Ultrasound in Medical Education

A ROADMAP FOR INTEGRATING ULTRASOUND INTO MEDICAL SCHOOL CURRICULA

June 1–2, 2014 • New York Hilton, New York, NY

—hosted by—

Help improve medical education • Make an impact • Influence medical school curriculum development
## Final Agenda

### 2014 Forum on Ultrasound in Medical Education

**A Roadmap for Integrating Ultrasound Into Medical School Curricula**

New York Hilton, 1335 Avenue of the Americas, New York, NY 10019

**June 1, 2014 | 6:00–7:15 pm**

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<th>Time</th>
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<tbody>
<tr>
<td>6:00–7:15 pm</td>
<td>Reception (Bryant Room)</td>
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**June 2, 2014 | 7:00 am–3:00 pm**

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<tr>
<td>7:00–8:00 am</td>
<td>Breakfast (South Corridor) Note: Please check out of your room and leave your luggage with the bell captain prior to 8:00 am</td>
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<td>8:00–11:50 am</td>
<td><strong>Morning Session (Murray Hill East)</strong></td>
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<td><strong>Introduction ~ 8:00–8:15 am</strong></td>
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<td></td>
<td>Steven R. Goldstein, MD</td>
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<td><strong>Medical Education: Ultrasonography as a Basic Clinical Competency ~ 8:15–9:00 am</strong></td>
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<td>Richard A. Hoppmann, MD</td>
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<td><strong>Roadmap to Getting Started ~ 9:00–9:20 am</strong></td>
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<td>Zachary P. Soucy, DO</td>
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<td><strong>General Concepts in Developing an Ultrasound Curricula ~ 9:20–10:20 am</strong></td>
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<td>David P. Bahner, MD, RDMS, and J. Christian Fox, MD, RDMS</td>
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<td><strong>Break ~ 10:20–10:40 am</strong></td>
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<td><strong>How Does Radiology Fit In? ~ 10:40–11:00 am</strong></td>
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<td>John S. Pellerito, MD</td>
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<td></td>
<td><strong>Challenges and Pitfalls: How to Overcome Barriers to Implementation ~ 11:00–11:20 am</strong></td>
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<td>Barry J. Knapp, MD</td>
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<td><strong>Ultrasound as a Learning Tool: the Student Perspective ~ 11:20–11:50 am</strong></td>
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<td>Shannon B. Kim, MD (Class of 2013), Duncan Norton, MD (Class of 2014), Chanel Fischetti (Class of 2015)</td>
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<td>11:50 am–1:00 pm</td>
<td><strong>Lunch and Learn (Nassau Room)</strong></td>
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<td><strong>How Ultrasound Changes Anatomy Education ~ 11:50 am–12:40 pm</strong></td>
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<td>Craig W. Goodmurphy, PhD</td>
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<td><strong>Break ~ 12:40–1:00 pm</strong></td>
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<td>1:00–2:00 pm</td>
<td><strong>Hands-on Stations and Simulators Scanning Areas (Gramercy Room)</strong></td>
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<td><strong>Cardiac, Thyroid, Musculoskeletal, and Vascular (Carotid)</strong></td>
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<td>2:00–3:00 pm</td>
<td><strong>Roundtable Discussions (Murray Hill West)</strong></td>
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<td>**Questions</td>
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<td><strong>Panel Review of Roundtable Discussions and Closing Remarks</strong></td>
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<td>Steven R. Goldstein, MD</td>
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2014 Forum on Ultrasound in Medical Education
A Roadmap for Integrating Ultrasound Into Medical School Curricula
New York Hilton, 1335 Avenue of the Americas, New York, NY 10019

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For the complete toolkit, visit the
AIUM/SUSME Ultrasound in Medical Education Portal:

http://meded.aium.org/home

Over 160 additional references can be found at the website above.
AIUM/SUSME Ultrasound in Medical Education Portal

http://meded.aium.org/home

All of the documents in your course packet – and much more, including over 160 additional references – can be found at the website above.

***Please remember to consider signing up for the AIUM MENTORS program discussed in the course. This is a great way to use social media for new ideas, network with others in your area, and let others know there is Ultrasound in Medical Education (USME) activity at your school. If you have not signed up already, please visit the site above, go to the “Mentor Program” tab on the left of the screen, and click on the hyperlink “volunteer form.” The form will take approximately 4-5 minutes to fill out.

***If you are the point of contact for your school for USME, please go to the site above and select the “Medical School” tab on the left, click on the hyperlink “please add your school’s information here.”

QUICK LINKS: Documents highlighted below are large. We have elected to not print them as they are examples/references which can easily be accessed by computer and downloaded for free.

1) Proposed Curriculum for a 4-year MD/RDMS Program at The Ohio State University College of Medicine: http://files.aium.org/toolkit/Proposed_Curriculum_OSUCM.pdf


3) An integrated ultrasound curriculum (iUSC) for medical students: 4-year experience: http://www.ncbi.nlm.nih.gov/pmc/articles/PMC3064888/


5) Making Waves: Ultrasound Use Increases in Medical Education: https://www.aamc.org/newsroom/reporter/dec2012/323592/ultrasound.html
How to Integrate US into the Curriculum

1. **Anatomy**
   a. Coordinate live ultrasound scanning with the anatomy curriculum by body part or anatomic section
   b. Bring the ultrasound unit into the Dissection lab and show ultrasound images corresponding to anatomic sections
   c. Scan a cadaver to evaluate tissue texture and different anatomic spaces including joints
   d. Correlate ultrasound images to CT scans to show the appearance of organs with different modalities
   e. Encourage scanning of models or students to appreciate 3D orientation of anatomic landmarks

2. **Physiology**
   a. Utilize Doppler scanning to show differences in blood flow in arteries and veins
   b. Coordinate live scanning with physical diagnosis classes
   c. Perform echocardiography to show changes in cardiac cycle and valvular events
   d. Focus on physiological events including menstrual changes of the ovary and uterus, normal and abnormal transplant blood flow, and changes in mesenteric flow with a meal
   e. Observe changes in fetal growth

3. **Pathology**
   a. Build a library of ultrasound images to compare to pathology specimens
   b. Work with the pathology department to identify specimens with ultrasound correlation
   c. Review ultrasound images with corresponding CT abnormalities

