

Appendix

Appendix A.

Comprehensive Pretest Assessment. Copyright [2018] Mayo Foundation for Medical Education and Research.

Mini Assessment. Copyright [2018] Mayo Foundation for Medical Education and Research.

Hands-on Skills Tasks. Copyright [2018] Mayo Foundation for Medical Education and Research.

Ultrasound Knowledge Pre-Test

* Required

1. Email address *

2. Please write your name *

3. Do you consent to participate in the data collection of this study? ***Mayo Clinic: Office for Human Research Protection
Oral Consent Script**

Protocol Title: A Novel, Longitudinal Curriculum in Bedside Ultrasound for Internal Medicine Residents
IRB #: 16-009820
Principal Investigator: Michael Boniface, MD

You are being asked to participate in a research study about the effectiveness of a novel curriculum in ultrasound training among internal medicine residents.

If you agree to participate you will be asked to participate in a series of short multiple choice and hands on assessments that will be paired with the educational modules in ultrasound over the next six months. Your names and your performance on these assessments will be recorded in the study database. Assigning a de-identified participant identification number is not feasible due to the requirement of direct observation during hands on portion of ultrasound task assessments and your name and identity already being personally known to us. You will receive no compensation as payment for your participation.

The risk associated with the research study is the additional burden of time required to complete these assessments. However, the educational activities themselves will be considered part of routine didactics and the expectation for attendance will be no different than other morning report sessions. The assessments however, in the form of multiple choice examinations and directly observed hands-on tasks, are considered part of this investigation and you may refuse to answer any or all of the portions of these you do not wish to. There will be no penalty or negative impact reflected on your residency performance or record should you choose to not participate in this study. We otherwise do not anticipate you to be exposed to any risks outside those normally associated with routine educational sessions and training.

The benefits which may reasonably be expected to result from this research study are to help develop and refine a longitudinal curriculum in point-of-care ultrasound that may be implemented in subsequent years during your residency training, providing you with an additional skillset that may further enhance your ability to care for patients.

Please understand your participation is voluntary and you have the right to withdraw your consent or discontinue participation at any time without penalty. Specifically, your current or future enrollment in a graduate medical education program here at Mayo Clinic will not be jeopardized if you choose not to participate.

If you have any questions about this research study you can contact me at (321) 243-4938 or Boniface.michael@mayo.edu. If you have any concerns, complaints, or general questions about research or your rights as a participant, please contact the Mayo Institutional Review Board (IRB) to speak to someone independent of the research team at 507-266-4000 or toll free at 866-273-4681.

Mark only one oval.

- Yes
 No

Introduction and Physics

4. A target structure which appears dark or black relative to the surrounding tissue on ultrasound is described as: *

Mark only one oval.

- Hypoechoic
- Hyperechoic
- Isoechoic
- Homogeneous
- Radiolucent

5. Which of the following is NOT an artifact commonly encountered using ultrasound? *

Mark only one oval.

- Enhancement
- Shadowing
- Transposition
- Reverberation
- Mirroring

6. Frequency is _____ resolution *

Mark only one oval.

- Directly Proportional to
- Indirectly Proportional to
- Equal to
- Independent of

7. "Duplex" refers to the following: *

Mark only one oval.

- Color Doppler
- Spectral Doppler
- Venous Ultrasound
- Filling Defects
- Superimposed Display Modes

8. Which of the following is NOT a display mode of scanning? *

Mark only one oval.

- A-mode
- B-mode
- C-mode
- M-mode

9. Which of the following human tissues would you describe as having the least echogenicity? *

Mark only one oval.

- Bone
- Fat
- Spleen
- Liver
- Muscle

eFAST Examination

10. Which of the following is typically not visualized during a eFAST examination? *

Mark only one oval.

- Morrison's Pouch (Hepatorenal space)
- Pouch of Douglas (Retrovesicular space)
- Subphrenic Space
- Pericardial space
- Paracolic Gutter
- None of the above

11. Which of the following is the indication for a FAST examination? *

Mark only one oval.

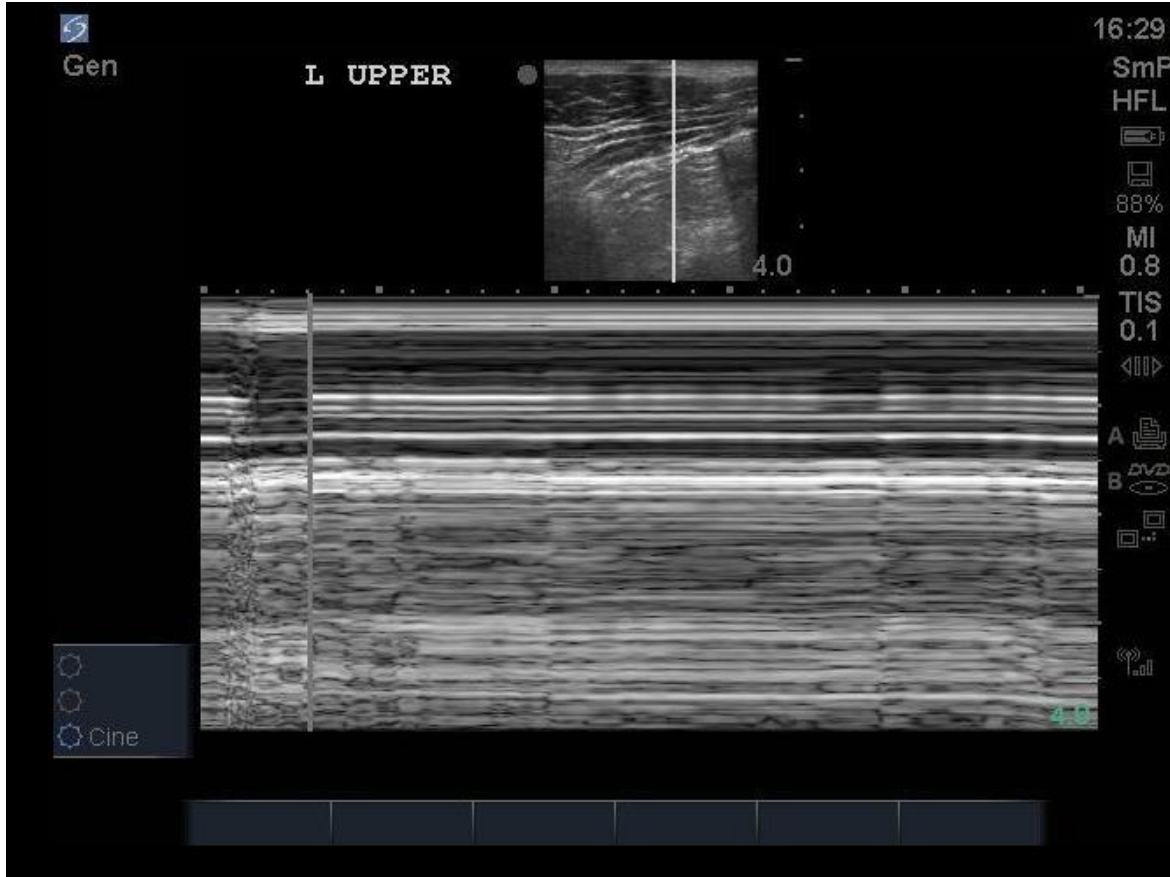
- Blunt Trauma
- Penetrating Trauma
- Abdominal Pain with Hypotension
- Early Pregnancy with syncope
- All of the above

