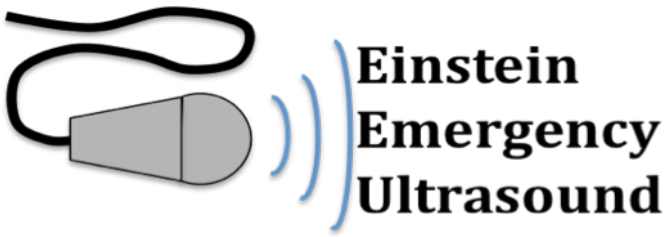

Emergency Ultrasound Rotation Manual
2020-2021

Einstein Healthcare Network
Department of Emergency Medicine
Division of Emergency Ultrasound

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1) Introduction to the Ultrasound Rotation

Welcome to Ultrasound!

a. Background and Educational Goals

The goal of this rotation is to provide you with the knowledge base and skills to use point-of-care ultrasound (POCUS) to enhance your practice as an emergency physician.

The American College of Emergency Physicians (ACEP) approved a policy statement that defined the goals, scope of practice, and appropriate training and credentialing for the use of ultrasound by emergency physicians. These guidelines are widely accepted as the criteria for proficiency in emergency ultrasound.

The Einstein US curriculum adheres to the ACEP guidelines. As such, when you successfully complete your residency, your future employer will likely grant your privileges to perform (and bill for) your ED-performed ultrasounds, without supervision and without radiology confirmation. Per the ACEP guidelines:

> "Typically, emergency ultrasound is a goal-directed focused ultrasound examination that **answers brief and important clinical questions** in an organ system or for a clinical symptom or sign involving multiple organ systems. Emergency ultrasound is synonymous with the terms bedside, point-of-care, focused, clinical and physician performed. Emergency ultrasound is complimentary to the physical examination but should be considered a separate entity that adds anatomic, functional, and physiologic information to the care of the emergent patient.
>
> Emergency **ultrasound is an emergency medicine procedure**, and should not be considered in conflict with exclusive "imaging" contracts seen with consultative ultrasound.
>
> Emergency ultrasound is performed, interpreted, and integrated in an immediate and rapid manner dictated by the clinical scenario. It can be applied to any emergency medical condition in any setting with the limitations of time, patient condition, operator ability, and technology limitations."

In 2012, both the American Board of Emergency Medicine (ABEM) Board of Directors and Residency Review Committee (RRC) listed ultrasound as one of the 24 milestones that should be achieved by graduates of an EM residency. Thus gaining proficiency in ultrasound is now a necessary component of successfully completing a residency in emergency medicine. During this block, it is the goal of the residency program and the US faculty to provide education that meets and exceeds the guidelines and positions of ACEP, ABEM, and the RRC. There are two important components to achieving proficiency in point-of-care ultrasound:

- Acquiring the technical skills required to obtain the required images
- Acquiring a clinical understanding of how to interpret the acquired images and incorporate them into your clinical care

Duties and Requirements

This four-week block is designed to allow you to obtain the core knowledge base, bedside image acquisition skill, and image interpretation skill to competently perform point-of-care ultrasound (POCUS).

- **Perform 140 adequate ultrasound studies.** Refer to the "Required Views" section of your US manual.
- **US Image of the Month - In order to incorporate evidence-based medicine into your ultrasound rotation, each resident will be asked to select an image that you find particularly unique or educational that can be shared with the rest of the department. This will be presented during Wednesday Resident Conference in the form of a PowerPoint and submitted as a case write up. (See Example)**
- **US Journal Club – Participate and present 1 US journal article during monthly ultrasound journal club. The date and article will be assigned in advance.**
- **Complete end of rotation ultrasound examination**

Schedule:

Mornings: Toxicology

Afternoons: From 12:30pm-5pm, you are expected to be in the department doing ultrasound. This will either be by yourself or with an ultrasound-credentialed faculty member.

- **Thursday Afternoons are typically reserved for QA done virtually**

***Supervised Scanning Shifts:**

During your rotation, you will spend some of your afternoons working with US-credentialed EM faculty. These attendings will spend an afternoon to work with you to teach you the hands-on component of US image acquisition and interpretation.