4. **Clinical Rotations**
   a. Radiology
   b. Cardiology
   c. OB/Gyn
   d. Emergency
   e. Critical Care
   f. Pediatrics
   g. Vascular Surgery
   h. Urology
   i. Anesthesia
   j. Internal Medicine

5. **Senior Electives**
   a. Radiology
      i. Abdominal Scanning
ii. OB/GYN
b. Vascular Laboratory
   i. Venous Ultrasound
   ii. AAA Screening
c. Emergency Ultrasound/FAST scan
d. Cardiac Imaging
e. Image-Guided Procedures
Checklist for Ultrasound Proficiency

Basic Ultrasound
1. Can verbalize how diagnostic ultrasound produces images
2. Can verbalize the relationship of frequency/resolution/penetration
3. Can distinguish between various modes of ultrasound (B, M, Color, Doppler)
4. Can verbalize Bioeffects of ultrasound and ways to maximize patient safety
5. Can verbalize relationship between patient/probe/picture

Basic Knobology
1. Can select patient and correct application
2. Can adjust depth and gain appropriately
3. Can use body markers and comments to label images

Basic Scanning
1. Can select appropriate transducer and activate probe
2. Can maneuver probe and image structures in orthogonal planes
3. Demonstrates proficiency in Sweep/Rock and Slide/Rotate/Heel Toe

FAST Protocol
1. Demonstrates ability to image the Hepatorenal space and potential spaces
2. Demonstrates ability to image the Splenorenal space and potential spaces
3. Demonstrates ability to image the subxiphoid view of heart and save a clip
4. Demonstrates ability to image the Posterior cul de sac in orthogonal planes

Focused Cardiac Scan
1. Demonstrates ability to image the heart in a subxiphoid view
2. Demonstrates ability to image the heart in a rescue parasternal view
3. Demonstrates ability to utilize M mode to document a heart rate
4. Demonstrates ability to identify pericardium and area for fluid accumulation

Focused Intrauterine Pregnancy Scan
1. Demonstrates ability to image the uterus from a transabdominal approach
2. Demonstrates ability to use the zoom button to augment the image size
3. Demonstrates ability to utilize M mode to document fetal heart rate
4. Demonstrates ability to save a video clip sweep through the entire uterus

Basic Networking
1. Demonstrates ability to order an Emergency Scan in IBEX/IDX
2. Demonstrates ability to populate a worklist on ultrasound machine/s
3. Demonstrates ability to complete an exam in IDX
4. Verbalizes basic troubleshooting techniques when system is nonfunctional
Checklist for Intermediate Ultrasound Proficiency

**Introductory Assessment**
1. Mastered and documented completion of Basic Proficiency in Ultrasound
2. Met with Ultrasound Director and Developed portfolio and vocational path
3. Completed all necessary surveys/credentialing

**Intermediate Ultrasound**
1. Can verbalize forms of attenuation and effect on scanning
2. Can verbalize secondary and tertiary methods to improve image quality
3. Can verbalize sonographic signatures of common anatomy and artifacts

**Intermediate Knobology**
1. Demonstrates ability to measure and calculate using preset tables
2. Demonstrates ability to improve image quality with focus/frequency/maps
3. Demonstrates ability to utilize Doppler and color flow correctly
4. Demonstrates ability to save video clips and multiple images

**Intermediate Scanning**
1. Demonstrates ability to scan a variety of patients and troubleshoot
2. Demonstrates ability to utilize range of probes

**Transvaginal Ultrasound for Intrauterine Pregnancy**
1. Demonstrates appropriate transducer selection and preparation
2. Demonstrates ability to image uterus in sagital and coronal plane
3. Demonstrates ability to zoom in on suspected pregnancy
4. Demonstrates ability to measure GS, CRL, and Uterus
5. Demonstrates ability to detect free fluid in Posterior cul de sac

**Ultrasound Guided Procedures**
1. Demonstrates ability to select and prepare transducer
2. Demonstrates ability to differentiate vein from artery
3. Demonstrates ability to cannulate a simulated vessel in Short Axis
4. Demonstrates ability to cannulate a simulated vessel in Long Axis
5. Verbalizes complications and ways to maximize patient safety

**Intermediate Abdominal Scanning**
1. Demonstrates ability to scan the kidney in orthogonal planes
2. Demonstrates ability to image gallbladder, portal vein, liver, and pancreas
3. Demonstrates ability to image and measure the bile duct along its length
Checklist for Advanced Ultrasound Proficiency

Advanced Scanning
1. Demonstrates ability to scan multiple organs and indications
2. Able to communicate sonographic terminology
3. Able to utilize ultrasound equipment and spectrum of knobs

Focused Critical Care Scanning
1. Demonstrates the sonographic approach to the patient in shock
2. Demonstrates the sonographic approach to the patient with dyspnea
3. Able to measure the IVC/RA junction with M mode and determine a rough guide to central venous pressure
4. Able to utilize ultrasound to demonstrate Endotracheal tube placement
5. Able to image the lung to determine pneumothorax, lung sliding, and lung point
6. Able to determine cardiac function and estimated ejection fraction

Focused Vascular Scanning
1. Able to image and identify Femoral/Popliteal vessels
2. Able to use B Mode compression techniques to rule out clot
3. Demonstrates ability to use color and spectral flow in augmentation
4. Demonstrates ability to produce an arterial and venous waveform

Focused Ophthalmologic Scanning
1. Verbalizes appropriate technique and concerns regarding US of the eye
2. Demonstrates appropriate technique for imaging the anterior and posterior structures within the eye without applying pressure to the orbit
3. Demonstrates ability to measure the ONSD 3mm posterior to the retinal line

Focused Peripheral Ultrasound-Guided Nerve Blocks
1. Demonstrates the ability to distinguish nerves at multiple levels
2. Demonstrates ability to recognize and identify surrounding structures
3. Demonstrates ability to guide needle and place local anesthetic within sheath
General Concepts in Developing an Ultrasound Curricula

- Problem Identification and General Needs Assessment
- Targeted Needs Assessment
- Goals and Objectives
- Educational Strategies
- Implementation
- Evaluation and Feedback

1. **Problem Identification and Needs Assessment**: Ultrasound has become more portable and accessible to the everyday clinician yet the requisite training and expertise is not commonplace for the practicing clinician. Ultrasound equipment and expertise is not uniformly available to all the specialties that could use this tool in the care of their patients.

