



UNIVERSITY OF SOUTH CAROLINA

School of Medicine

The Integrated Ultrasound Curriculum (iUSC)

First Year (M1)

Orientation week – before classes begin

1. Small group introductory ultrasound session
 - Basic instrumentation and knobology
 - Image orientation
 - Hands-on scanning of neck vessels

All education material available to students online throughout all four years: learning modules, videos, laboratory handouts and notes.

Fall Semester - in conjunction with Gross Anatomy

1. Introduction to cardiac ultrasound (laboratory session)
 - Parasternal long axis view (PLAX) - B-mode only; identification of heart chambers, valves, review screen orientation and image orientation marker location, knobology, depth, focus, frequency, gain adjustments
2. Neck ultrasound (laboratory session)
 - Carotid artery – B-mode and color flow mode – trace from common carotid to bifurcation, transverse and longitudinal views, basic principles of color flow Doppler
 - Internal jugular vein – B-mode and color flow mode; anatomic differences of internal jugular vein and carotid artery, shape, vessel wall, collapsibility, perform valsalva
 - Thyroid gland – B-mode; thyroid (both lobes and isthmus); echotexture, nodules, cysts, measurements, label structures, thyroid lobe volume estimation
3. Kidney and bladder ultrasound (laboratory session)
 - Urinary bladder – B-mode; identify bladder, measure bladder volume, note artifacts like posterior acoustic enhancement
 - Ureteric jets – Color flow mode; test of total ureteric obstruction
4. Right and left upper quadrants (laboratory session)
 - Liver, gall bladder, right/left kidney, Morison's pouch, diaphragm, and right costophrenic angle – B-mode
5. Introduction to musculoskeletal ultrasound – the knee (laboratory session) – B-mode

- Anterior longitudinal suprapatellar view – patella, quadriceps tendon, femur, suprapatellar bursa
- Suprapatellar tranverse flexed knee view - quadriceps tendon, femoral condyles, articular cartilage
- Infrapatellar longitudinal view – patellar ligament, fat pad, tibia
- Anisotropy artifact

6. Ultrasound OSCE – proper transducer selection, preset selection, probe orientation, scan and identify right kidney/liver/Morison’s pouch, left kidney/spleen, PLAX of the heart, carotid/internal jugular; student is also evaluated on their interaction with the standardized patient

Spring Semester – in conjunction with Physiology

1. Introduction to vascular ultrasound -vascular hemodynamics (laboratory)

- Common carotid artery analysis
 - B-mode – transverse and longitudinal views
 - Color flow – direction of flow
 - Spectral Doppler/Pulse wave – measure velocity, Peak Systolic Velocity (PSV), End Diastolic Velocity (EDV), arterial and venous pulse wave forms

2. Heart ultrasound – hemodynamics (laboratory)

- Apical 4 chamber view (B-mode and color flow mode) – wall motion, valve motion, cardiac cycle with color flow

3. Heart Sounds and ECHO (laboratory)

- Students work in pairs – one captures PLAX view showing both the aortic valve and mitral valve while other student listens with stethoscope and notes relationship of heart sounds and valve closure. Students then reverse roles.

4. Cardiogenic shock – cardiac views: PLAX, apical 4-chamber, subcostal (laboratory session)

- Cardiomyopathy – assess wall motion and shape of the left ventricle (LV) during cardiac cycle
- Cardiac tamponade – assess for pericardial effusion, the right ventricle (RV) size and compression with cardiac cycle
- Pulmonary embolism – assess for RV strain: size and compression with cardiac cycle; assess RV and right atrium (RA) for thrombosis

Spring Semester – in conjunction with Neuroanatomy

Brain and cranial nerves (presentation and demonstration)

- Ultrasound measurement of optic nerve sheath diameter for assessment of increased intracranial pressure
- Ultrasound assessment of direct and consensual pupillary light reflex
- Ultrasound assessment of ocular movement for patients with marked orbital swelling

Spring Semester – in conjunction with Introduction to Clinical Medicine

Problem Based Learning (small group discussion) – ultrasound relevant cases such 20 year old student who collapses during a basketball game – family history of sudden death and physical examination reveals a murmur – evaluation includes ECG, chest x-ray, and ECHO show hypertrophic cardiomyopathy