The bulk of your time should then be spent scanning patients together in the ED. Advance preparation is key so you can maximize your scanning time! Ensure that you are able spend adequate time across the breath of ultrasound topics.

***Ultrasound QA**

During the course of your rotation, you will participate in ultrasound QA sessions, where you will meet with the ultrasound faculty to review your images and discuss any questions that have come up during the week. **These will usually take place on Thursday afternoons and will take place via ZOOM or Microsoft Teams**

Elective Opportunities:

PGY-3 and PGY-4 residents have the opportunity to participate in an Ultrasound Elective as part of their elective time. These rotations will be approximately 2-3 weeks.

Personal learning objectives should be discussed with the Ultrasound Director prior to starting the elective. During the elective, you will be expected to participate in both supervised and independent scanning shifts, read assigned supplemental material, and attend lectures/QA sessions that take place during your elective time.

Ultrasound Study At Home Curriculum

1) **Online US Text:** Introduction to Bedside Ultrasound Volumes 1 and 2 by Matt Dawson and Mike Mallin available through Apple iBooks

2) **SonoSite Institute:** This resource has several web based courses that should be completed during your US Rotation to supplement your ED scanning

Website: Sonositeinstitute.com/courses

Username: guptanee@einstein.edu

Password: einstein

Other Websites:

1) CoreUltrasound.Com -> Provides Access to 5min Sono and Ultrasound Podcast
2) ThePocusAtlas.Com -> provides access to US Images/Videos

Week 1

1. **Gallbladder**
    a. Text Volume 2 Chapter 15: RUQ
    b. http://5minsono.com/gb/
    c. Ultrasound Podcast
        i. Episode 35 – Gallbladder Ultrasound
        ii. Episode 144 – Gallbladder Ultrasound
    d. SonoSite Institute – Gallbladder

2. **Renal**
    a. Text Volume 1 Chapter 6: Renal
    b. http://5minsono.com/hydro/
    c. http://5minsono.com/bladder-vol/
    d. Ultrasound Podcast
        i. Episode 27 – Renal Ultrasound
        ii. Episode 131 and 132 – Renal Ultrasound

3. **First Trimester Pregnancy**
    a. Text Volume 1 Chapter 7: Pregnancy
    b. http://5minsono.com/fhr
    c. Ultrasound Podcast
        i. Episode 88 – Pregnancy Ultrasound Part 1
        ii. Episode 89 – Pregnancy Ultrasound Part 2
    d. SonoSite Institute – Pelvic First Trimester Preg

Week 2

4. **Echo**
    a. Text Volume 1 Chapter 2 Basic Cardiac
    b. http://5minsono.com/heart_views/
    c. http://5minsono.com/cardiacfunction5minvid/
    d. http://5minsono.com/per_eff/
    e. http://5minsono.com/rhf/
    f. Ultrasound Podcast
        i. Episode 28 – Cardiac Ultrasound
        ii. Episode 7 – Abnormalities on Echo
        iii. Episode 63 – Pericardial Tamponade
        iv. Episode 174 – Cardiac Ultrasound Cases
    g. SonoSite Institute – Cardiac Imaging 1
    h. SonoSIte Institute – Cardiac Imaging 2

5. **Lung**
    a. Text Volume 1 Chapter 4: Lung
    b. http://5minsono.com/b-lines-new/
    c. http://5minsono.com/pleuraleffusions/
    d. www.coreultrasound.com/pneumothorax/
    e. www.coreultrasound.com/how-to-perform-a-pulmonary-exam/
    f. Ultrasound Podcast
        i. Episode 139 – Airway and Pulmonary Ultrasound in Trauma
        ii. Episode 179 – Lung Ultrasound with Vicki Noble
        iii. Episode 134 and 135 – Lung Ultrasound
    g. SonoSite Institute – Lung Ultrasound

