

Point of Care Ultrasound: Pearls for Heart Failure Management



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Conflict of Interest Disclosures

- **Grants/research support:**
- **Consulting fees:** Lantheus Medical Imaging
- **Speaker fees:**
- **Other:** Steering Committee: NovoNordisk (SOUL trial)

- I will not discuss off-label uses

OBJECTIVES

- 1) Understand the purpose and basic components of point of care ultrasound (POCUS)
- 2) Describe typical POCUS findings associated with Heart Failure
- 3) Understand the pitfalls of POCUS technology and interpretation
- 4) BONUS: role of POCUS in COVID19

POLL: My exposure to POCUS would be best characterized by which of the following statements:

- 1) I regularly use POCUS in clinical assessments with confidence
- 2) I am occasionally using POCUS, and feel confident in my skills
- 3) I am occasionally using POCUS, but do not feel confident in my skills
- 4) I have limited prior echo experience and am contemplating getting a POCUS device
- 5) I have access to a POCUS device, but have no idea how to use it
- 6) I don't have access to a POCUS device, but wish I did, and want to learn how to use it
- 7) POCUS? It's just HOCUS-POCUS. Why do we need it?
- 8) None of the above

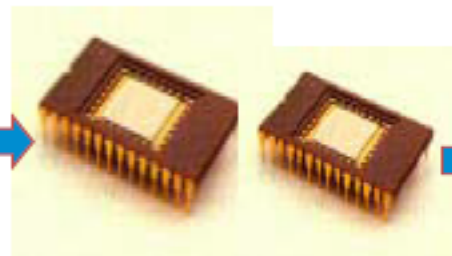
What is Point-of-Care Ultrasound?

- **Ultrasonography performed and interpreted by the clinician at the bedside and integrated in to patient care in real time**



- goal directed workflow
- diverse specialties
- multi-system interrogation
- 24/7 availability
- repeatable

Portability and Miniaturization of Ultrasound Systems

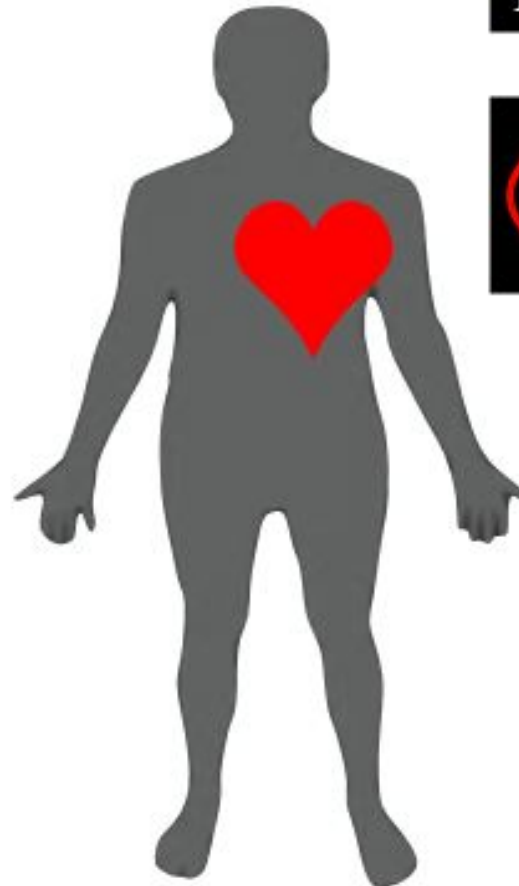
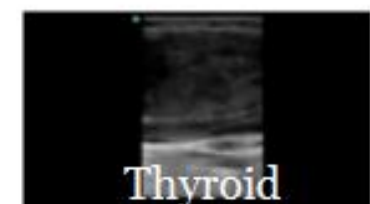
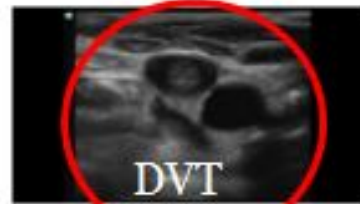
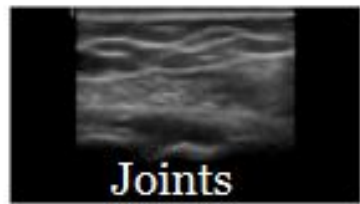
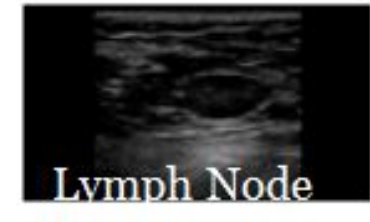
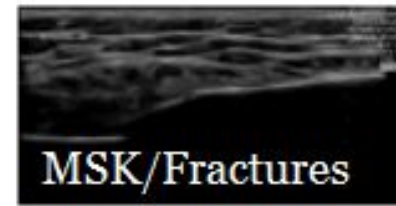