Second Year (M2)

Fall Semester – in conjunction with Introduction to Clinical Medicine (ICM)

1. Cardiac ultrasound - standard cardiac views (laboratory session)

- Parasternal long and short axis views, apical 4 and 5 chamber, subcostal; assess chambers, valves, wall thickness and motion
3. General abdomen (laboratory session)
 - Liver, gall bladder, kidneys, spleen, urinary bladder; identify structures and measure organ size
 4. Abdominal Aorta and Inferior Vena Cava (IVC) assessment (laboratory session)
 - AAA screening; transverse and longitudinal, B mode, color flow and pulse wave, three measurements, characteristics that differentiate aorta from IVC
 - IVC – B mode and M Mode, measurement and IVC collapsibility index
 5. Lower extremity venous ultrasound (laboratory session)
 - Rule out deep venous thrombosis (DVT) in femoral, saphenofemoral junction, and popliteal vein – 2 point/level compression test, color flow Doppler, normal phasic venous flow, non-phasic venous flow, venous flow augmentation

Fall Semester – in conjunction with Pathology

Ultrasound images incorporated into lectures and small group clinicopathologic sessions to demonstrate pathologic and ultrasound correlates and enhance the transfer of pathology knowledge to the clinical diagnostic arena - many topics and images

Fall Semester – Physical Diagnosis Pilot (2014)

Small group physical diagnosis hands-on sessions – seventeen ultrasound components used to improve physical examination skills and enhance the accuracy of the physical examination – systems included: cardiovascular, pulmonary, abdomen, nervous system, ocular, and musculoskeletal

Spring Semester – in conjunction with ICM

1. Female pelvic ultrasound - transabdominal (laboratory session)
 - Uterus, ovaries, pouch of Douglas, endometrium
2. Abdomen review and Pancreas ultrasound - (laboratory session)
 - Upper abdominal vascular structures and transverse view of the pancreas – B mode – identify anatomical segments of the pancreas and normal echotexture
3. Ultrasound guided procedures (laboratory session with ultrasound phantoms)
 - Central venous access (Internal jugular vein)
 - Pleural effusion detection and pleurocentesis
 - Ascitic fluid/free fluid in peritoneal cavity - detection and paracentesis
4. Assessment of patient with undifferentiated shock (laboratory session)
 - **RUSH** protocol: **R**apid **U**ltrasound for **S**hock/**H**ypotension – assess LV function, rule out pericardial effusion/tamponade, assess for RV strain from pulmonary embolus (PE), volume status from IVC size and dynamics, scan abdomen and pelvis for free fluid, assess lungs for pneumothorax and pulmonary edema, assess aorta for rupture, assess femoral vein for DVT
5. Ultrasound OSCE

Ultrasound OSCE station as part of an end-of-year comprehensive clinical skills OSCE. Each student conducts a focused history and physical examination on a standardized patients with one of three possible

clinical scenarios then performs two corresponding ultrasound examinations: urinary bladder and abdominal aorta, renal/diaphragm and thyroid, cardiac and femoral vein.

Spring Semester – in conjunction with Pathology

Ultrasound images incorporated into lectures and small group clinicopathologic sessions to demonstrate pathologic and ultrasound correlates and enhance the transfer of pathology knowledge to the clinical diagnostic arena - many topics and images

Spring Semester – in conjunction with Introduction to Clinical Medicine

Problem Based Learning (small group discussion) – ultrasound relevant cases such as pregnancy with heart failure due to rheumatic heart disease – ECHO with mitral stenosis, chamber enlargement and “hockey-stick” mitral valve leaflet, lung ultrasound with B lines, fetal ultrasound

Open ultrasound labs

- During the first two years (M1 and M2) open laboratory sessions are held weekly during a time when no other classes are scheduled. Students are encouraged to come in pairs or small groups and practice their ultrasound skills on each other. At least one ultrasound faculty member is available to help with scanning and answer questions.