12. In which of the following patients is surgical consultation or operative intervention the most immediate next step as opposed to radiology-based diagnostic imaging? *

Mark only one oval.

- Unstable trauma patient, FAST negative
- Unstable trauma patient, FAST Positive
- Stable Trauma Patient, FAST positive
- Stable Trauma Patient, FAST negative
- None of the above (all are visualized)

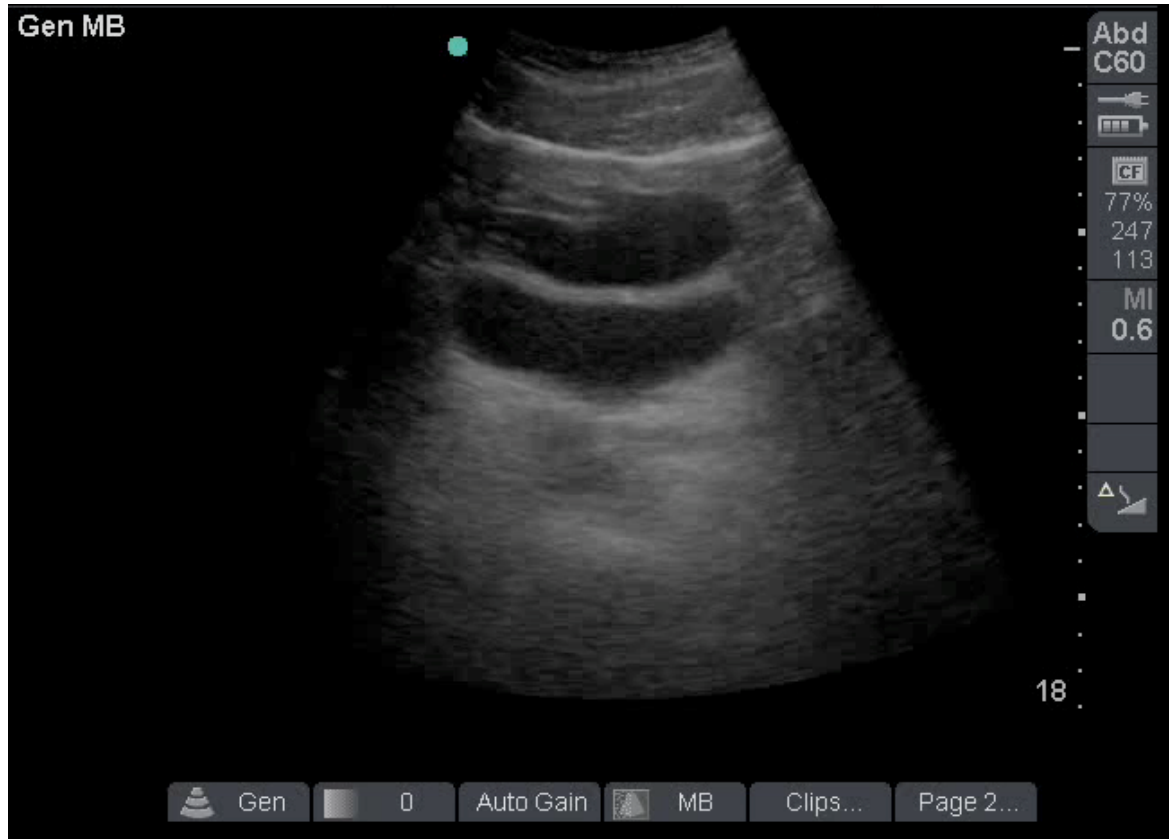
13. True or False: This eFAST examination is positive for pneumothorax *



Mark only one oval.