2. **Targeted Needs Assessment**: Each learner that delineates a specialty choice will narrow their ultrasound needs (e.g. CCUS → thoracic ultrasound). As students/learners refine their career goals, the ultrasound curricula will requisitely focus on those skills necessary for their eventual specialty.

3. **Goals and Objectives**: The goals and objectives to learn the psychomotor task of acquiring and interpreting ultrasound images will be consistent for each focused ultrasound procedure (e.g. performing a focused cardiac ultrasound) and will become more specific as the curriculum advances.

4. **Educational Strategies**: The educational strategy of the Ultrasound Academy will be employed for all learners and is demonstrated in the Ultrasound Echo document. Surveying all learners, access to asynchronous online material and assessment through Carmen learning management system, Synchronous didactics, hands on deliberate practice, saving images to a digital portfolio, patient exams in a clinical environment, modular assessment of ultrasound skills in a practical examination, final recommendation.

5. **Implementation**: These curriculum are currently being implemented in the clinical skills lab, clinical settings in the Emergency department, ICU and on various rotations.

6. **Evaluation and Feedback**: Online Carmen Quizzes, practical hands on examinations, final yearly assessment of skill sets, and bedside teaching are some of the methods for providing ultrasound competency feedback to learners.

**Reference**

Curriculum Development for Medical Education: A Six-Step Approach 2nd Ed. David Kern, Patricia Thomas, Mark Hughes, Johns Hopkins Press 2009
Ultrasound in Undergraduate Medical Education: Talking Points

What is your school’s structure?
- Traditional course-based didactics versus integrated/organ-system-based
- What is your affiliation with the medical school?
  - Is there a department of Emergency Medicine at the medical school?
  - Is there a required EM clerkship?
  - Is EM active in teaching other topics/subjects already?
- What are the logistics of student didactics and clinical rotations?
  - Didactics centralized or spread out, mainly large- or small-group formats; clerkships centralized or geographically separated
- Will there be “curricular reform” at your school anytime soon?
- What are unique considerations/focuses of your school/program?

What is your goal?
- Complementary teaching of complex anatomic relationships (ie, rotator cuff, cardiac)
- Complementary teaching of physical exam (ie, aortic or thyroid palpation, GU exam, cardiac auscultation)
- Integration of anatomy, physiology, pathology, and medical decision-making (ie, ACEP core applications with an added emphasis on anatomy/physiology)
- “Stanford 25” physical exam skills list: bedside ultrasound is #25, and teaching of at least 15 of the other 24 can be augmented using ultrasound
- Help students explore and reinforce concepts covered in anatomy and physiology and pathology, enhancing learning by using multiple modalities (gross dissection, textbooks, physical exam, and ultrasound)

Challenges frequently faced:
- No place in an already crowded curriculum
- Students will not develop physical exam skills
- What to do when you find pathology in students
- Just more technology between the doctor and patient
- Lack of proven educational value of ultrasound
- Faculty too inadequately trained in ultrasound to teach
- Inadequate resources to invest in a new curriculum (machines, models, etc)

Evidence base of ultrasound in medical education:
- Mainly descriptions of curriculum and experience
- Paucity of research-based outcomes
  - Plethora of positive student feedback
  - Significant face validity
- Does integrating ultrasound into undergraduate medical education:
  - Improve student scores on anatomy and physiology exams?
  - Increase the likelihood that they will use it to reach more accurate, timely, and cost-effective diagnoses and guide high-risk, invasive procedures?
  - Which question is more important, and what is our goal...
Why not just teach during residency?

- Nearly all specialties are using bedside ultrasound already, and its use is constantly expanding. This is (or is becoming) a core skill for physicians.
- Rather than teaching fundamentals, during residency you should concentrate more on pathology and time-sensitive information that directly guides clinical management.

Strategy:

- Look for small windows where ultrasound can be integrated
- Areas where course and clerkship directors are most receptive
- Integrate with gross anatomy, physiology, and physical exam
- Start small, do a good job, then expand
- Don’t try to teach everything all at once
- Longitudinal integration is much more effective, and enhances learning and long-term retention
- Keep student:faculty ratio low (ideally 5:1 or less)
- Gather student feedback to drive further opportunities
- Students can drive the process! MS-1 and MS-2 comments:
  - “I feel it has been the most practical clinical training I have had thus far in medical school.”
  - “This is what keeps me motivated while doing the basic science courses. I would love to have more opportunity to use this to reinforce my anatomy while getting hands-on use with equipment I will be using later in my career.”
- Find allies within the medical school to champion its integration
  - Must have faculty from multiple specialties at your institution; also consider multiple facilities, if feasible
  - Advantages of junior versus senior faculty
  - Medical school dean (bring your ultrasound machine and medical student!)
  - Grand rounds speakers – ultrasound topics
  - Take advantage of the simulation center
  - Consider involvement of other health professionals (PA, NP, techs)
  - Many of these “allies” will also become your instructors

Teaching formats and considerations:

- Mandatory versus elective student participation
  - Can you handle the entire class at once?
  - Consider beginning with elective participation to gather experience, instructors, educational curriculum, feedback (students and faculty) – and you can limit the number of participants
- Didactic classroom lectures versus web-based learning modules
- Mandatory hands-on laboratory sessions; open ultrasound practice sessions
- Interest groups (EM, radiology, and surgery easily integrate)
Resources (machines, models, and instructors):
✓ machine: purchase; borrow from ED, clinics, sim center, radiology, vendors
✓ models: medical students, phantoms, paid models, simulators
✓ instructors:
  o specialists: EM, radiology, cardiology, OBGYN, surgeons, critical care
  o residents: EM or radiology (esp during their U/S rotations)
  o peer-to-peer: interested MS-2 students volunteer for extra training, then serve as assistant instructors
  o medical school faculty: train them as instructors (quid pro quo)