THEN

NOW



POCUS Scope

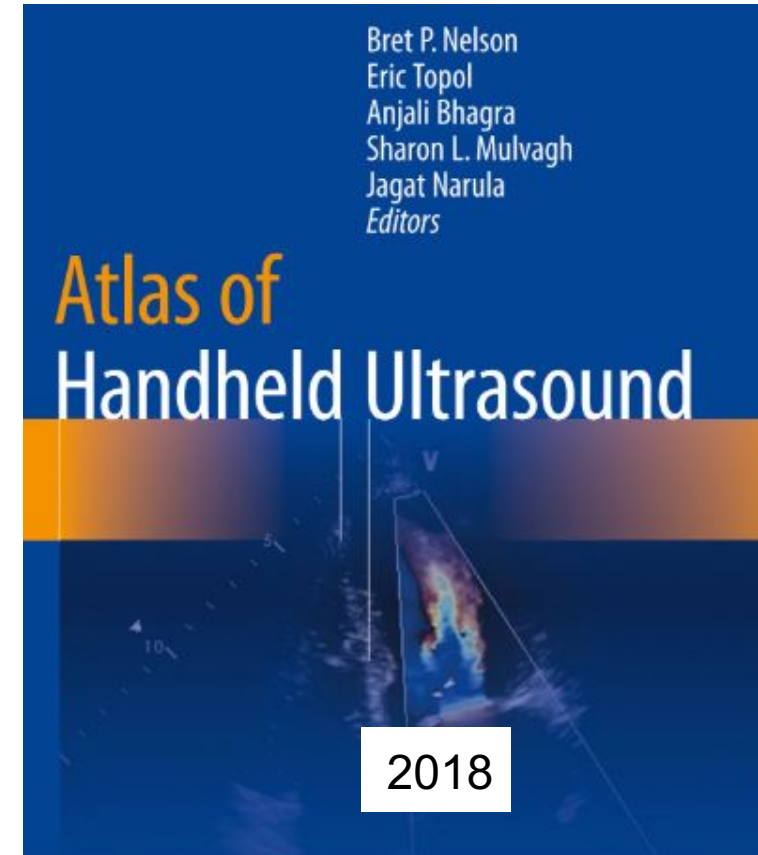
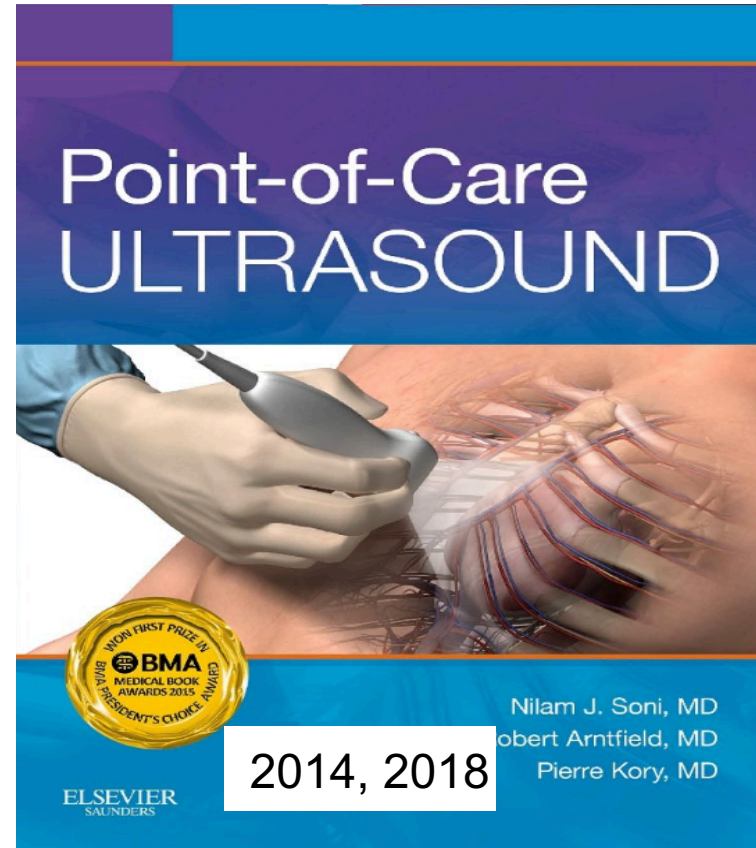
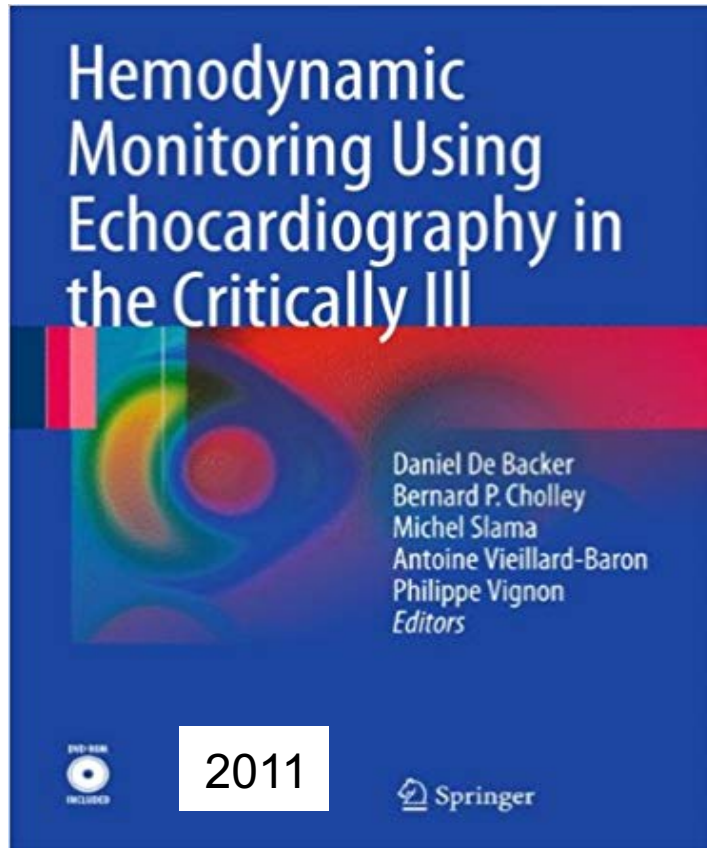


REVIEW ARTICLE

CURRENT CONCEPTS

Point-of-Care Ultrasonography

Christopher L. Moore, M.D., and Joshua A. Copel, M.D.