- True
- False

14. True or False: This FAST examination of the pelvic window is positive for free fluid *

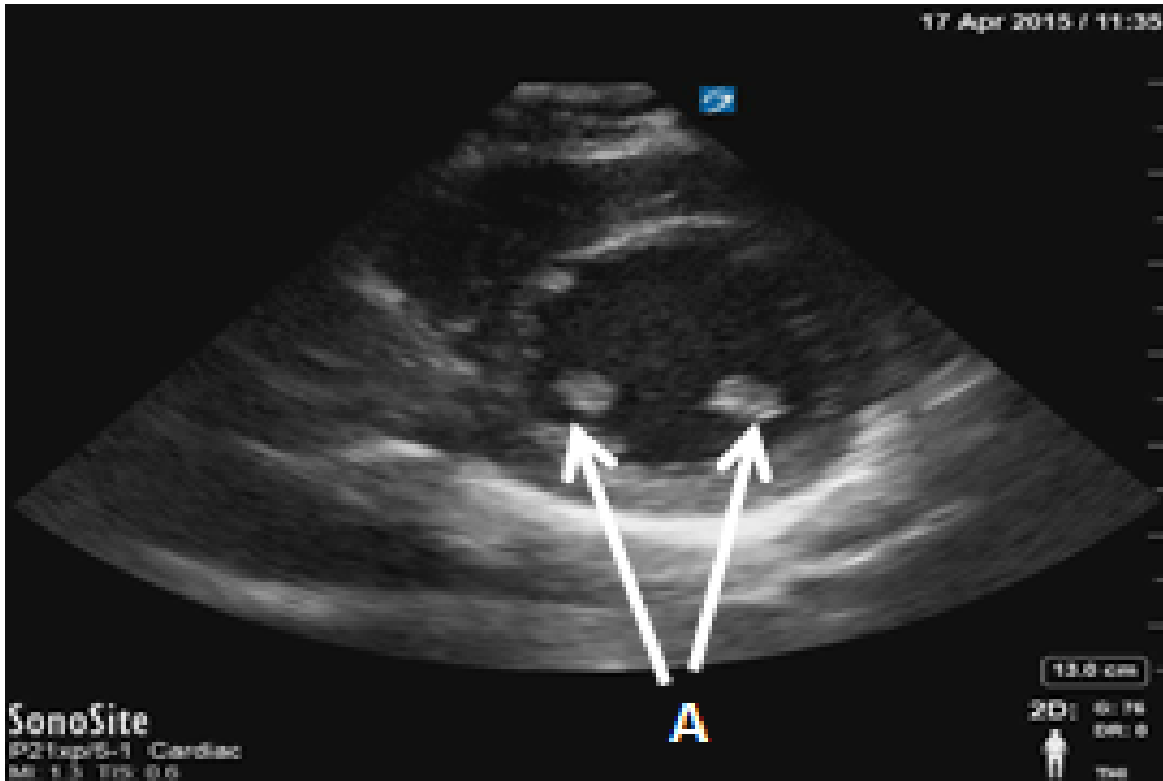


Mark only one oval.

- True
- False

Echocardiography

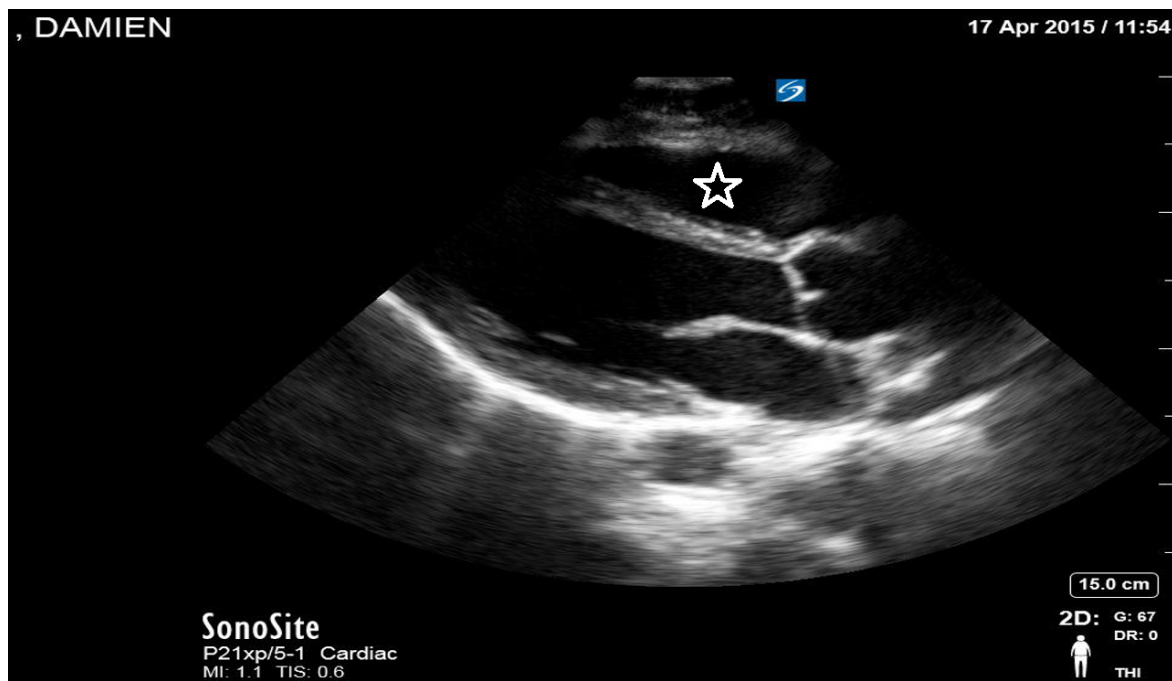
15. What are the structures designated by the arrows? *



Mark only one oval.