“Sell it to the dean”
✓ Admissions: an ultrasound program can separate your school from the competition
✓ Student satisfaction: all deans want students to be happy with their education
✓ Grants: education, quality, patient safety, best practices, rural areas
✓ Potential for CME courses: source of revenue, build referral base, offer courses to alumni, etc.
✓ Patents and Licenses: ultrasound technology, teaching materials, simulation, phantoms
✓ Donors: ultrasound is very attractive to donors

Resources:
- ACEP guidelines (mainly for MS-4 EM U/S electives)
- SUSME
- WINFOCUS
- www.sonoguide.com

Closing thoughts:
✓ If ultrasound is integrated in a longitudinal manner, then it can become more than just a teaching tool, but also a clinical tool that can be integrated into daily practice.
✓ Ultrasound has applications across almost all specialties – it is a core clinical skill for physicians.
✓ Exposing medical students early and longitudinally to ultrasound builds a widespread foundation of knowledge in ultrasound, and allows residency training to focus on applications that directly affect patient care, cost, and safety.
✓ Medical schools are realizing that they need to teach ultrasound, or be left behind.

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California, Irvine), Dave Bahner (Ohio State University), Richard Hoppman (University of South Carolina), and James Hwang (Kaiser Permanente).
2013 PrimER for US Champions at an Academic Center

Identify Champion for each Critical Care area
Determine Scope of Practice for each clinical area
Develop Protocols for Education, Clinical Care, Research, Administration

Story Board Process of Integration (Education, Clinical, Research, Administration)
- Each step delineated by a geometric figure that signifies level of completion
- Circles = attention area  Triangles = Process in place  Square = Completed Task

Take inventory of Personnel
- Partition into 1. Early Adopters 2. Enthusiastic learners 3. Reluctant Users
- Develop strategies for each type of user
- Develop incentives/disincentives to encourage use of US

Education
- Embed US training into Curriculum
- Assign Ultrasound readings/CME- monthly starting in July
- Schedule Didactics/Hands On/Proctored Clinical Scanning times for each month
- Schedule Clinical Skills Sessions/Assessments 3-4/year

Clinical Scanning
- Equipment Accrual
- Rules of Use/Clinical Protocols
- Educational vs. Clinical Scanning policies
- Confirmatory Studies/ Medical Decision Making
- Saving Images/Video
- Review of Images/Q/A- Over reads and Feedback
- Ultrasound Rounds in clinical units- Decide on Days, times, process
- Monthly Reports of usage, interesting cases, over reads, problem areas

Research
- Identify Problem Areas and possible research
- Discuss with Super User Group
- Develop possible Ultrasound Solutions
- Develop Research Project
- IRB, Data Collection, Analysis

Administration
- Develop coordinator position/contact for each area
- Filing/Reports - Number each request sequentially and keep track of each case
- Survey of Use (department/unit, personnel)
- Equipment maintenance, cleaning, storage of images/video

Key personnel
- ICU Fellows
- MICU faculty
- Internal Medicine leadership
- SICU faculty and fellows
- Trauma teams
- Anesthesiology
- Specialties – e.g. Urology
- MSK faculty
Ultrasound interest group: a novel method of expanding ultrasound education in medical school

Nicole M. Dubosh · Nicholas Kman · David Bahner

Abstract

Purpose Ultrasound technology and clinical applications are advancing across many medical specialties and there exists an increasing need for ultrasound education in medical school. Few institutions, however, have incorporated this into the 4-year curriculum and barriers to curricular change remain. The Ultrasound Interest Group (USIG) is an alternative, extracurricular way for future operators to gain ultrasound exposure throughout all four years of medical school and develop the skill sets necessary to emerge as leaders in sonography.

Methods The USIG was designed using a student organization infrastructure. The mission is to promote ultrasound education and student leadership across the medical school, outside the required curriculum. Participation is voluntary and open to all medical students. Leadership consists of defined positions held by junior and senior medical students. The USIG holds four meetings per year, organizes clinical and scanning opportunities for students, sponsors ultrasound events, and distributes a newsletter.

Results The USIG has been an active student interest group for three academic years and had three sets of student leaders. Participants in USIG activities included first through fourth-year medical students each year. To date, the USIG had 12 meetings including 2 national and 4 local guest speakers. The USIG has organized scanning opportunities for students, sponsored events, and established a vertical model of structured mentorship.

Conclusion The USIG is a feasible method of promoting ultrasound education and student leadership among medical students. This model may be implemented at other medical schools as a centralized, organizing body for extracurricular ultrasound education.

Keywords Ultrasound · Medical students · Interest groups · Education

Introduction

Ultrasound technology and clinical applications are advancing across many medical specialties. Clinicians are discovering new uses for this imaging modality that are leading to improvements in patient care. At the same time, machines are becoming more compact, more affordable, and of higher quality [1]. Many physicians, however, continue to lack the skill set necessary to fully use this imaging modality in clinical practice [2]. In the last 10 years, ultrasound technology and miniaturization have outpaced the education of future operators. With these advancements, there exists an ever increasing need for ultrasound education in undergraduate medical training [3–6].
Few institutions have integrated ultrasound education into the 4-year medical school curriculum [7–10] despite evidence that medical students are capable of learning how to use and apply ultrasound during both their preclinical and clinical years [6, 7, 9–12]. This lag in incorporating ultrasound into undergraduate medical training may be due to a variety of reasons including lack of experience with ultrasound on the part of faculty educators, reluctance to change on the part of medical school administrators, or the turf mentality that exists across many specialties regarding the domain of ultrasound [6]. The logistics of how to include such training in an already full 4-year curriculum also comes into question by medical school deans and administrators. It is therefore worthwhile to investigate alternative, extracurricular ways for medical students to gain exposure to ultrasound, develop skill sets necessary to use this modality as future clinicians, and emerge as leaders in sonography.

Studies in academic medicine demonstrate that medical education often takes place in settings outside of the core curriculum [13]. One forum for this is student interest groups. These organizations are quite common in medical schools and they allow medical students to learn about and develop interests in different specialty areas [14, 15]. In considering ways to provide medical students with ultrasound educational opportunities, particularly in institutions where curricular change may not be immediately feasible, a student interest group is a reasonable option.