6. **EFAST**
    a. Text Volume 1 Chapter 1: FAST/eFAST
    b. http://5minsono.com/efast/
    c. http://5minsono.com/ptx/
    d. Ultrasound Podcast
        i. Episode 177 – EFAST
        ii. Episode 186 – FAST Exam Update
    e. SonoSite Institute – EFAST

Week 3

7. **Aorta**
    a. Text Volume 1 Chapter 3:Aorta
    b. http://5minsono.com/aaa/
    c. http://5minsono.com/ad/
    d. Ultrasound Podcast
        i. Episode 169 – Aorta Ultrasound
    e. SonoSite Institute – Aorta

8. **DVT**
    a. Text Volume 2 Chapter 12 DVT
    b. http://5minsono.com/dvt1/
    c. Ultrasound Podcast
        i. Episode 150 and 151 – DVT Ultrasound
    d. SonoSite Institute – Deep Vein Thrombosis

9. **RUSH**
    a. Text Volume 1 Chapter 1: Rush
    b. http://5minsono.com/rush/
    c. SonoSite Institute – Rush

Week 4

10. Ocular

a. Text Volume 2 Chapter 16 Ocular
b. http://5minsono.com/rdvd/
c. Ultrasound Podcast
    i. Episode 26 – Ocular US
d. SonoSite Institute – Ocular Ultrasound

11. MSK/Soft Tissue

a. Text Volume 2 Chapter 11 Musculoskeletal Basics
b. www.coreultrasound.com/cellulitis-vs-abscess/
c. Ultrasound Podcast
    i. Episode 181 - MSK Ultrasound

12. Bowel (SBO and Appendix)

a. Text Volume 2 Chapter 13 – Appendicitis
b. Text Volume 2 Chapter 14 – Small Bowel Obstruction
c. http://5minsono.com/appy/
d. http://5minsono.com/sbo/
e. Ultrasound Podcast
    i. Episode 36 – Small Bowel Obstruction

13. Procedural Ultrasound

a. Text Volume 2 Chapter 9 Procedures
b. Text Volume 1 Chapter 9 Central Lines
c. http://5minsono.com/cvc/
d. http://5minsono.com/para/
e. http://5minsono.com/fb/
f. SonoSite Institute – PIV Access, US Guided Paracentesis, Thorocentesis

2) Using the Ultrasound Machine

The Einstein Emergency Departments have multiple machines.

1) *Einstein Main Campus* – 3 Sonosite X-Portes, 1 Mindray M9, 2 Mindray TE7, 1 Butterfly IQ
2) *Einstein Montgomery* – 1 Sonosite X-Porte, 1 SonoSite M Turbo
3) Einstein Elkins Park – 1 Sonosite M-Turbo, 1 Sonosite X-Porte, 1 Zonare

Sonosite X-Porte

Mindray TE7

Mindray M9

a. Scanning Modes

M Mode – records activity on one point of screen over time (e.g. for pneumothorax or cardiac exams)

Doppler – also known as "spectral Doppler". Shows Doppler flow as a waveform

Color – shows Doppler flow as color

2D – also known as "B-mode", is the most commonly used scanning mode. Displays a basic black and white, real time image.

b. Probe Selection

Ultrasound imaging is based on the physics of sound waves. When electrical energy is applied to piezoelectric crystals within the ultrasound probe/transducer, high frequency sound (*ultra*sound) waves are produced. The sound wave bounces off objects in its path and returns to the transducer, creating an "echo". After the transducer receives the reflected echo, the wave is converted back into electrical energy that the ultrasound machine interprets as an image.

Most machines today provide you with the option to use multiple transducers. Each transducer employs different frequencies (frequency ranges for a given transducer are fixed) and has a different scanning "footprint". In this way, each transducer type is optimized for specific indications

Linear Array Probe:

The linear array probe (or "vascular probe") is designed for superficial imaging. It is a higher frequency probe (between 6 and 13 MHz) that allows for better resolution, but less depth of penetration. It is ideal for vascular access, soft tissue, and small part (e.g. ocular, testicular) examinations. It may also be used for regional nerve blocks.