- Valves
- Thrombi
- Papillary muscles
- Myoxmas
- None of the Above

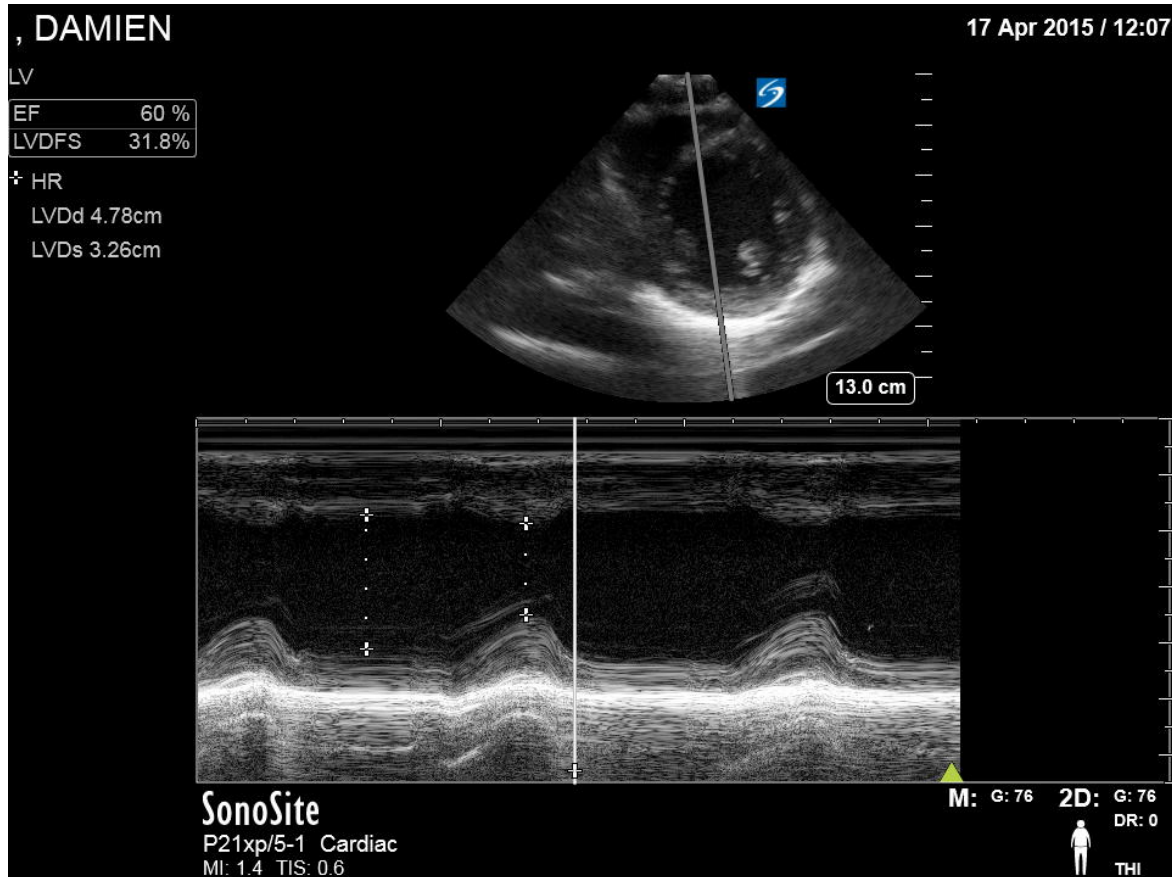
16. Which of the following statements is correct regarding the chamber of the heart designated by the star? *



Mark only one oval.

- Oxygenated blood fills this chamber during diastole
- Deoxygenated blood fills this chamber during diastole
- Oxygenated blood fills this chamber during systole
- Deoxygenated blood fills this chamber during systole

17. What is the method of estimating left ventricular systolic function shown below? *



Mark only one oval.

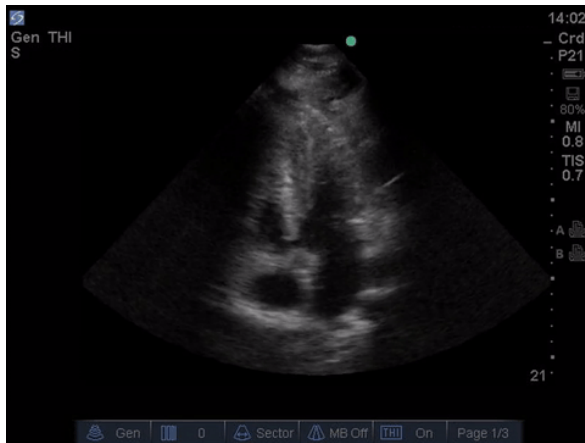
- E-point Septal Separation
- Fractional Shortening
- Simpson's Method
- Left Ventricular Outflow Tract VTI
- none of the above

18. Which of the following is not associated with echocardiographic findings in large or hemodynamically significant acute pulmonary embolism? *

Mark only one oval.

- McConnell's Sign
- Elevated RV systolic pressures
- "D" sign (septal bowing)
- RV free wall thickness greater than 5mm
- Greater than or equal to 1:1 ratio of RV:LV size

19. What is the primary pathology observed in the image below? (Free response, brief) *



20. Which factor may make it difficult to draw conclusions on volume status based solely on inferior vena cava fluid dynamics? *

Mark only one oval.

- Chronic Obstructive Pulmonary Disease
- Positive Pressure Ventilation
- Tricuspid Regurgitation
- Primary Pulmonary Hypertension
- All of the above

Lung Sonography

21. What describes a horizontal reverberation artifact between the skin and the pleura? *

Mark only one oval.

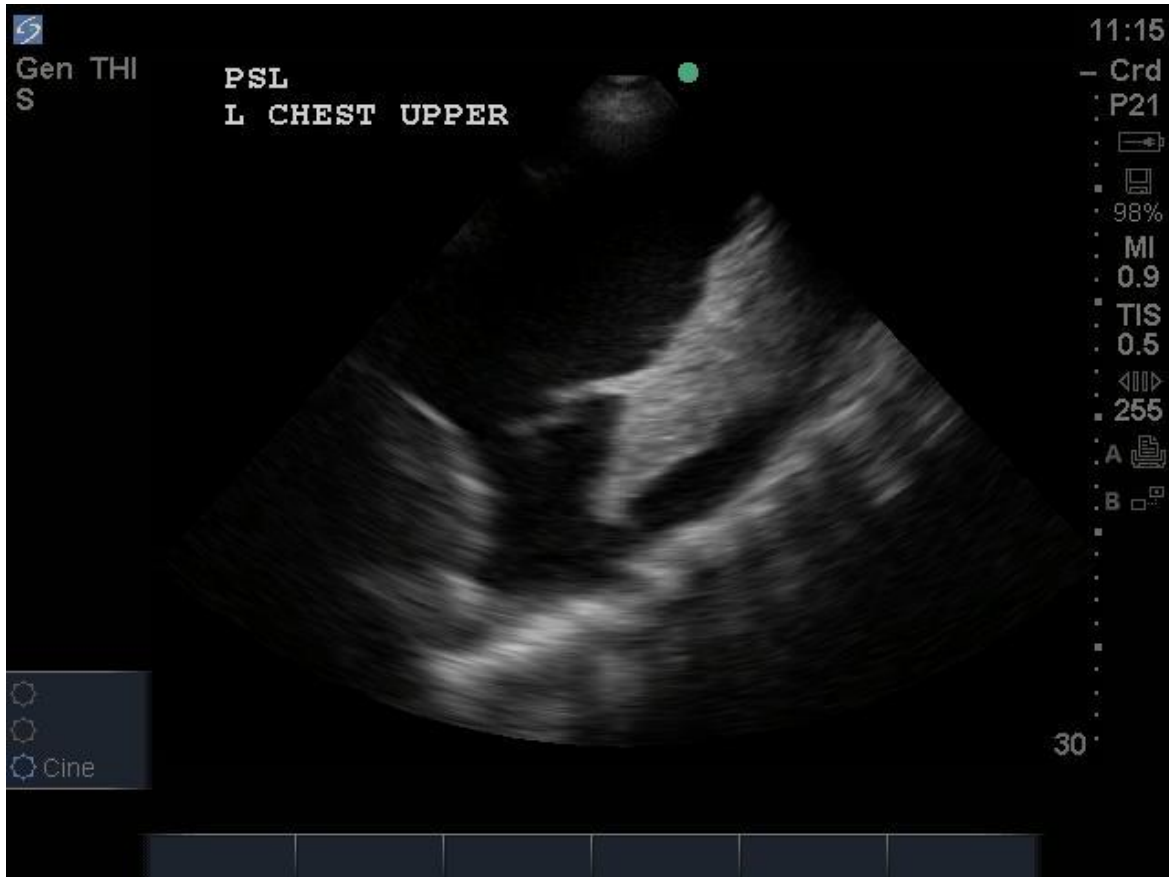
- A lines
- B Lines
- C lines
- P Lines
- None of the Above