Purpose: Expedite care

A tale of 2 Cases



CASE 1: 69 yo female, no prior cardiac history new onset dyspnea NYHA II

- Clinical assessment: (hx, physical findings, CXR, BNP)
 - **ED Dx: left heart failure, murmur**
- Managed w/ IV diuresis; Discharged: furosemide 40 mg od
- ***Out-pt Echo , Cards clinic (3 mos)***
- **BUT: one month later: severe dyspnea**; tried increasing furosemide
- **Returns to ED:** rales, murmur; hypokalemia and mild renal dysfunction
- ***Echo-pending.*** No clinical follow-up has occurred
- Admitted for Dx (**TTE**), Rx

69 year old female with dyspnea
–TTE one month after symptom onset



TTE: flail mitral leaflet, severe MR, normal EF

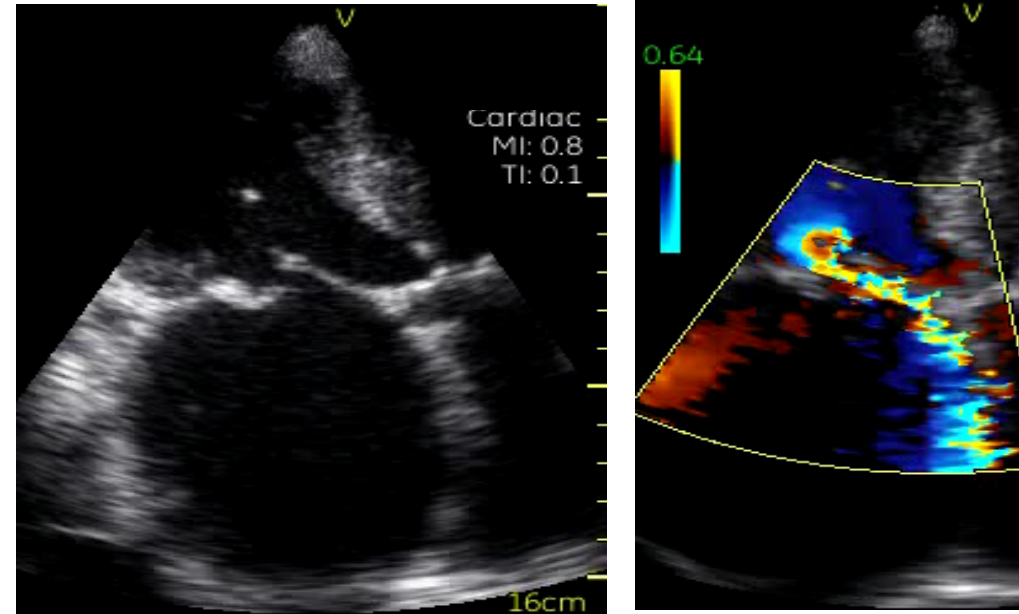


Case 2: 63 yo male , mild progressive dyspnea, sudden worsening, presyncope

- ED: murmur -CV consult - POCUS

POCUS: flail mitral leaflet, severe MR, normal LV function

- Admitted: intraop TEE, MV repair
- Back to work within 3 weeks



Case 1 vs Case 2?????



POCUS *made a difference* in management & outcome

The image features a dynamic, multi-colored starburst effect. The background is a deep, dark blue, densely populated with small, bright white and yellow stars. A central point of light radiates outwards, creating a spectrum of colors including purple, magenta, pink, orange, and yellow. The word "DISRUPTION" is prominently displayed in the center, rendered in a bold, yellow, italicized sans-serif font. The overall composition is energetic and visually striking, suggesting themes of innovation, change, or a bright future.

DISRUPTION

Basic Ultrasound controls (“Knobology”)

- Probe selection

- low** frequency: (2-5 MHz): **deep** structures: cardiac, abdomen

- high** frequency: (8-10 MHz): **shallow** structures: vascular, lung

US penetration is inversely proportional to the frequency



Basic Ultrasound Transducers/Probes
Vary in Frequency, Field of View, and Footprint



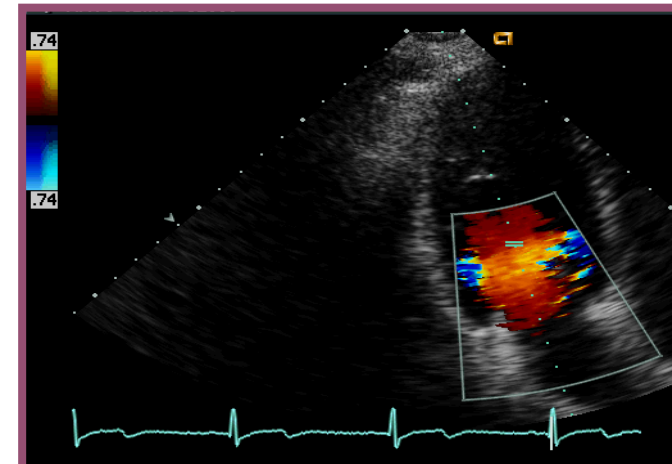
- 2-D controls

- depth
 - overall gain (brightness)