Curvilinear Probe:

For deep scanning, most operators choose a curvilinear probe (or "abdominal probe"). This probe has frequencies ranging between 2 to 5 MHz, giving it the capability of scanning to deeper depths. The drawback of this capability is that it must sacrifice resolution compared to other probes. Within this probe, the crystals are aligned in a curved position allowing for a fanning out of the beam as it penetrates deeper into the tissue, providing a wider view of the subject. These probes are often ideal for evaluating the abdomen and pelvis (i.e. FAST, AAA, renal, gallbladder).

Intracavitary Probe:

The intracavitary probe is designed for ultrasound evaluation of the female pelvis. In most cases in the ED, this translates to first-trimester obstetric complaints. Similar to the curvilinear probe, this probe has a curved face, producing a view of almost 180 degrees. This probe has a higher frequency than the curvilinear probe, 5 to 8 MHz, providing better resolution. Because of its shape, the intracavitary probe can also be used for the ED evaluation of peritonsillar abscesses.

Phased Array Probe:

The phased array (or "cardiac") probe has a lower frequency (between 1 and 5 MHz) and a compact, flat footprint that makes it ideal for imaging within the thorax. Sound waves emanate from a single point, which allows the user to maneuver between the ribs and more easily view the heart. The phased array probe can also function at lower frequencies for viewing the abdomen and pelvis, and can function to perform similar exams as the curvilinear probe.

d. Performing Scans:

The ultrasound machines can and should be used on a daily basis to help diagnose and treat patients. However, it is important that you follow some basic guidelines which his will allow us to ensure that ultrasound is being properly used to evaluate patients, that your scans are technically adequate and accurately interpreted, and that we can provide you with appropriate feedback. It will also provide the necessary documentation for your personal ultrasound credentialing, for billing, and to improving future training.

Remember that while you are scanning, patient care should take priority. Before scanning a patient, please ask the attending if it is ok to perform the ultrasound on the patient at that time. Please make sure that you do not delay appropriate medical care while performing ultrasounds.

Always clean the ultrasound probes *before and after* using them to evaluate a patient. See "Machine Care and Maintenance" below. Wipe the probes and keyboard surface thoroughly using a Caviwipe (in the gray/white or red/white, "not baby wipe" tubs).You should always introduce yourself upon entering the room and make sure that the patient is OK with your performing the scan. When performing scans without an ultrasound attending present, you should inform the patient that the scan is for training purposes and that you may not be able to provide them with any medical information based on your scan alone. **Any potentially abnormal findings that you identify should be relayed to provider taking care of the patient**, so that they may be address accordingly.

In order to perform a scan (and receive credit for your ultrasounds):

1. Enter the following information in the ultrasound machine for every scan:

   - Patient's first and last name
   - Medical Record #
   - Your 3 initials under "User/Operator"
   - If you are performing the scan with another resident who also desires credit for the study, enter their 3 initials as well

2. Make sure that you record a complete examination that includes all of the required images for the given indication, as described in this manual.

3. You will need to *end the exam* –The ultrasound will not be able to wirelessly upload your images unless the exam is formally ended in this way.

d. Machine Care and Maintenance

Ensure that the transducers and user interface (keyboard) are cleaned before and after every use. They can be wiped down thoroughly using the Caviwipes (in the red/white or gray/white plastic tubs in each room, with the "not-baby-wipe" logo). If the probe is not clean enough to put on you, don't put it on the patient. Do not use these wipes on the screen. The screen can be cleaned with a water dampened 4x4 gauze and then dried off.

Be mindful of the ultrasound probes – these cost $5000-10,000 to replace! The probe must always either be in your hand, or secured in its holding cup on the machine (never leave on a patient's bed or dangling). Dropping a probe can damage the piezoelectric crystals within, and severely impair image quality. Also be mindful of the probe's cord. Running over the cord with the wheels of the machine can do a lot of damage, and can result in having to replace the whole transducer.

After using the ultrasound, return it to its designated "home". There is a home for each ultrasound: one in Pod A, in the supplies nook, just to the right of the trauma room; one in the small nook in the hallway between Pods B and C (below the cupboards where the sterile probe covers are kept); and one underneath the tall countertop in Pod C. Each home has an electrical outlet. Always ensure that the ultrasound is plugged in when not in use.