22. Which transducer is the most appropriate to select for evaluation of the pleura? *

Mark only one oval.

- Phased Array
- High Frequency Linear
- Curvilinear
- Pleura is visualized equally well with all transducers

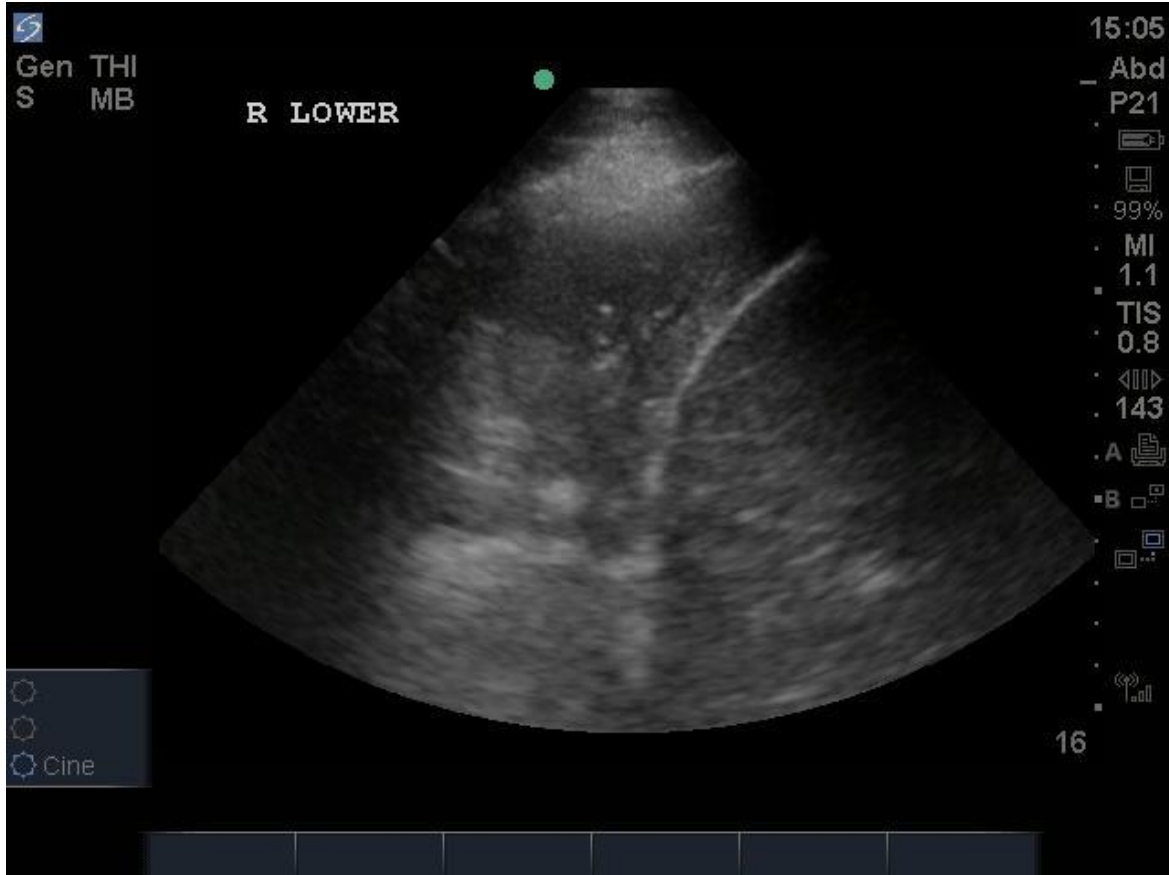
23. Which of the following abnormalities is not visualized in the accompanying image: *



Mark only one oval.

- Pleural Fluid
- Atelectasis
- Thoracic Spine
- Diaphragm
- All of the above are demonstrated

24. Which of the following is most likely to be the clinical syndrome accompanying this image: *



Mark only one oval.

- 39 year old man with ESRD presenting hypoxic and with BP 230/110 after missing hemodialysis
- 67 year old woman presenting with chest pain and dyspnea 7 days following total hip arthroplasty
- 89 year old woman presenting with altered mental status, cough, respiratory distress and fever of 103.2
- 26-year old man newly diagnosed with AIDS being treated for pneumonia in the ICU who develops sudden pleuritic pain and increased oxygen requirement

Deep Venous Thrombosis

25. When evaluating vascular structures behind the knee, what is the typical relationship between the popliteal artery and vein? *

Mark only one oval.