- Color Flow Doppler

- red: towards
 - blue: away



Ultrasound Tissue Characteristics

- *Echogenic structures are white*

- Bone
- Tissue
- Air

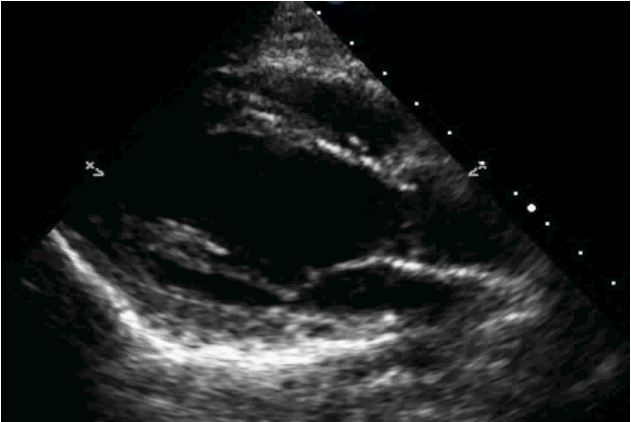
Ultrasound reflection

- *Echolucent fluid is black*

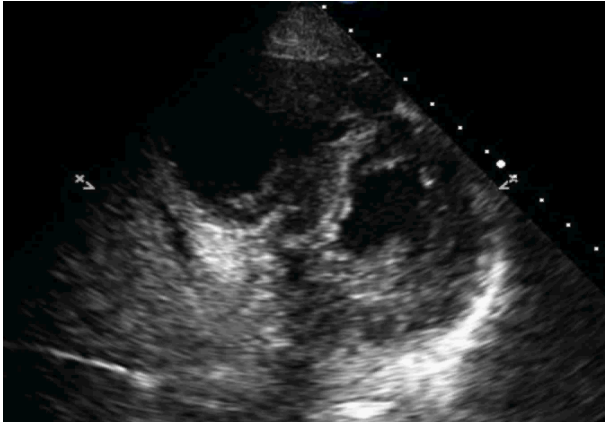
- **blood**
- **effusions**

Ultrasound transmission

Basic Point of Care Echocardiography for Heart Failure



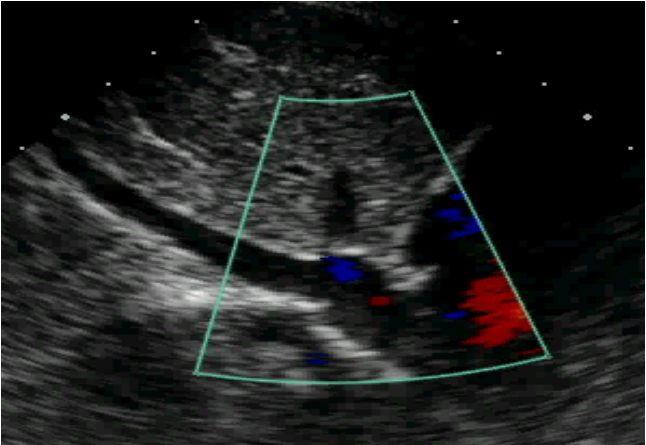
LV size/function



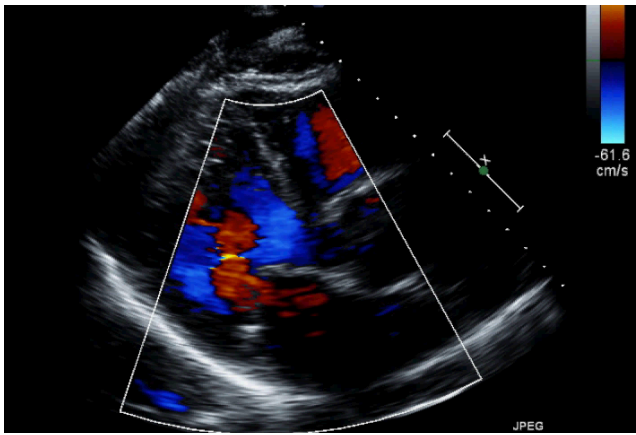
RV size/function



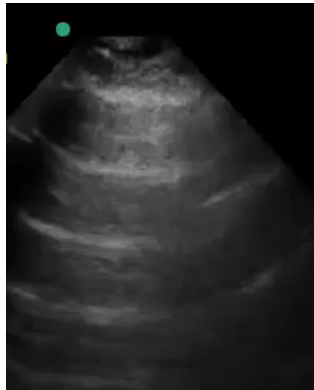
Pericardial Effusion