Third Year (M3)

Clinical Rotations include clerkship specific ultrasound instruction – internal medicine, family medicine, pediatrics, surgery, obstetrics and gynecology. Instructional methods include image review sessions, bedside ultrasound rounds, independent and supervised patient scanning, simulation center ultrasound sessions, Ultrasound Institute scanning sessions, specialty and subspecialty ultrasound observation.

Objective Structured Clinical Examinations (OSCE) are administered at the end of the clerkship – below are some of the OSCEs that have been used over the nine years.

1. Internal Medicine

- Thyroid ultrasound – patient with a “lump in the neck”, after the focused history and physical exam, each student must properly scan the thyroid and identify and measure a thyroid cyst
- Septic patient who needs central line placement for intravenous access

2. Family and Preventive Medicine

- Abdominal aortic aneurysm (AAA) screen - elderly patient with risk factors for AAA, student must discuss the procedure with the patient, perform the ultrasound examination, discuss results, and educate the patient about AAA
- Musculoskeletal ultrasound in a patient with joint pain

3. OB/GYN

- Two OSCE stations with previously captured images of findings that were covered with students during the rotation in observational and hands-on ultrasound learning sessions.
- OB ultrasound exam – patient is 27 weeks pregnant with a history of vaginal bleeding, student must perform an obstetrical ultrasound and determine fetal number, heart rate, placental location, and fetal position

4. Pediatrics

- Assess soccer player who has “passed out twice during practice” – PLAX view with appropriate measurements for assessment of hypertrophic cardiomyopathy

- Assess volume status / dehydration – 9 year old with history of nausea/vomiting and poor oral intake, student must assess volume status using the aorta/inferior vena cava ratio
- Interpretation of lung ultrasounds of a case of bacterial pneumonia with air bronchograms and pleural effusion

5. *Surgery*

- Assess a trauma patient using the FAST exam (**F**ocused **A**bdominal **S**onography for **T**rauma) – each student must scan a patient for trauma and demonstrate Morison’s pouch, spleen/kidney interface, urinary bladder, sub-xiphoid view of the heart

One-week M3 Selectives

- Emergency Medicine – supervised instruction and scanning of important emergency medicine ultrasound protocols, image review sessions, online emergency medicine ultrasound learning modules
- Critical Care Medicine - supervised instruction and scanning in the intensive care unit for assessment of volume status, heart function, pneumothorax, and other important critical care scans

Ultrasound Pocket Devices on Primary Care Clerkships (Internal Medicine, Family Medicine, Pediatrics)

- While on primary care clerkships students are issued pocket ultrasound devices for use and are encouraged to capture images from the heart, abdomen, and pelvis for submission and review at the end of the rotation.

Ultrasound M3 Gate OSCE

- All students at the end of the M3 year are required to complete a Gate OSCE that assessing a student’s readiness to progress to the M4 year. An ultrasound station is included.
- Assessment includes capturing a PLAX view of the heart and a longitudinal view of the inferior vena cava with a pocket ultrasound device to assess for heart function and volume status
- Students must evaluate cardiac and IVC ultrasound loops on a laptop computer for overall heart function, pericardial effusion, and volume status

Fourth Year (M4)

- Four week emergency medicine ultrasound elective – online emergency medicine ultrasound learning modules, supervised instruction and scanning of emergency medicine patients and image review, a minimum of 10 eFAST examinations is required.
- Traditional Radiology elective with and ultrasound component that includes ultrasound learning modules, image review and “hands-on” ultrasound sessions focused primarily on guided procedure skill development
- Ultrasound Independent Study Month – work with ultrasound faculty and fellows to expand knowledge and skill in ultrasound. Includes scanning and ultrasound simulation, assisting with M1 and M2 ultrasound labs, participating in original research, and preparation of a 30 minute presentation on a ultrasound topic of their choosing
- Two day Capstone ultrasound course offered at the end of the 4th year – stresses ultrasound skills most important for students as they prepare for internship (ultrasound guided procedures, FAST exam, RUSH exam, lung ultrasound and soft tissue ultrasound to differentiate abscess and cellulitis).
- M4 acting internships – students on acting internships have been offered pocket ultrasound devices when available