- Vein is seen deep to the artery
- Vein is seen superficial to the artery
- Vein is seen lateral to the artery
- They typically are not seen together

26. What is the most important technique to become comfortable interpreting when performing ultrasound evaluation for lower extremity DVT? *

Mark only one oval.

- Color Doppler
- Augmentation
- Compressibility
- Respiratory Variability

27. What is demonstrated in the accompanying image? *



Mark only one oval.

- Acute Deep Vein Thrombosis
- Chronic Deep Vein Thrombosis
- Augmentation
- Normal Deep Vein
- Venous Valve

28. What is demonstrated in the accompanying clip? *



Mark only one oval.

- Acute Deep Vein Thrombosis
- Chronic Deep Vein Thrombosis
- Augmentation
- Normal Deep Vein
- Venous Valve

Renal/Bladder

29. When evaluating the left kidney, the ultrasound transducer should be initially placed in a more _____ position relative to the that of the right kidney *

Mark only one oval.

- Cephalad & Posterior
- Cephalad & Anterior
- Caudal & Posterior
- Caudal & Anterior

30. The presence of which of the following provides evidence against the diagnosis of obstructive uropathy? *

Mark only one oval.

- Urine output greater than 1.5cc/kg/hr
- Ureteral (Bladder) jets
- Bladder volume greater than 500cc
- Post-void residual volume less than 100cc
- Absence of Hydronephrosis

31. **The presence of hydronephrosis in a patient presenting with flank pain and microscopic hematuria: ***

Mark only one oval.

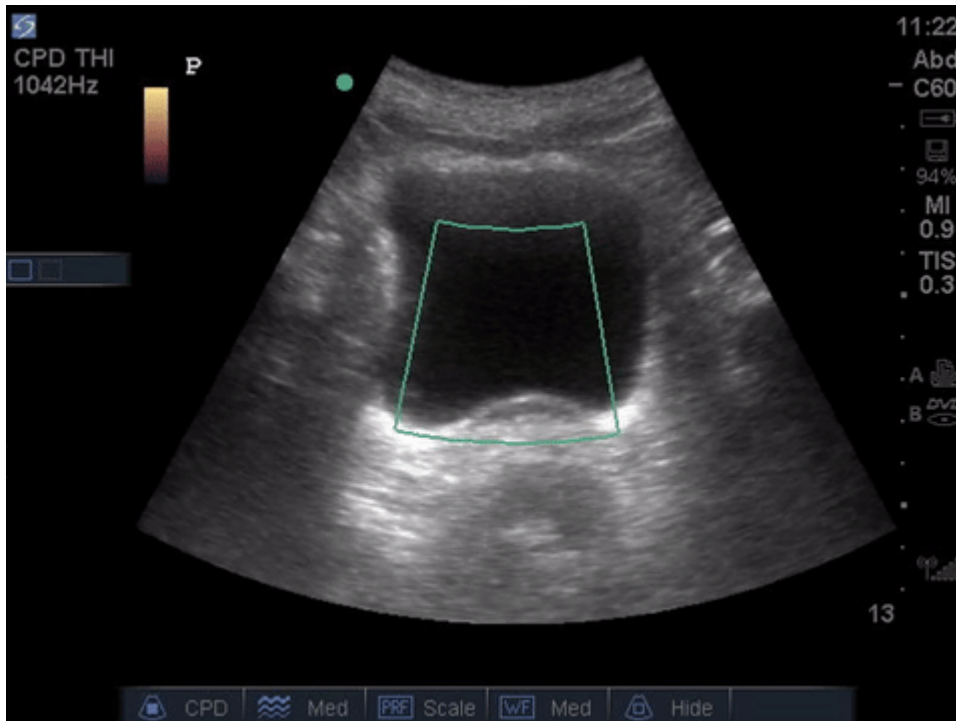
- A - Definitely rule in nephrolithiasis
- B - Definitely rules out other pathological presentations
- C - May be seen in other disease states such as abdominal aortic aneurysm
- A & B

32. **A 33 year old man with history of recurrent nephrolithiasis presents to the ER with acute onset colicky flank pain, vomiting, and microscopic hematuria. Renal function is normal, adequate analgesia is achieved during treatment, and he subsequently tolerates fluids by mouth. Bedside ultrasound shows mild lateralizing hydronephrosis. What is the next best step in management? ***

Mark only one oval.

- CT scan of the abdomen/pelvis without contrast
- CT scan of the abdomen/pelvis with delayed contrast (CT IVP)
- Urology Consultation
- Admit to Internal Medicine
- Discharge with outpatient followup

33. **What is demonstrated in the following clip? ***



Mark only one oval.

- Patency of the ureter
- Bladder wall hemorrhage
- Transmitted motion artifact from the iliac vessels
- Post-TURP hemorrhage
- None of the above

Background Information

34. Please select your level of training *

Mark only one oval.

- PGY-1
- PGY-2
- PGY-3

35. Please select your specialty *

Mark only one oval.

- Categorical Internal Medicine
- Prelim - Diagnostic Radiology
- Prelim - Radiation/Oncology
- Prelim - Dermatology
- Prelim - Ophthalmology
- Prelim - Anesthesiology
- Prelim - Neurology
- Other

36. Did you participate in a curriculum in point-of-care ultrasound in medical school? *

Mark only one oval.

- Yes
- No

37. Please self-describe your level of experience with point-of-care ultrasound *

Mark only one oval.

1	2	3	4	5	
No experience	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Extremely Experienced

38. How often do you utilize point-of-care ultrasound *

Mark only one oval.

1	2	3	4	5	
Never	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Every clinical shift/workday

39. Respond to the following statement: "Proficiency in point-of-care ultrasound is valuable to my education and ability to care for patients" *

Mark only one oval.

1	2	3	4	5	
Strongly Disagree	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Strongly Agree

40. Respond to the following statement: "I am satisfied with the level of instruction in point-of-care ultrasound during my training." *

Mark only one oval.