Methods

Under the guidance of an emergency medicine ultrasound director, students at The Ohio State University College of Medicine created the Ultrasound Interest Group (USIG). The mission of this student-run organization is to promote ultrasound educational opportunities and student leadership across the medical school, outside of the required curriculum. It was designed to serve as a central repository for all ultrasound educational activities for students within the College of Medicine. As an extracurricular program, membership is voluntary and it is open to all matriculating students within the College.

The USIG uses The Ohio State University student organization infrastructure for funding and leadership purposes. As a registered student organization both within the University and the College of Medicine, the interest group can obtain financial support from both sources. From the University, the interest group receives $200 annually for operating costs (printing, food for interest group meetings, recruitment) and can apply for up to $3,000 in funding for a specific event. The USIG also receives $300 annually from the College of Medicine Student Council to use for any interest group-related expenses. The USIG bylaws state that leadership is composed of junior and senior medical students and the specific positions include President, Vice President, Secretary, and Treasurer. The roles of President and Vice President are to be held by fourth-year medical students whereas those of Secretary and Treasurer are to be held by second-year students. In accordance with student organization policies within the College of Medicine and the University, there is a faculty advisor. The USIG is designed to hold four interest group meetings per year, organize scanning sessions for students, facilitate structured mentorship opportunities, improve ultrasound exposure at College of Medicine events, and distribute an interest group newsletter to all medical students.

Results

The USIG has been an active, registered student organization within the College of Medicine and University for three academic years and had three sets of student leaders. The faculty advisor is a registered diagnostic medical sonographer (RDMS) certified emergency physician and ultrasound director for the College of Medicine and Department of Emergency Medicine. The USIG held four interest group meetings per year with guest speakers (Table 1). The meetings consisted of interest group announcements, talks by guest speakers, ultrasound demonstrations, case presentations, and free lunch for those in attendance. Local and national guest speakers have discussed the use of ultrasound and its latest advances in cardiology, gastroenterology, emergency medicine, critical care, and anesthesiology as well as the RDMS certification process. Interest group meetings were attended by first through fourth-year medical students and the interest group began to keep complete meeting attendance records during its third year of existence (Table 2).

In addition to meetings, the USIG offered scanning opportunities for medical students and created innovative programs for structured mentorship. All students have access to the ultrasound machines in a clinical skills lab. An online scheduling system allows students to request both an ultrasound model and an experienced student proctor for individual practice sessions. The interest group has also organized clinical scanning shifts in the Emergency

<table>
<thead>
<tr>
<th>Table 1</th>
<th>Summary of USIG meetings and speakers by year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic year</td>
<td>Number of meetings</td>
</tr>
<tr>
<td>2008–2009</td>
<td>4</td>
</tr>
<tr>
<td>2009–2010</td>
<td>4</td>
</tr>
<tr>
<td>2010–2011</td>
<td>4</td>
</tr>
</tbody>
</table>
Department and Department of Gastroenterology with ultrasound-trained attending oversight. Both the skills lab and clinical hands-on experiences allowed participants to visualize normal and pathologic sonographic findings.

The USIG has sponsored and participated in College of Medicine and University events. The Ultrasound Olympics developed as an interest group competition in which students compete against each other in six different focused ultrasound exams: FAST, aorta, cardiac, pelvic, procedures, and median nerve. Instituted during the second year of USIG, this annual event is now being considered by College of Medicine leadership as a medical school wide event. Qualifying scans were scored and assessed for image quality and acquisition time. Medals were awarded to the top three students in each category and a “Sonographer’s Cup” was awarded to the overall highest scorer that participated in all categories. Within the College of Medicine, the USIG has put on ultrasound demonstrations at three student activities fairs, two parents’ weekends, and one second-look day for incoming students. The interest group also sent representatives to a university-wide alumni fundraiser event to bring attention to educational innovations within the medical school.

Finally, the USIG has produced quarterly newsletters each year since it began. These newsletters featured articles on recent USIG events, a case of the month, educational opportunities, and scanning tips. They were distributed to all students via email and served as an additional learning tool.

Table 2 USIG meeting attendance for 2010–2011 academic year

<table>
<thead>
<tr>
<th>Meeting date</th>
<th>Topic</th>
<th>Guest speaker</th>
<th>Number of students in attendance</th>
</tr>
</thead>
<tbody>
<tr>
<td>8/30/2010</td>
<td>Overview of ultrasound and USIG, scanning demonstrations</td>
<td>None</td>
<td>97</td>
</tr>
<tr>
<td>12/8/2010</td>
<td>Endoscopic ultrasound</td>
<td>Gastroenterologist</td>
<td>28</td>
</tr>
<tr>
<td>2/28/2011</td>
<td>Echocardiography</td>
<td>Cardiologist</td>
<td>24</td>
</tr>
<tr>
<td>5/18/2011</td>
<td>State of ultrasound education in medical school, cases</td>
<td>None</td>
<td>21</td>
</tr>
</tbody>
</table>

Discussion

The Ultrasound Interest Group has been well received by participants and student leaders. In addition to serving as an extracurricular forum for expanding ultrasound education, it was designed to facilitate structured mentorship among students. It has been well established that mentoring can offer a multitude of benefits in terms of personal and professional development for mentees [16]. Despite the fact that greater than 90% of all residents agree that mentorship is important, only 40% of medical students have identified a mentor [17]. Results from a survey conducted by Stenforos-Hayes et al. [18] suggest that similar benefits as well as interest in teaching and professional development can also be attained by mentors in a structured mentorship program. In our interest group, we created a vertical mentorship model. The leadership infrastructure and the creation of the proctor pool were designed with this purpose in mind. The student-to-student structured mentorship allows the less experienced student to learn ultrasound skills from more advanced students and at the same time allows the fourth-year students to gain teaching and leadership experience. Physician-performed ultrasound is less defined in terms of training requirements and scope of practice among medical specialties; it is important that educational programs focus on the development of teaching and leadership skills in addition to simply expanding ultrasound knowledge.

At this institution, interest groups have traditionally consisted of only first and second-year students. The USIG was designed for the specific purpose of encouraging medical students of all 4 years to share experiences and questions about ultrasound technology, clinical applications, and education. With the USIG’s unique leadership structure, the proctor pool, and variety of events, this interest group has maintained participation of first through fourth-year students.

