

Teaching Point of Care Ultrasound Skills in Medical School:

Keeping Radiology in the Driver's Seat

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Rationale and Objectives: Ultrasound is used increasingly in medical practice as a tool for focused bedside diagnosis and technical assistance during procedures. Widespread availability of small portable units has put this technology into the hands of many physicians and medical students who lack dedicated training, leaving the education and introduction of this key modality increasingly to physicians from other specialties. We developed a radiology-led program to teach ultrasound skills to preclinical medical students.

Materials and Methods: To develop this new ultrasound program we 1) established a program leader, 2) developed teaching materials, 3) created a hands-on interactive program, and 4) recruited the necessary instructors. The program was piloted with the first-year medical student class of 154 students. The introductory session was assessed by pre- and post-activity Likert scale-based surveys.

Results: Of 154 (68.8%) students, 106 completed a voluntary online survey before starting the program and 145 students (94.2%) completed a voluntary survey after the session. Students found the program educationally valuable (4.64 of 5) and reported that it improved their understanding of ultrasound imaging (4.7 of 5). Students' reported confidence in identifying abdominal organs, intra-abdominal fluid, and Morison pouch that was significantly higher on the postactivity survey compared to the presurvey ($P < .001$ for all).

Conclusions: We piloted a radiology-led program to teach ultrasound skills to preclinical medical students. Students found the experience enjoyable and educationally valuable.

Key Words: Medical student education; point of care ultrasound; preclinical curricula.

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Ultrasound has been a useful diagnostic imaging tool since the introduction of grayscale imaging in the 1970s. While originally the purview of radiologists, rapidly evolving technology, and smaller ultrasound units have put this imaging modality into the hands of a wider range of physicians including subspecialists closer to the point of service. Ultrasound is now used routinely by cardiologists, obstetricians and gynecologists, emergency medicine physicians, critical care physicians, surgeons, and hospitalists for point

of care uses including focused diagnostics, as a physical examination adjunct, and for bedside procedure guidance (1). A portable ultrasound device is a far more accurate and powerful tool to identify a suspected pleural effusion, for example, rather than relying simply on a stethoscope. In 1988, ultrasound was called "the stethoscope of the future" in the *Journal of Radiology* (2) and that future has largely arrived.

Although ultrasound can be a powerful tool, it is a complex imaging modality, and skillful interpretation and mastery takes years of specialized training. Formal diagnostic examinations, as well as ideally focused examinations, should be performed by imaging experts with specialized training in residency or fellowship. That said, targeted limited ultrasound examinations are already being performed routinely at the bedside by a wide array of physicians, often with little or no formal imaging training.

Medical students now encounter bedside ultrasound as soon as they begin clinical rotations, and similar to other tools in the physician's armamentarium, they are eager to learn to use it appropriately. Several medical schools have begun incorporating hands-on ultrasound training into their formal curricula (3,4) rather than assuming that students will learn

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these skills adequately on the wards. Benefits to formal instruction include more quality control, standardization of training, and opportunity for competency assessment. Additionally, the complexity of ultrasound imaging can be stressed, so that physicians with limited focused skills do not overestimate their level of expertise and better understand when a radiologist must be consulted. Even at programs without a longitudinal clinical ultrasound program, ultrasound is sometimes used in the preclinical years as an educational tool to teach anatomy. This has been shown to be both effective and well received by the learners (5–8).

Although becoming more common, most medical schools have yet to include an ultrasound program into their formal curriculum, and they may face a number of logistical challenges in doing so. These no doubt vary from institution to institution but may include lack of time in the existing curriculum, a lack of ultrasound units available for dedicated student use, a lack of level-appropriate teaching materials, and a lack of teaching time resources among busy clinical faculty.

National organizations are creating programs to help schools in this capacity, mainly by creating and offering shared teaching materials. The American Institute of Ultrasound in Medicine has an “ultrasound in medical education portal” on its Web site with many resources for developing ultrasound teaching programs (9). Another group, the Society for Ultrasound in Medical Education has a number of online resources such as independent learning modules available for public use (10). A live event called ULTRAFest hosted by the emergency medicine departments at the University of California, Irvine and Stanford University over the past 3 years even offers free hands-on ultrasound training to medical students who register for the annual course. At this event, physicians from various specialties including “anesthesia, cardiology, critical care, emergency medicine, internal medicine, nephrology, obstetrics/gynecology, ophthalmology, orthopedics, pediatrics, rheumatology, sports medicine, and urology” teach students a variety of workshops ranging from abdominal diagnostics (aorta, renal, gallbladder, and obstetrics/gynecology) to basic echocardiography (11). Although these shared resources may be valuable and the common educational mission is admirable, the concerning thing about these groups is the relative absence of radiologists from their ranks (12). The groups are led almost exclusively by emergency medicine physicians and obstetricians/gynecologists who may be less expert in medical imaging than career radiology-trained ultrasonographers. Likewise, in the literature, radiologists are absent from the group of early investigators exploring ultrasound as an innovation in medical education.

As most schools have yet to use these resources or develop their own ultrasound curricula for medical students, radiologists still have an important opportunity to get involved at the beginning of this educational shift by establishing content guidelines and curricular standards, as the experts. It is reasonable that a future internist might learn to use ultrasound to guide vascular access or diagnose pleural effusion during a standardized medical school curriculum. However, it is not

reasonable to assume that they would learn an adequate amount to competently perform more complex diagnostic studies. Demand for ultrasound programs in medical school curricula will likely continue to increase. Maintaining control over the content can ensure that level-appropriate knowledge and skills are emphasized. For the sake of both patients and our specialty, if radiologists are not performing all imaging studies, it is best to “maintain a seat at the table” with regards to education standards, training, and competency assessment. Additionally, when radiologists are directly involved and perceived by students as the “imaging experts,” this type of program increases exposure to and interest in our field (13).

Herein, we describe the development of a radiology-led program to teach ultrasound skills beginning the very first week of medical school. We addressed issues of limited resources and teaching time and specifically describe methods by which radiologists are central to the effort. We evaluated the program created at our institution via qualitative surveys. We hypothesized that students would respond very favorably to the program and find it educationally valuable.

MATERIALS AND METHODS

Needs Assessment

Our medical school has approximately 150 students per class. Our setting is an academic tertiary care facility, which has a strong emphasis on primary care. The school has an integrated curriculum that introduces clinical content alongside basic science material from the first day students arrive. Modernization of the school’s anatomy lab facility provided an opportunity to explore new curricular innovations and acquire new digitally based equipment to improve the anatomy education program (14). A multidisciplinary team of educators, including both anatomists and radiologists, was charged with assessing needs for the new laboratory space and teaching program.

The needs assessment was comprised of

- A literature search found that ultrasound is a useful, interactive tool in teaching preclinical anatomy (5–8). Before the program began, radiologic anatomy was taught using a conventional lecture format, and x-ray and computed tomography images that were reviewed during cadaveric dissections. Ultrasound had not been previously incorporated into the anatomy curriculum. The multidisciplinary group decided that the lack of ultrasound instruction in the anatomy program was an educational gap, as a teaching aid, and because broad exposure to the technology would be important for future point of care uses.
- A review of student use of various technologies, specifically ultrasound, compared to the level of training provided. Ultrasound units were already being provided for senior medical student use in a patient simulation center, so students were already using the equipment, but there was no formal training program available in the curriculum.

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