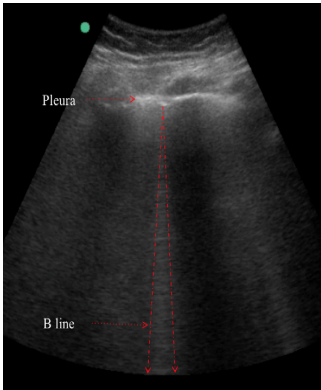
IVC - Volume Status



Significant Valvulopathy



A-lines



B-lines

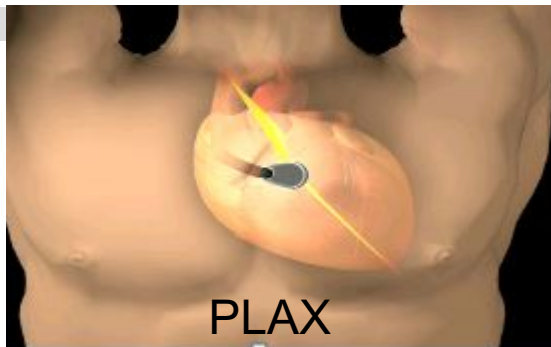
Lung Exam

Basic Exam: Cardiac

Majority of info can be obtained from PLAX, Subcostal

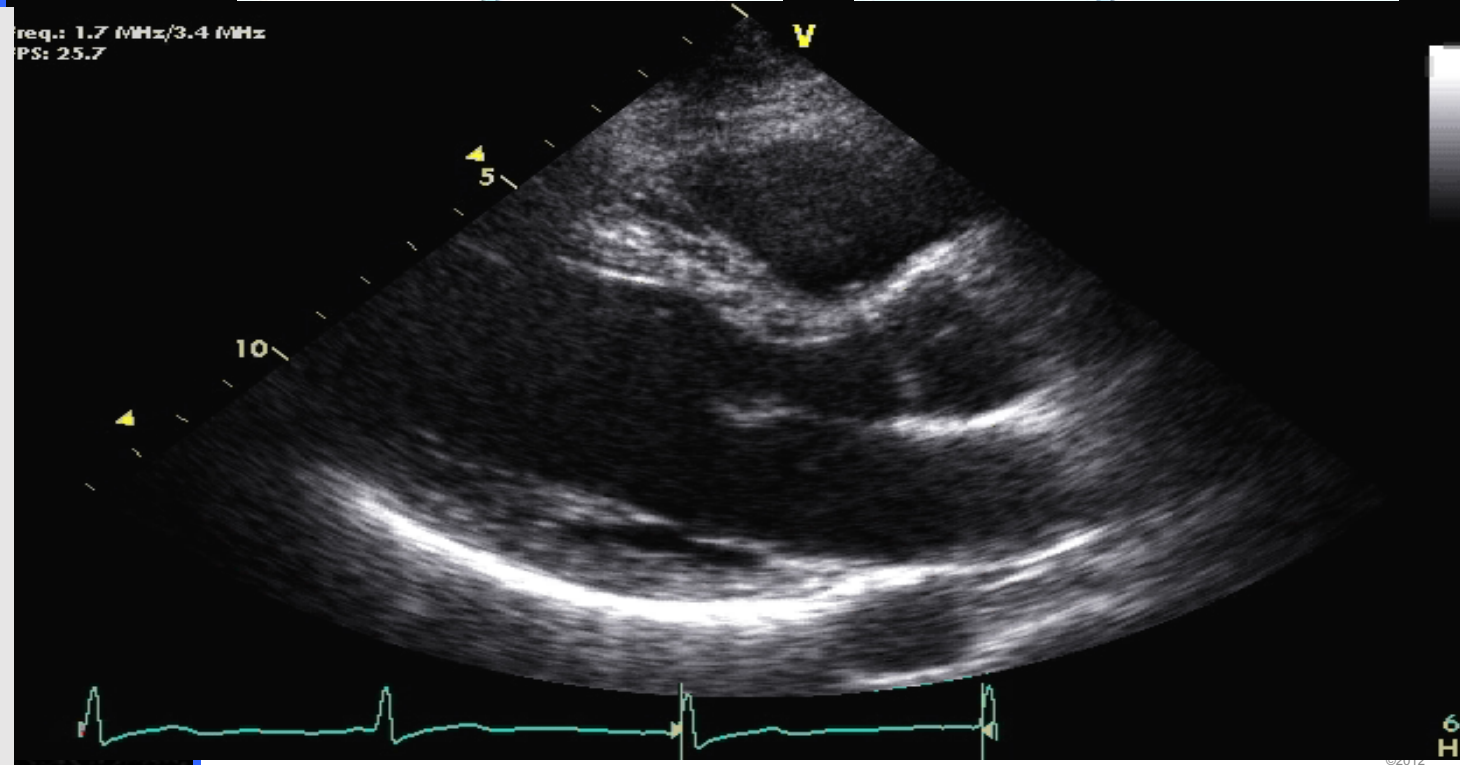


- *Parasternal: Long Axis (PLAX), Short Axis*
- Apical
- Subcostal



PLAX

- LV size
- LV function
- RV size, function
- Pericardial fluid?
- Asc aorta size
- MV, AV

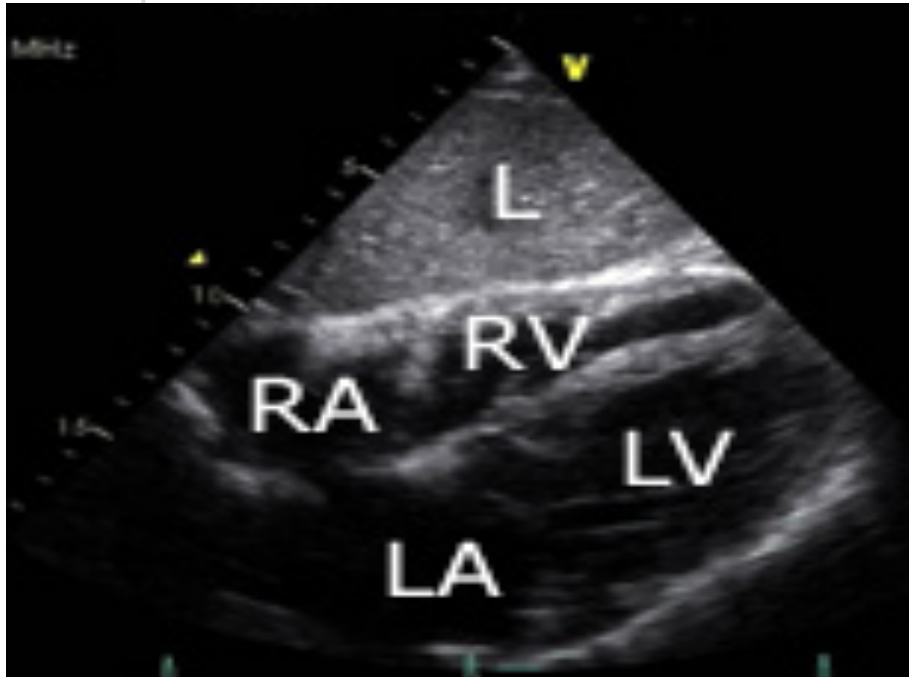
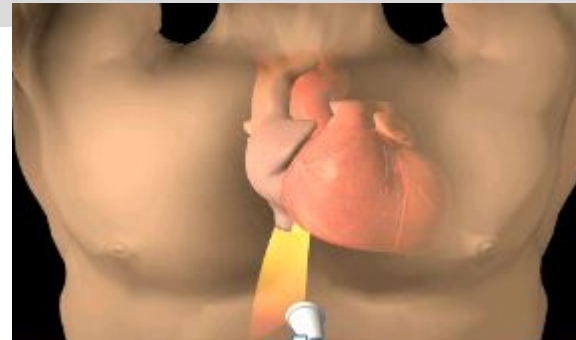
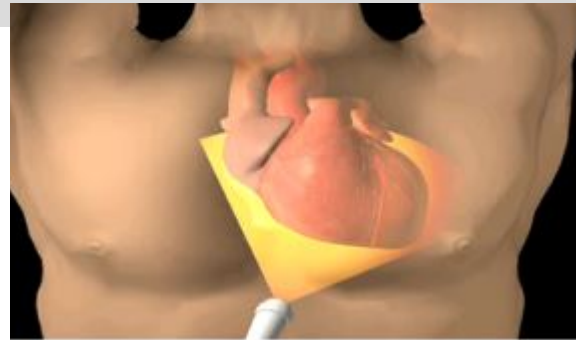