The Ultrasound Interest Group is one component of the entire medical student ultrasound program at our institution. The Ohio State University College of Medicine curriculum is based on repeated exposures to various focused ultrasound exams over 4 years. All medical students participate in core curricular ultrasound exercises in courses including anatomy, introduction to clinical medicine, and the emergency medicine fourth-year clerkship. Motivated students can participate in elective or extracurricular ultrasound programs such as the Ultrasound Interest Group, enriched lecture series for first and second-year students, research projects, and a fourth-year ultrasound honors rotation. Many of the USIG members also participate in one or several of these other elective ultrasound opportunities. The USIG allows students to take leadership positions in organizing ultrasound activities within the College of Medicine, such as the Ultrasound Olympics.
Future directions

In its third year of existence, the USIG is still evolving based on student input and educational needs. One future goal is to create more student clinical scanning opportunities in other specialties. As multiple specialties begin to investigate how portable ultrasound can be used in their patient care, opportunities may arise to help medical students learn this skill in their future practice. Another goal is to develop a structured evaluation process to better respond to student input and assess the efficacy of this educational program. We plan to administer brief written evaluations to students after interest group functions and at the end of the academic year to elicit feedback. We also plan to review students’ scans following each scanning session to track their progress, identify areas of weakness, and provide them with feedback. In addition, the USIG aims to cosponsor workshops with other student interest groups in the College of Medicine in an attempt to get more students involved with ultrasound and to facilitate learning.

Since the penetrance of focused ultrasound spreads disproportionately by specialty and by geographic area, there has not been a top-down push toward regulating this skill set. The strategy with the USIG has been to engage the students in an effort to get them interested and involved. We hope to use a “grassroots” approach to instilling ultrasound in medicine from the bottom-up. These future physicians will learn the capabilities of focused ultrasound and the alternatives to managing various types of patients with this modality. With the changes in health care and limitations on expensive imaging, ultrasound may arise as an alternative if more individuals are appropriately trained.

Conclusion

The Ohio State University College of Medicine Ultrasound Interest Group is a feasible method of promoting ultrasound education and student leadership among medical students. As ultrasound education begins to grow within medical school, it is important for students to be engaged and shape how it will affect their future practice. By utilizing the interest group infrastructure and modifying the current governance to include structured mentorship throughout all 4 years, the USIG has attempted to become a resource for all students interested in using ultrasound in their careers. This model may be implemented at other medical schools as a centralized, organizing body for extracurricular ultrasound education.

Acknowledgments

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Conflict of interest

None.

References

6 Things I Wish I'd Done In Medical School

Rick Pescatore, Medical Student
Philadelphia College of Osteopathic Medicine
February 17, 2014

1) **Return to the Anatomy Lab.** By the time I realized how excellent a resource the cadavers could be, it was too late. We waste hours memorizing structures of little importance during our first year of medical school, but now with a few years of clinical experience under my belt, the chance to explore anatomy one more time would be immensely helpful. I could track the course of the subclavian vein around the clavicle and visualize the retroperitoneum and quiz myself on its contents. Instead of being concerned with the tensor veli palatini and countless other details of dubious significance, I could explore the airway unaccosted by the sound of a desaturating monitor.

2) **Spend more time with the nurses.** What few hours I've stolen with the nursing team have been immensely educational. Nursing care encompasses a whole unseen spectrum of patient care, and the unique considerations encountered by these professionals add a too-frequently forgotten dimension to the practice of medicine. Whether it's finally decoding the infusion pumps which trip me up time and again, mastering the monitors, understanding the logistical considerations behind medication administration, or more fully appreciating the science of wound care and prevention, a bit more time with the nursing experts who walk the halls would be a welcome opportunity.

3) **Trust, but verify.** I learned too late that much of what we are taught is rarely rooted in fact. Medical dogma is passed down from physician generation to physician generation, and we hold the responsibility to our colleagues and patients to ensure we understand the evidence and science behind each pearl.

4) **Come earlier to FOAM.** Most who read these blogs probably are already familiar with the open access medical education movement. The resources available online, particularly those united under the banner of "FOAM," (Free Open Access Meducation) offer an incredible wealth of information. I wasted too much of my didactic years with low-yield articles, searching for relevant material. The online resources help separate the wheat from the chaff, and make it easier for an eager learner to grow.

5) **An Ultrasound Rotation.** This one is more specific to certain residencies than others, but there's no doubt that the practice of bedside ultrasonography is rapidly becoming the standard of care. Proficiency in basic ultrasound studies is a force multiplier and a critical tool in the clinical exam, as well as a useful adjunct in certain procedures. There are many excellent electives in bedside ultrasonography, and given the chance again, I would readily take the time to increase my familiarity with the ultrasound probe.

6) **Remember what matters.** At the beginning of first year, I skipped a friend's wedding because of an exam early the next week. I wish I hadn't done that. Four years later, I can see that there will always be another hour for books and highlighters, but your best friends only walk down the aisle so many times.
Point-of-Care Ultrasound in Medical Education — Stop Listening and Look
Scott D. Solomon, M.D., and Fidencio Saldana, M.D.

In 1816, the French physician René-Théophile-Hyacinthe Laennec, inspired by children communicating by tapping a pin on one end of a long piece of wood and listening at the other end, rolled a “quité” of paper into a cylinder to listen to the heart of a sick young woman, instead of placing his ear directly on her bare chest. This improvised tool designed to protect a patient’s modesty evolved into the wooden instrument that eventually became the modern stethoscope. Nearly 200 years later, the stethoscope is unique among medical devices in that it is used by virtually every type of physician and, with the exception of electronic versions offering amplification and filtering, has changed minimally in style and technology. A fixture around the necks of physicians and medical students, it endures as an icon of our profession.