	1	2	3	4	5	
Very Unsatisfied	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Very Satisfied



Introduction/Physics:

1. For most applications, where should the indicator dot on the display be located?
 - a. Top left
 - b. Top right
 - c. Bottom left
 - d. Bottom right

2. The following image is taken in which anatomical plane?
 - a. Axial
 - b. Coronal
 - c. Sagittal



3. Which transducer is most appropriate for echocardiography applications?
 - a. Convex Array
 - b. Phased Array
 - c. Sequential Array
 - d. Endocavitary
 - e. None of the above
4. The piezoelectric effect refers to the following property of certain materials:
 - a. Conversion of matter to energy
 - b. Conversion of mechanical energy to electrical energy
 - c. Conversion of sounds waves to light waves
 - d. Conservation of energy
5. Which of the following is not a potential behavior of sound waves interacting with a medium?
 - a. Reflection
 - b. Absorption
 - c. Scatter
 - d. Retention
 - e. Transmission

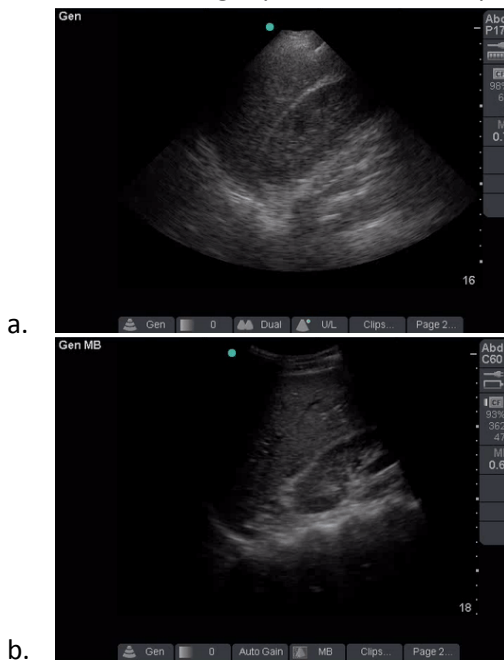
eFAST Examination:

1. True or False: FAST examination is less sensitive than a supine AP chest radiograph for the detection of pneumothorax

2. In which of the following patients may the FAST examination have only limited utility?
 - a. 40 year old man in high speed rollover motor vehicle collision
 - b. 18 year old woman 3 weeks late for her period with syncope and hypotension
 - c. 32 year old woman with irritable bowel syndrome presenting with abdominal pain
 - d. 53 year old man with cirrhosis who fell off his roof presenting with abdominal pain
 - e. None of the above

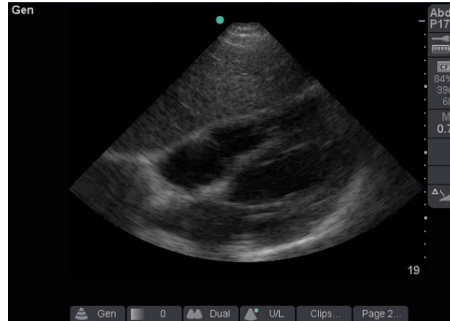
3. Regarding the sensitivity of the FAST exam for the detection of free intraperitoneal fluid, what is the smallest volume that may be reasonably detected by an experienced sonographer?
 - a. 50cc
 - b. 200cc
 - c. 500cc
 - d. 1000cc

4. Which of the following clips shows an example of a positive FAST examination?





c.



d.

5. True or False: This FAST examination of the pelvic window is positive for free fluid



Lung

1. Which of the following is most likely to be the clinical syndrome accompanying this image:
 - a. 39 year old man with ESRD presenting hypoxic and with BP 230/110 after missing hemodialysis
 - b. 67 year old woman presenting with chest pain and dyspnea 7 days following total hip arthroplasty
 - c. 89 year old woman presenting with altered mental status, cough, respiratory distress and fever of 103.2
 - d. 26-year old man newly diagnosed with AIDS being treated for pneumonia in the ICU who develops sudden pleuritic pain and increased oxygen requirement

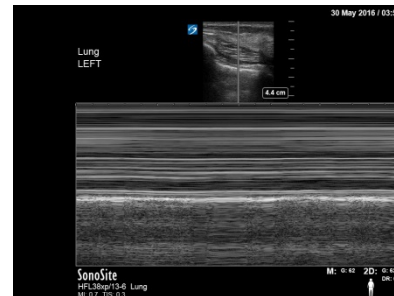


2. What do B-lines represent?
 - a. Interstitial fluid
 - b. Alveolar fluid
 - c. Pleural fluid
 - d. Pneumothorax
 - e. Pulmonary Embolism

3. What describes a well-established algorithm for use of ultrasound when evaluated undifferentiated dyspnea in critical patients?
 - a. RED Protocol
 - b. GREEN Protocol
 - c. BLUE Protocol
 - d. GRAY Protocol
 - e. MAGENTA Protocol
 - f.

4. Which best describes the accompanying image?
 - a. Normal
 - b. Pneumothorax
 - c. Pleural Effusion
 - d. Pulmonary Edema
 - e. This is not lung

5. What is not visualized well on ultrasound?
 - a. Pulmonary Edema
 - b. Pleural Effusions
 - c. Pneumonia/Consolidation
 - d. Normal Lung
 - e. A and C

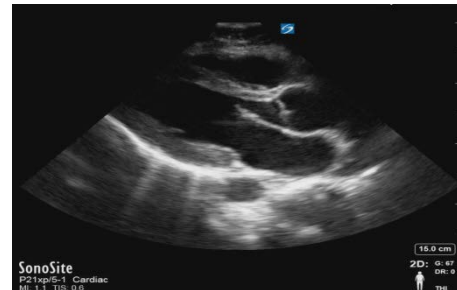


Cardiac/ECHO

- 1. What is designated by the arrow?
 - a. Inferior Vena Cava
 - b. Pericardial Effusion
 - c. Pleural Effusion
 - d. Intra-abdominal fluid
 - e. Esophagus



- 2. What is the name of the following echocardiographic window:
 - a. Subcostal
 - b. Parasternal short
 - c. Parasternal long
 - d. Apical 4 chamber
 - e. Supraclavicular