QPATH-E

Qpath™

QPATH allows for ultrasound image archiving and data management of ED-performed scans. When you complete your ultrasound study and "end exam", the images will automatically wireless upload to the QPATH server. After several minutes, you can retrieve and review your images, and create a worksheet that communicates your findings and interpretation.

QPATH is loaded onto all computers in the ED, and can also be pulled up on your phone, laptop, or tablet. Look for the "QPATH " icon on the desktop and double click it.

Log on using the username and password you use for your Einstein email. Contact your Ultrasound Director if you have any problems with your logon.

All Studies Must:

- **Labeled Correctly**
- **Have proper attending assigned to the study**
- **Have proper worksheet assigned**
- **Worksheets completed within 5 days**

3) Learning Objectives by Indication

By the end of your rotation, you will be expected to be able to describe each of the following (per the ACEP Emergency Ultrasound Guidelines):

a. Aorta

- Describe indications and limitations of focused ultrasound in the evaluation of abdominal aortic aneurysms
- Define the local relevant anatomy including the aorta with major branches, inferior vena cava, and vertebral bodies
- Understand the standard ultrasound protocol required when evaluating for abdominal aortic aneurysms
- Recognize the relevant focused findings and pitfalls when evaluating for abdominal aortic aneurysms.
- Types of aneurysms
- Measurement technique

b. Biliary

- Describe the indications and limitations of focused biliary tract ultrasound
- Define the relevant local anatomy including the gallbladder, portal triad, inferior vena cava, and liver
- Understand the standard ultrasound protocol when performing focused biliary ultrasound
- Recognize the relevant focused findings and pitfalls when evaluating for cholelithiasis and cholecystitis

c. Cardiac

- Describe the indications and limitations of focused emergency echocardiography
- Define the relevant cardiac anatomy including cardiac chambers, valves, pericardium, and aorta
- Understand the standard ultrasound windows (subcostal, parasternal, and apical) and planes (four chamber, long and short axis) necessary to perform focused echocardiography when evaluating for cardiac activity and pericardial effusions
- Recognize the relevant focused findings to detect cardiac activity and pericardial effusions with or without tamponade
- Estimate qualitative left ventricular function
- Estimation of central venous pressure through examination of inferior vena cava compliance
- Understand how ultrasound can allow the examiner to estimate cardiac function and central venous pressure to guide resuscitation in patients with cardiopulmonary instability
- Recognize a dilated aortic root and/or descending thoracic aorta
- Understand clinical relevance and potential pitfalls.

d. DVT

- Describe the indications and limitations of focused ultrasound for the detection of deep venous thrombosis
- Understand the standard ultrasound protocol when performing a focused exam for the detection of deep venous thrombosis of the upper and lower extremities:
    - Vessel identification
    - Compression
    - Augmentation
- Define the relevant local anatomy associated with ultrasonic detection of deep venous thrombosis in the upper and lower extremities.
- Develop an understanding of Doppler physics and instrumentation to include: Color Doppler, Power Doppler Imaging
- Recognize the relevant focused findings and pitfalls when evaluating for deep venous thrombosis.

e. FAST

- Describe the indications, clinical algorithms, and limitations of bedside ultrasound in blunt and penetrating thoracoabdominal trauma
- Define the relevant local anatomy including the liver, spleen, kidneys, bladder, uterus, pericardium, and lung bases
- Understand the standard ultrasound protocol required when evaluating for hemoperitoneum, hemopericardium, hemothorax, and pneumothorax
- Recognize the relevant focused findings and pitfalls related to the detection of hemoperitoneum, hemopericardium, and hemothorax
- Describe how volume status can be evaluated and monitored by evaluating left ventricular function and inferior vena cava compliance

f. Ocular

- Describe the indications and limitations of focused ultrasound of the ocular structures and orbit
- Define the relevant local anatomy associated with ultrasonic evaluation of eye and orbit structures
- Understand the standard ultrasound protocol when performing a focused exam for the detection of:
    - Posterior chamber hemorrhage
    - Retinal detachment
    - Other structural disruption
- Recognize the relevant focused findings and pitfalls when evaluating for ocular pathology

g. Pregnancy

- Describe the relevant local anatomy including the uterus, cervix, adnexa, bladder and cul-de-sac
- Describe the indications and limitations of focused sonography in first-trimester pregnancy pain and bleeding