Yet during the past 50 years, diagnostic ultrasonography has replaced auscultation as the primary method of evaluating the mechanisms of the heart and perceiving into the abdomen, vasculature, and uterus without exposing patients or fetuses to ionizing radiation. In cardiovascular medicine, echocardiography is the most used and cost-effective imaging method, despite the development of many other powerful new technologies. Ultrasound machines were once uniformly bulky, cart-like devices that were rolled awkwardly around hospital wards and into cramped patient rooms, but they have shrunk drastically with the advent of faster microprocessors and improvements in miniaturization. Now, fully functional ultrasound machines are available in the form of laptop computers, and devices with slightly reduced functionality that are not much bigger than a smartphone fit in clinicians’ pockets or palms (see photo). Moreover, as these devices become less expensive — they’re currently priced under $10,000 — they’re becoming more accessible to physicians and specialists beyond radiologists and cardiologists.

Despite some protectionist attempts to restrict the use of new imaging technologies to professionals with comprehensive training, the broadening use of these devices has served to denaturalize and universalize ultrasonography.
This trend has been led by emergency physicians, whose training now includes basic abdominal, cardiac, and obstetrical ultrasound exams, as well routine use of ultrasonography for procedures such as catheter placement. Intensivists and anesthesiologists have also begun using point-of-care ultrasound devices in intensive care units.

Carefully performed clinical studies have shown that diagnostic ultrasonography can be superior to the physical exam. In one study, first-year medical students using point-of-care ultrasound outperformed board-certified cardiologists using bedside cardiovascular physical examination in identifying cardiac abnormalities, identifying 75% of conditions, as compared with 49% identified by the cardiologists.2 Another study showed that medical students using point-of-care ultrasound more accurately estimated liver size than did board-certified interns performing a physical examination.3 The few studies specifically evaluating handheld devices have generally shown that the information obtained was accurate, though dependent on the operator's skill.4 As the use of and training in point-of-care ultrasound has grown in medical specialty residencies, medical schools have begun asking whether ultrasound training should be part of standard undergraduate medical education, both as a teaching tool and as a way to instill a diagnostic skill. Direct visualization of organs by ultrasound, correlated with cadaveric examination, atlases, or other imaging modes, can be a powerful adjunct to the traditional teaching of anatomy, physiology, and physical diagnosis. But the use of this technology as a diagnostic extension of the physical exam may represent a transformative change for medical training.

Several U.S. medical schools, recognizing its potential value, now offer ultrasound training early in the undergraduate curriculum. At the University of South Carolina and the University of California, Irvine, ultrasound training now begins during orientation; the technology is then used in classes in anatomy and physiology during the first year and is incorporated into physical diagnosis, problem-based learning, and eventually clinical rotations. Other medical schools have followed suit. This past year, Harvard Medical School introduced a pilot ultrasound curriculum designed to integrate ultrasound into the teaching of physical examination, in which students perform ultrasound and physical exams on their peers and correlate their findings. The Icahn School of Medicine at Mt. Sinai started an extensive, standardized program in ultrasound technology.

"Forty handheld ultrasound units were made available for use by 140 entering students," according to Jagat Narula and Bret Nelson, who direct the program, "with the expectation that all students will be proficient in identifying normal anatomy during the first year and will be able to differentiate between normal and abnormal in the subsequent years." Mt. Sinai has also distributed handheld units to all the internal medicine interns rotating through various intensive care units and is developing algorithms for the differential diagnosis of presenting symptoms. Although each institution will evaluate students' competence with the technology—at the University of South Carolina, for instance, students are observed performing a 15-minute series of ultrasound scans—widespread incorporation of ultrasonography into the physical examination for the next generation of physicians will most likely require rigorous assessment of the technology's benefit and the reporting of results.

Two major developments need to converge before point-of-care ultrasound is likely to replace the stethoscope. The first is technological: these devices will need to be even smaller and more ergonomic and may need to gain additional functionality, such as the ability to amplify lung or bowel sounds. Second, a generation of physicians will need to be trained to view this technology as an extension of their senses, just as many generations have viewed the stethoscope. That development will require the medical education community to embrace and incorporate the technology throughout the curriculum.
There are, however, several challenges to widespread adoption of point-of-care ultrasound in medical school training. Most new medical technologies tend to be reserved for subspecialists, who then train others in a top-down manner. If medical students begin learning to use this technology, they may show up on rounds feeling more empowered than their teachers, who at best will need to be trained in the new techniques but at worst may resist their adoption. Other practical issues, such as whether findings should be recorded in a hospital’s picture archiving and communication system (PACS) and whether physicians should be allowed to bill for these procedures, also require consideration. Most experts believe that these limited exams will serve as screening tools, much as auscultation does currently, but will not substitute for formal ultrasound examinations.

Not everyone agrees that sophisticated imaging devices should be put in the hands of every medical student, intern, and resident. The risk of misdiagnosis is high when diagnostic ultrasound is used by inexperienced practitioners. The amount of training required to perform a competent ultrasound examination is not trivial. Cardiology fellows with a strong background in cardiac anatomy, physiology, and pathophysiology typically require 4 to 6 weeks to learn the basic echocardiographic examination. Although medical students trained in ultrasonography may be able to make relatively crude diagnoses — determining whether ventricular function is normal or reduced, assessing vena cava size, or detecting gallstones — more sophisticated anatomical assessment will require substantially more training. False positive findings may lead to additional and often unnecessary testing, and false negatives may provide unwarranted reassurance and result in undertreatment, especially since greater faith in “high tech” information may lead to the exclusion of other data. A further concern is that these devices distract students from the core principles of physical diagnosis, especially if introduced early in training, and will interpose another layer of technology between doctor and patient.

Such apprehensions have always accompanied the introduction of new medical technologies. In his preface to the English translation of Laenec’s “A Treatise on the Diseases of the Chest and on Mediastinal Auscultation,” John Forbes wrote, “Notwithstanding its value, I am extremely doubtful, because its beneficial application requires much time, and gives a good deal of trouble both to the patient and the practitioner.” Any new technology requiring training and expertise is met with similar skepticism will depend on whether training in its use becomes standard for future physicians and whether placing these devices in their hands is shown to improve medical practice at the point of care.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

From the Cardiovascular Division, Brigham and Women’s Hospital and Harvard Medical School, Boston.