Basic Exam: Cardiac

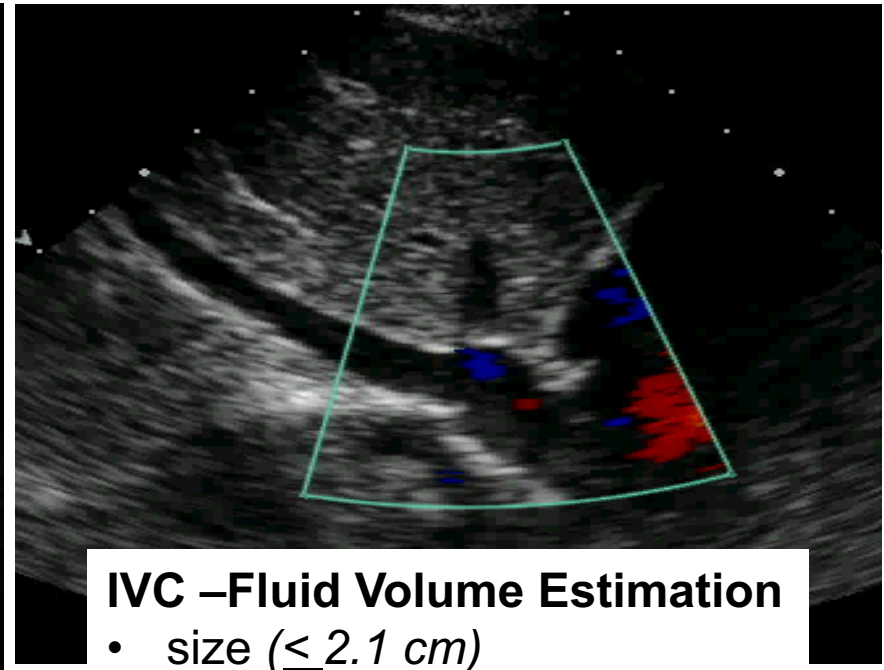
Majority of info can be obtained from PLAX, Subcostal