- 3. Cardiac Tamponade occurs when the pericardial fluid volume exceeds:
 - a. 50cc
 - b. 100cc
 - c. 200cc
 - d. 500cc
 - e. None of the above
- 4. Which of the following is not an echocardiographic finding diagnostic for cardiac tamponade?
 - a. Right atrial diastolic collapse
 - b. Right ventricular diastolic collapse
 - c. Alternans
 - d. Atrioventricular valve inflow variation greater than 25% with respiration
 - e. None of the above

- 5. What is the structure designated with the label below?
 - a. Pericardial Effusion
 - b. Pleural Effusion
 - c. Aorta
 - d. Inferior Vena Cava
 - e. None of the above



DVT

1. Which of the following is not a deep vein?
 - a. Common Femoral Vein
 - b. Superficial Femoral Vein
 - c. Deep Femoral Vein
 - d. Greater Saphenous Vein
 - e. Popliteal Vein
2. What is the sensitivity of limited point-of-care ultrasound for detecting deep venous thrombosis? (choose closest answer)
 - a. 50%
 - b. 60%
 - c. 70%
 - d. 80%
 - e. 90%

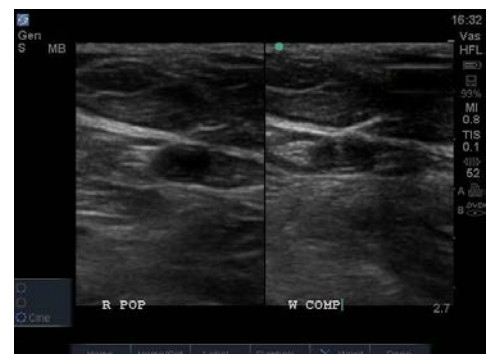
3. What is demonstrated in the accompanying clip/image?
 - a. Acute Deep Vein Thrombosis
 - b. Chronic Deep Vein Thrombosis
 - c. Augmentation
 - d. Normal Deep Vein
 - e. Venous Valve



4. What is demonstrated in the accompanying clip/image?
 - a. Acute Deep Vein Thrombosis
 - b. Chronic Deep Vein Thrombosis
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 - d. Normal Deep Vein
 - e. Venous Valve

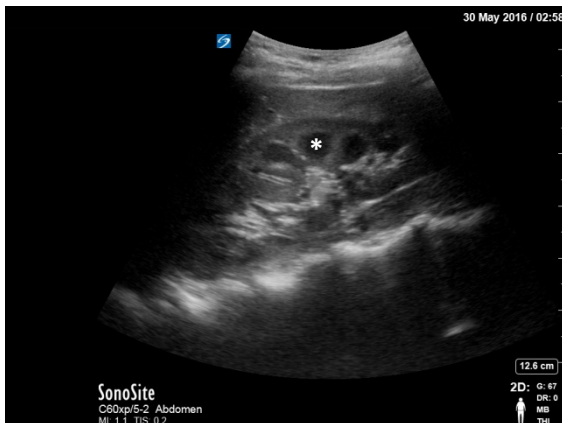


5. What is demonstrated in the accompanying clip/image?
 - a. Acute Deep Vein Thrombosis
 - b. Chronic Deep Vein Thrombosis
 - c. Augmentation
 - d. Normal Deep Vein
 - e. Venous Valve



Renal/Bladder:

1. In a normal kidney, which of the structures will often not be visualized?
 - a. Renal Cortex
 - b. Medullary pyramids
 - c. Ureter
 - d. Calyces
 - e. C and D
2. Which maneuver or intervention may improve the visualization of the kidneys?
 - a. Forced Exhalation
 - b. Deep inspiration
 - c. Use of the High Frequency Linear transducer
 - d. M-Mode
3. True or false: Ultrasound is a sensitive tool for the diagnosis and characterization of ureterolithiasis
4. Which of the following is NOT a required criteria for a simple (Bosniak 1) renal cyst
 - a. Imperceptible wall
 - b. Rounded
 - c. No internal echoes
 - d. Diameter less than 3cm
5. Identify the structures marked with the asterisks
 - a. Renal calyx
 - b. Renal Medulla
 - c. Renal Cortex
 - d. Renal Cyst (simple)
 - e. Renal cell carcinoma



Hands-on (Psychomotor) Sonography Tasks:

Introduction to Standard Physics and Instrumentation (Equipment/Knobology)

1. Select/Activate the phased array transducer
2. Set the depth to 16cm
3. Select the abdominal pre-set mode
4. Obtain an axial view on the inferior vena cava (or other abdominal structure, graded on understanding of anatomical plane and transducer indicator convention)
5. Change the scanning mode to M-mode

Focused Assessment using Sonography in Trauma

1. Demonstrate a view of Morrison's pouch
2. Identify the termination of the spine line at the diaphragm
3. Evaluate where you would look for suspected free fluid in the left paracolic gutter
4. Demonstrate a subxiphoid view of the heart
5. Demonstrate a "sandy-shore" or "seashore" sign

Limited Transthoracic Echocardiography

1. Identify the descending thoracic aorta in a parasternal long view
2. Identify the ventricular septum in a parasternal short view of the heart
3. Identify the mitral valve in an apical four chamber view
4. Identify the right ventricle in a subxiphoid view
5. Evaluate IVC diameter using M-mode

Renal / Collecting System

1. Demonstrate a long axis view of the right kidney
2. Demonstrate a short axis view of the left kidney
3. Demonstrate a method for reconciling ambiguity between collecting system structure vs vascular structure (color doppler)
4. Demonstrate a method for calculating bladder volume
5. Demonstrate a method for visualizing ureteral jets

Lung

1. Identify "a-lines"
2. Identify and evaluate the pleura in "B-mode"
3. Demonstrate a technique for pneumothorax detection using "M-mode"
4. Identify the diaphragm and where small pleural effusions would be visible
5. Find the Pathology: (Correctly recognizes presence of moderate pleural effusion on High-Fidelity Trainer)

Deep Venous Thrombosis

1. Identify the common femoral vein (proximal to saphenous)
2. Identify the proximal saphenous vein
3. Demonstrate a technique for differentiating between artery and vein (compressibility, color/spectral doppler)
4. Demonstrate compressibility of the common femoral vein
5. Demonstrate compressibility of the popliteal vein