home institution, this was not the case at other hospitals I visited. My familiarity with ultrasound allowed me to be more involved during away rotations, and gave me a chance to share what I had learned with residents and faculty there. I had an introductory lecture on ultrasound with residents helping teach the practical portion. We were reviewing DVT scans and discussing how to locate the

femoral vein. The resident who was teaching had only recently learned DVT scans, and was not as familiar with the anatomy or how to perform certain functions. Having learned femoral vein ultrasound during my first year, I had performed many DVT scans, and was able to help my fellow students identify the structures and some of the techniques for assessment of DVT, like augmentation and phasicity.

Becoming skilled with ultrasound was one of the earliest opportunities for me to be more than a passive observer in my medical education, giving me some of my earliest and most memorable interactions with patients. I frequently spent several hours in the lab with the same models and learned how to converse and form relationships with patients. Patients seem to genuinely enjoy bedside ultrasound. It is often one of the few opportunities they get to have one-on-one time with their doctor with minimal interruptions. Often when I am scanning, it is my chance to discuss the non-medical aspects of their lives. It also provides patients with a chance to have a greater voice in their care. In my experience, being able to show patients their images as you collect them and interpret them often helps alleviate some of the stress their illness brings. Patients have told me that seeing first-hand what we are describing when we give them our assessment and plans puts them at ease. Going over the image specifics is a small way to strengthen the trust between my patients and me.

Some of the first interactions I had with clinicians also came

through the ultrasound curriculum. One of my more memorable experiences was during my ICU rotation. Our patient needed a lumbar puncture, but due to a prolonged ICU stay, the patient was edematous, and it was difficult to palpate the spinous processes needed to accurately place the needle. When I suggested we attempt to use ultrasound to first find the spinous processes, both the residents performing the procedure and the supervising attending were surprised, as if they had never considered ultrasound as an option. It was a chance to try a new approach to a classic procedure that has been performed much the same way since its existence, and it was exciting as an intern to share something new with clinicians who were several years my senior.

Additionally, I have been able to interact with medical students and residents from various other programs through ultrasound education days, away rotations, interviews and visiting students. One of the most surprising things was that what I had learned as a first-year medical student, many of my colleagues and peers had not received until their fourth or intern year, if at all. The ultrasound curriculum at other schools was often minimal, with only a few lectures and limited time to practice. It was difficult to understand that something that was so essential to my medical education that helped shaped my practice of medicine was missing from many others' curricula. I can remember feeling somewhat proud that my classmates and I were learning a skill that distinguished us from other medical students and shaped the

physicians we became.

Although I am only a few months into my residency training, my ultrasound skills have continued to be an invaluable tool, one that I am as comfortable using as my stethoscope. It has strengthened my clinical decisions and enabled me to take greater ownership of my patients. My four years of ultrasound education has allowed me to incorporate bedside ultrasound into my initial assessment and plans for my patients. It has also helped shape my discussions with my colleagues and attendings. One of the more recent examples was a pediatric patient I had with an area of erythema and swelling in his inguinal crease. I was able to ultrasound the area, and noticed a fluid collection that was likely an abscess.

Instead of reporting redness and swelling with a broad differential, I was able to provide a more accurate assessment, and objective findings that reinforced my diagnosis. This enabled me to prevent radiation exposure to the patient and also to determine that the best treatment was surgical drainage.

As an Emergency Medicine resident, I employ ultrasound daily, and it is evident to me that learning ultrasound as a medical student has influenced every aspect of how I practice and care for patients from diagnosing to treating. It has afforded me opportunities to interact with students, residents, faculty and even the public as a learner, a teacher, and an advocate. Ultrasound as a general purpose medical tool will continue to become more commonplace, from large academic centers to urgent cares

and community hospitals. Ultrasound is finding its place as a safe tool that dramatically changes how we care for patients and I can only see it continuing to improve. Basic ultrasound is a skill that every medical professional should be able to employ, and beginning training in medical school is something I wholeheartedly support.

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1. Filly R. Ultrasound: The stethoscope of the future, *alas. Radiology* 1988;167(2):400.
2. Geria RN, Raio CC, Tayal V. Point-of-care ultrasound: not a stethoscope-a separate clinical entity. *J Ultrasound Med* 2015;34(1):172-3.
3. Nelson BP, Hojsak J, Del Rossi E, Karani R, Narula J. Seeing Is Believing: Evaluating a Point-of-Care Ultrasound Curriculum for 1st-Year Medical Students. *Teach Learn Med* 2017;(1):85-92.
4. Bahner DP, Goldman E, Way D, Royall NA, Liu YT. The state of ultrasound education in U.S. medical schools: Results of a national survey. *Acad Med* 2014;89(12):1681-6.
5. Howard ZD, Noble VE, Marill KA, Sajed D, Rodrigues M, Bertuzzi B, et al. Bedside Ultrasound Maximizes Patient Satisfaction. *J Emerg Med* 2014, 46:46-53.
6. Heegaard W, Hildebrandt D, Spear D, Chason K, Nelson B, Ho J. Prehospital ultrasound by paramedics: results of field trial. *Acad Emerg Med* 2010;17(6):624-30.
7. Steinwandel U, Gibson NP, Rippey JC, Towell A, Rosman J. Use of ultrasound by registered nurses - A systematic literature review. *J Ren Care* 2017;43(3):132-42.
8. Hoppmann RA, Rao VV, Bell F, Poston MB, Howe DB, Riffle S, et al. The Evolution of an Integrated Ultrasound Curriculum (iUSC) for Students: 9-year Experience. *Crit Ultrasound J* 2015;7(1):18.