- Understand the standard ultrasound protocol including transabdominal and endovaginal views when performing focused pelvic ultrasound in early pregnancy
- Understand the role of ultrasound and quantitative b-hCG in a clinical algorithm for first-trimester pregnancy pain and bleeding
- Understand the differential diagnosis of early pregnancy including intrauterine pregnancy, embryonic demise, molar pregnancy, ectopic pregnancy, and indeterminate classes
- Recognize the relevant focused findings and pitfalls when evaluating for early intrauterine pregnancy and ectopic pregnancy:
    - Early embryonic structures
    - Location of embryonic structures in pelvis
    - Findings of ectopic pregnancy
    - Pseudogestational sac
    - Adnexal masses

h. Renal (Urinary Tract)

- Describe the indications and limitations of focused urinary tract ultrasonography.
- Define the relevant local anatomy including the kidneys and collecting systems, bladder, liver, and spleen.
- Understand the standard ultrasound protocol when performing focused urinary tract ultrasound.
- Recognize the relevant focused findings and pitfalls when evaluating for hydronephrosis, renal calculi, renal masses, and bladder size

i. Soft Tissue and Musculoskeletal

- Describe the indications and limitations of focused ultrasound of soft tissue and musculoskeletal structures.
- Define the relevant local anatomy associated with ultrasonic evaluation of soft tissue and musculoskeletal structures to include:
    - Skin
    - Soft tissue
    - Bones
    - Muscle
    - Tendon
    - Lymph nodes
- Recognize the relevant focused findings and pitfalls when evaluating of the following:
    - Soft tissue infections (abscess vs. cellulitis)
    - Foreign body location and removal
    - Fractures
    - Tendon injury (laceration, rupture)
    - Joint identification (upper extremity, lower extremity)
    - Subcutaneous fluid collection identification

j. Thoracic (Pulmonary)

- Describe the indications and limitations of focused ultrasound of the thorax
- Define the relevant local anatomy associated with ultrasonic evaluation of thoracic structures
- Understand the standard ultrasound protocol when performing a focused exam for the detection of: pleural effusion, pneumothorax
- Recognize the relevant focused findings and pitfalls when evaluating for thoracic pathology

k. Vascular Access and Procedural Ultrasound

- Describe the indications and limitations when using ultrasound to assist in bedside procedures
- Understand the 2D approaches of transverse and longitudinal approaches to procedural guidance with their advantages and disadvantages
- Define the relevant local anatomy for the particular application
- Understand the standard protocols when using ultrasound to assist in procedures. These procedures may include:
    - Vascular access - central and peripheral
    - Abscess identification and drainage
    - Pericardiocentesis
    - Paracentesis
    - Thoracentesis
    - Foreign body detection and removal
    - Bladder aspiration
    - Arthrocentesis
    - Pacemaker placement and capture
- Recognize the relevant focused finding when performing ultrasound for procedural assistance

4) Required Views

Aorta — Required views	Pearls
1. Clip through the entire Aorta from subxiphoid process to aortic bifurcation 2. When possible, obtain measurements at: a. "Proximal" = above the SMA. May see celiac trunk, splenic vein, or liver. b. "Mid" = level at/below SMA / renal veins. No specific landmarks seen. c. "Distal" = Just proximal to bifurcation d. "Bifurcation" (if possible) = Split of aorta into 2 iliac arteries. Measure each iliac artery. 3. Longitudinal (sagittal) aorta: 1 clip 4. Must include at least 1 measurement of maximal diameter	• Landmarks of aortic branches may or may not always been seen • Measurements are made from outer wall to outer wall • Beware of missing a AAA by misidentifying a thrombus within the lumen, and measuring only the perceived "lumen" • Avoid missing saccular aneurysm or dissection flap by obtaining longitudinal views • In your interpretation, note presence/absence of AAA (aorta >3 cm) and iliac aneurysm (iliac artery >1.5 cm)