- Parasternal: Long Axis (PLAX), Short Axis
- Apical
- *Subcostal*

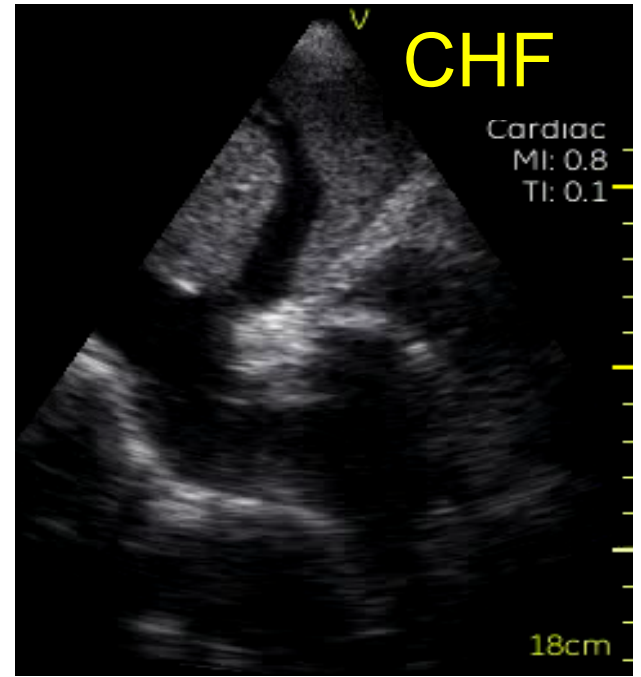


4-chamber view
-assess pericardial effusion



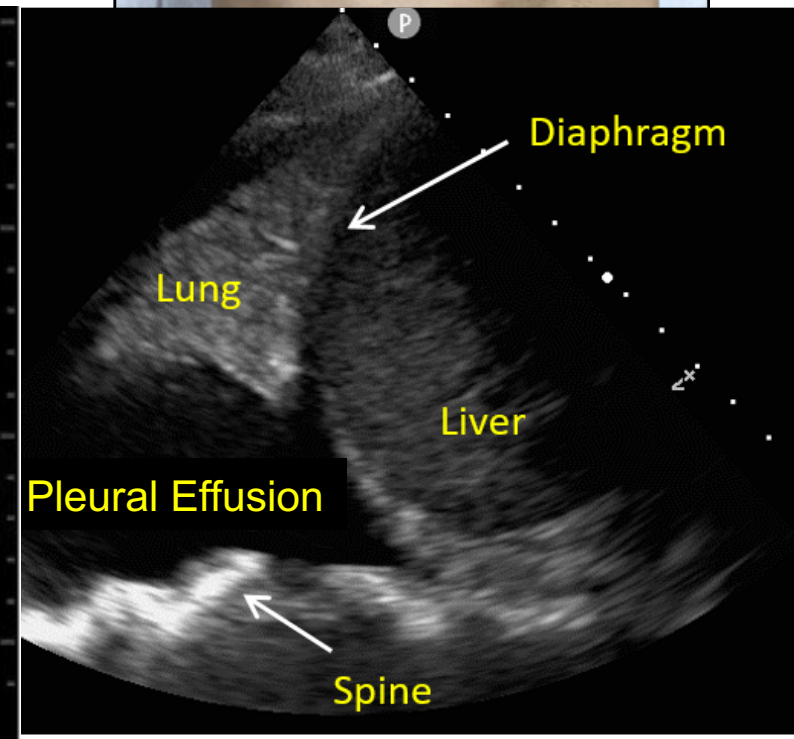
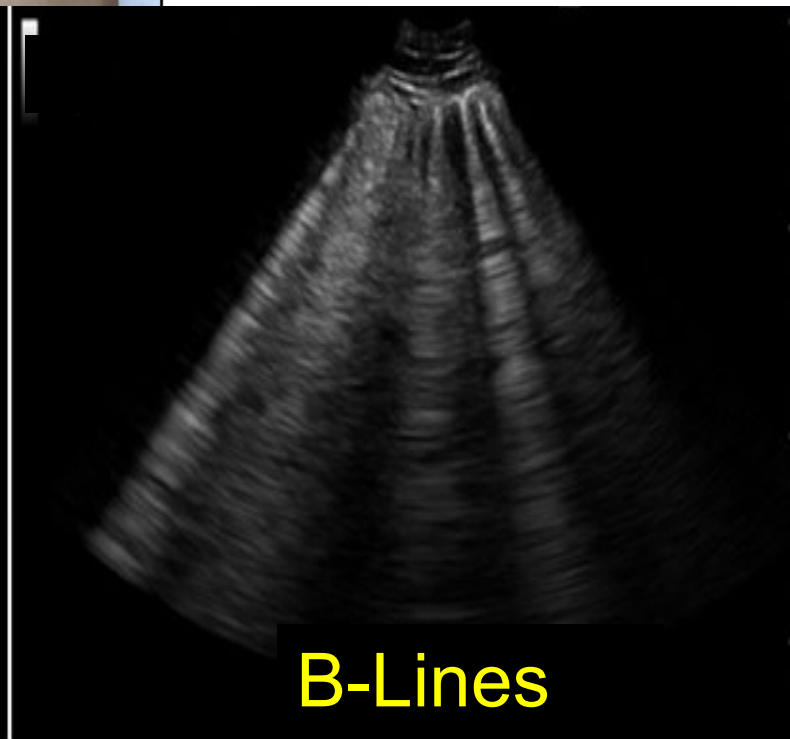
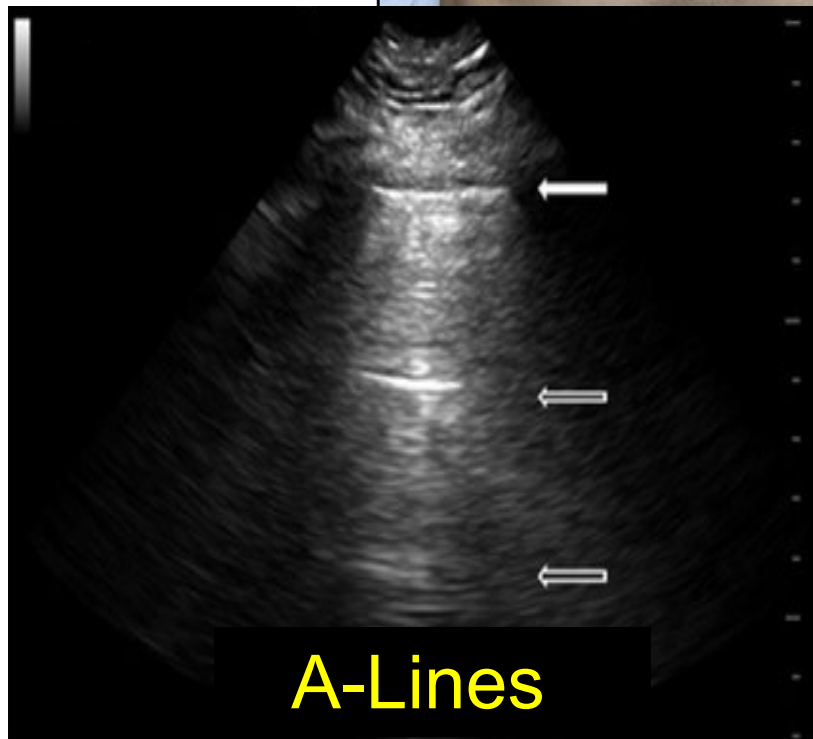
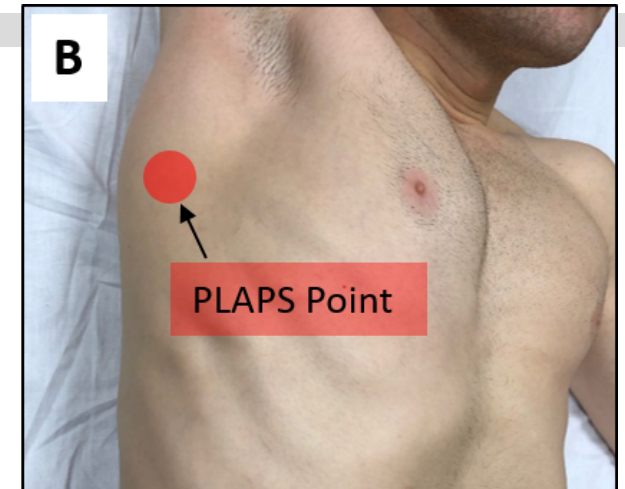
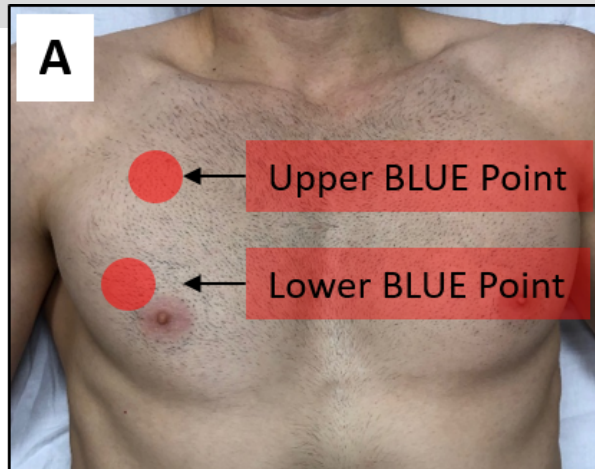
IVC –Fluid Volume Estimation