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How To Choose Ultrasound Equipment For Training Medical Students

John S. Pellerito, M.D. FACR, FAIUM, FSRU

The choice of ultrasound equipment for training medical students depends on multiple factors. The size of the ultrasound class, budget and space requirements are some of the considerations for the type of ultrasound unit to be considered. The goals of the program should also be taken into account when deciding on an ultrasound machine. Will the unit be used for a single application or will it be used to train students in multiple applications including cardiac, vascular and abdominal studies? Ultrasound units will differ in their utility and flexibility.

Compact or portable ultrasound units may prove to be the best choice for multiple reasons. Since they are portable, they can be carried to different educational venues including the classroom or anatomy lab, bedside, simulation center or clinic. Portable units tend to be less expensive than full-size all-purpose units found in hospital radiology or cardiology departments. They also will have a simpler interface for beginners in ultrasound training.

The optimal ultrasound unit must have satisfactory temporal and spatial resolution so that anatomic detail is not sacrificed in favor of size or price. Be sure to involve ultrasound experts and faculty from your institution in this decision so that adequate sonographic quality is guaranteed. “Pocket” ultrasound units that are currently available may not be the best choice for training students since they do not have sufficient quality for multiple applications. They also do not allow teaching of image formation since they do not include controls and functions for these purposes. Simple control functions including image gain, depth, focal zone control and frequency range are necessary for teaching “knobology” and image optimization. In addition, these simple units do not have adequate color and pulsed Doppler capability or noise suppression.

The number of units will depend on the size of the ultrasound class. This will depend on how many students will train on the unit at any given time. Optimal student to ultrasound unit ratio is 3-5:1 although some schools will have 1 unit per 10 students.

All major ultrasound vendors should be invited to “partner” with the school or university. Discussions with vendors should include the type of ultrasound configuration required. Vendors with experience with other medical school programs will be able to assist in choosing an appropriate unit and configuration. The configuration will depend on the types of applications or exam types that will be performed. A set of transducers will also be chosen depending on the number of applications. Once the configuration is established, pricing for the package becomes the critical issue.
The package should include applications support for teaching faculty how to use the ultrasound unit. Multiple sessions are usually required for training faculty on a new ultrasound device. Applications specialists can be very helpful in setting up the unit and connecting to PACS and classroom monitors. Many of these applications specialists have teaching experience and enjoy exploring different exam types with faculty to facilitate comfort with the unit. Device service and maintenance should also be included. Some vendors also offer image storage and management or PACS solutions and software for image transmission. A list of ultrasound vendors can be found in the Equipment section of this portal.

Other options for obtaining equipment for a new ultrasound curriculum include the purchase of used equipment or borrowing equipment from another area or department. Used equipment may be available from vendors and any discussion should include terms of warranty and maintenance. Used equipment may be an important consideration for a program with a limited budget. For a fledgling program with no budget for ultrasound equipment, borrowing units from another department or area may be a consideration. Faculty from radiology, emergency medicine or cardiology may be able to work out terms to utilize existing equipment to train medical students. In a university setting, faculty and sonographers may have preexisting materials and lecture series that are used for training residents and fellows. These facilities may be able to incorporate medical students into their curriculum.

There are many steps to integrating ultrasound into a medical curriculum. Acquisition of ultrasound units is an important consideration requiring time and expertise in addition to faculty, space and budget. Many vendors offer experience and support for this endeavor. In addition, new programs can contact one of the volunteers or mentors associated with an existing program that is listed in the portal for assistance.
Medical school ultrasound education Frequently Asked Questions (FAQ’s)

Why should a medical school implement ultrasound training in their curriculum? If medical school is meant to train the next generation of clinicians, it is important to always consider those tools that are available at the bedside and make sure 21st century clinicians are able to use these tools.

Why start ultrasound training in medical school? The challenge of ultrasound has been operator dependency and the opportunity for repeated exposure to learning ultrasound can augment medical student’s understanding of anatomy, physiology and approach to clinical problems at the patient’s bedside.

Do medical students enjoy using ultrasound? Medical students, like most people, enjoy getting their hands on technology and visualizing structures that remain hidden from view by surface anatomy.

How can medical students be expected to master performing ultrasound with a busy curriculum already full of material for them to learn? Many students who utilize ultrasound state it helps them to understand anatomy and cross sectional relationships along with understanding key physiologic principles. Many state it augments their understanding.

Are there programs that have implemented ultrasound in medical school? Yes, the literature is full of projects involving medical students and some schools such as Wayne State, University of South Carolina, Ohio State, and University of California Irvine have developed robust medical student ultrasound programs.

How does one start an ultrasound program within medical school? There is not a prescriptive path that fits every medical school. It usually begins with a point person or champion that advocates for implementing ultrasound into the curriculum and building a program one piece at a time.

Are there barriers to implementing an ultrasound program in medical schools? Apathy is the biggest barrier, along with time investment, money for salary support, equipment accrual, faculty support, and an already crowded curriculum.

Why should a dean of a medical school embrace the thought of ultrasound in medical education? Deans trying to coordinate a competitive advantage should picture the future of health care and wonder… 10-20 years in the future, will ultrasound be more used or less used? Will more physicians be using these tools in medical centers, the third world, and austere environments? Will the risk-benefit cost of expensive, potentially harmful modalities such as computed tomography be as prevalent in the future of health care or will ultrasound be more prevalent? Thoughtful questions about patient safety,
cost of screening and early diagnostic benefits of ultrasound should be considered when shaping the curriculum for future clinicians over the next 2 decades.

**What is the Ultrasound First movement?** Ultrasound first is an educational campaign launched by the AIUM to highlight the benefits of early ultrasound as safe, affordable and effective.

**I thought ultrasound was only used to look at babies. Can physicians in other specialties use this modality?** The capability of ultrasound equipment to transmit sound energy into the human body and produce images has been explored by physicians of multiple specialties to use in the care of their patients. The *New England Journal* article “Point of Care Ultrasound” (*NEJM* 2, 2011) delineates the use of ultrasound in most medical specialties.

**How could ultrasound be used to replace the traditional methods of medical education?** The best way to integrate ultrasound is not to replace previous educational methods but augment and facilitate the medical education process.

**How can ultrasound be used in the teaching of medical education principles?** Clinical correlations from patient screening, procedural guidance, and undifferentiated patient presentations are important ways to highlight how bedside ultrasound can be used to manage the clinical needs of patients in multiple settings.