Biliary — minimum 3 views	
1. Gallbladder: 2 clips a. Longitudinal clips b. Transverse clips (with measurement of anterior GB wall) 2. Common bile duct: 1 view with measurement of CBD diameter	• GB wall measurement should be of the anterior wall in transverse view • Measure the CBD from inner wall to inner wall • When evaluating the CBD/portal triad, include a color Doppler image that demonstrates flow in the portal vein and hepatic artery, but no flow in the CBD • In your interpretation, make sure to note presence/absence of: - Gallstones - Sonographic Murphy's sign (localized tenderness over GB fundus) - GB wall thickening (>3-4 mm) - Pericholecystic fluid - CBD dilation (age dependent, but a CBD should generally be <4 mm)

<u>Cardiac</u> — minimum 4 **video clips** 1. Subxiphoid / Subcostal 2. Parasternal Long Axis (PSLA) 3. Parasternal Short Axis (PSSA) 4. Apical 4-chamber 5. ***IVC Measurement*** a. If applicable try to obtain a clip of the IVC to assess for respiratory variations.	<u>Pearls</u> • Please use the cardiac setting (hit "Exam" and choose "Cardiac") • If possible, record all basic cardiac views as stills and video clips • If you are unable to obtain all 4 views, please write a brief explanation in your SWS report • In your interpretation, note presence/absence of: - Pericardial effusion - Abnormal LV function

<u>DVT</u> — minimum 2 zones which can be captured as clips or in split screen. 1. <u>Greater saphenous vein (GSV)</u> branching from CFV a. Uncompressed b. Compressed c. Above and below entry d. <u>Femoral Vein</u> (Compress as you move down the leg) 2. <u>Popliteal vein (PV)</u> a. Uncompressed b. Compressed c. Trace to the level of the trifurcation **Following the course of the vein will increase sensitivity*** **Each leg counts as one study so you must start a new study for each leg, even if it is the same patient.**	• How much compression should you use? If the artery is seen to compress without the vein compressing, consider that a "non-compressible" vein. • <u>Obtain still images in split screen.</u> To activate split screen, hit "Dual" at the very top row of buttons, toward the right. To toggle between the two sides of the screen, hit "Update" • A clip can be recorded if there is a question about compressibility • In your interpretation, note the presence/absence of compressibility (and therefore DVT)

EFAST —	Pearls
1. Subxiphoid cardiac (PSLA is an alternative) 2. RUQ/Morison's pouch (liver, kidney) 3. LUQ/subphrenic (spleen, kidney) 4. Pelvic – 2 views (transverse and sagittal) 5 and 6. L and R diaphragm/thorax — to evaluate for hemothorax 7 and 8. L and R anterior thorax — Lung Sliding (Clip) - Optional M-mode to evaluate for pneumothorax	• Make sure you scan through the *entire* area/interface, and capture a still image that is representative of what you see • To look for hemothorax, start in the RUQ/LUQ views, and move slightly toward the head to see the diaphragm and pleural space above • To look for pneumothorax, look for pleural sliding between 2 anterior ribs. Document a "seashore" sign or "stratosphere" sign in M-mode. • In your interpretation, note the presence/absence of: - Free fluid in the peritoneum - Free fluid in the pericardium - Free fluid in the pleural space - Pneumothorax - Any other abnormal finding

Ocular — minimum 2 views	
1. Globe anatomy image (in transverse and sagittal) 2. Optic nerve sheath measurement *Only if clinically relevant	• Place a generous amount of gel on the closed eyelid – this allows you to "float" the probe above the eye to avoid placing pressure on the globe. • The optic nerve sheath is measured 3mm posterior to the optic disc. Normal diameter is <5mm in adults. • In your interpretation, note the presence/absence of: - Ocular pathology, e.g. retinal detachment, vitreous detachment or hemorrhage, lens dislocation, foreign body - Elevated optic nerve sheath diameter, indicating increased intracranial pressure (ICP).

Pregnancy — minimum 2 views
(Transabdominal or Transvaginal)

Transabdominal
1. Sagittal
   a. Midline view of uterus (including endometrial stripe)
   b. If possible: R and L adnexa

2. Transverse
   a. Uterus (including endometrial stripe)
   b. If possible: R and L adnexa

Transvaginal
1. Sagittal
   a. Midline view of uterus (including endometrial stripe)
   b. R and L adnexa

2. Coronal
   a. Uterus (including endometrial stripe)
   b. R and L adnexa

If pregnancy is seen, obtain:
- Image of gestational sac, yolk sac, and/or fetal pole
- M-mode of fetal heart rate, or clip demonstrating heart flicker
- Gestational age determination via crown-rump length or biparietal diameter measurements

Pearls

- If patient is pregnant (positive β-HCG), note if intrauterine pregnancy (IUP) is seen or if IUP is indeterminate or not seen.

- *Important!*
  To call presence of an IUP: must have minimum of a gestational sac and a yolk sac or fetal pole.
  A gestational sac alone may be the "pseudogestational sac" of ectopic pregnancy.

- Also important! If you perform a transabdominal US on a pregnant patient with pain or vaginal bleeding and do not see a definitive IUP, the patient must receive a follow up endovaginal US in the ED. This can be performed by radiology or with an *ultrasound credentialed* emergency department attending.

- Mind the concept of ALARA (As Low As Reasonably Achievable) – use as little US energy as possible with pregnancy imaging. B-mode and M-mode are lower energy modalities; avoid Doppler.

- In your interpretation, note:
  - Presence/absence of definite IUP
  - If possible, note:
    - FHR or fetal cardiac activity
    - Gestational age
    - Presence of pelvic free fluid
    - Any other abnormalities

Renal (Urinary Tract) — minimum 6 views 1. Right kidney: 2 views a. Longitudinal b. Transverse 2. Left kidney: 2 views a. Longitudinal b. Transverse 3. Bladder: 2 views a. Longitudinal b. Transverse	Pearls • **Ureteral jets** can be evaluated if there is concern for a ureteral obstruction. Hold the probe over trigone of bladder (transverse view, with bladder in maximal dimension) and place color Doppler window over posterior bladder – should see jet flows from ureters on both sides. • If dilation of the renal pelvis is seen, use color flow to determine if dilation is vascular or ureteral • In your interpretation, note presence/absence of: - Hydronephrosis (mild, moderate, or severe) - Bladder distension

Soft Tissue and Musculoskeletal — minimum 2 views 1. Longitudinal 2. Transverse	• Any structure of interest can be imaged – e.g. ruptured/partially torn tendons, muscles, bones, fractures, joints, dislocations, effusions, abscess, foreign body • Obtain images of the structure of interest in two orthogonal planes • In your interpretation, note presence/absence of: - Pathology in the imaged area

Thoracic (Pulmonary) — minimum 6 views 1. Anterior thorax for pneumothorax — 1 view on each side a. Clip or M-mode can be used 2. Bilateral hemithoraces a. Assess for A lines, B-lines, b. 1 view on each side c. Minimum depth of 15cm 3. Posterior hemithoraces/diaphragms for pleural effusion —1 view each side	Pearls • Pneumothorax exam can be performed using either the linear or curvilinear probes, with still images saved in M-mode • The rest of the pulmonary exam should be performed using the curvilinear probe with depth ~15 cm to enable evaluation of lung parenchyma • In your interpretation, note presence/absence of: - Pneumothorax - Increased Lung Density (B-lines) - Pleural effusion - Any other abnormality

Vascular Access and Procedural — minimum 1-2 views 1. Vascular access – requires 1 view of the vessel before cannulation, during cannulation, or after cannulation 2. Other Procedures – require 2 views of the anatomy intervened upon	• Most procedures can be assisted by ultrasound, e.g. abscess I&D (pre- and post-drainage), paracentesis, thoracentesis, nerve blocks, LP • In your interpretation, note: - Anatomy seen - Success of procedure performed