- size (≤ 2.1 cm)
- respiratory variation:
decreases > 50% with sniff



Basic Exam: Lung

Lungs just don't get in the way!
Valuable info in the *artifacts* observed



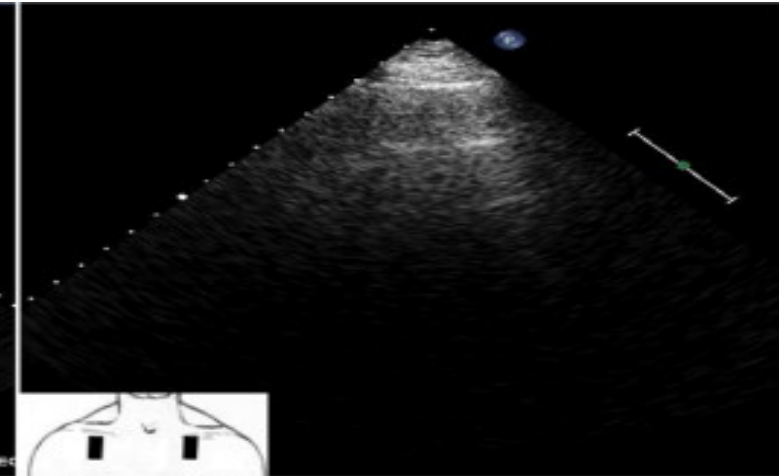
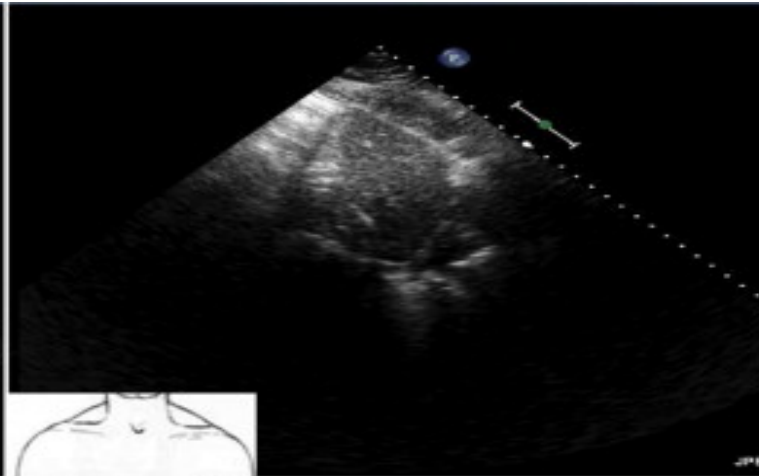
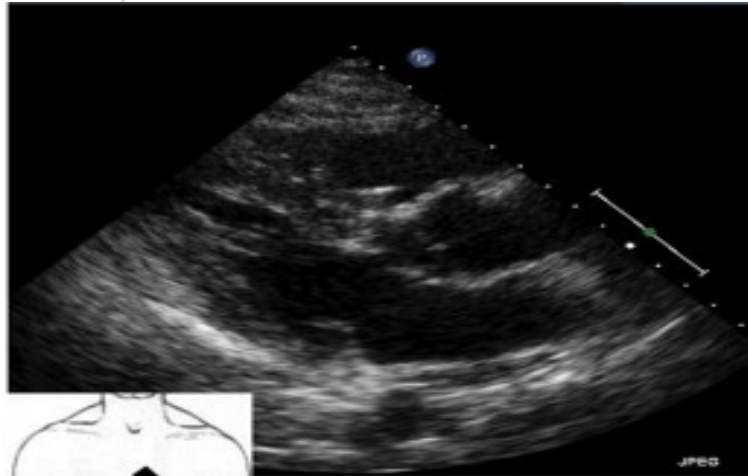
Integration: Cardiopulmonary Limited US Exam (CLUE) in the diagnosis and management of CHF



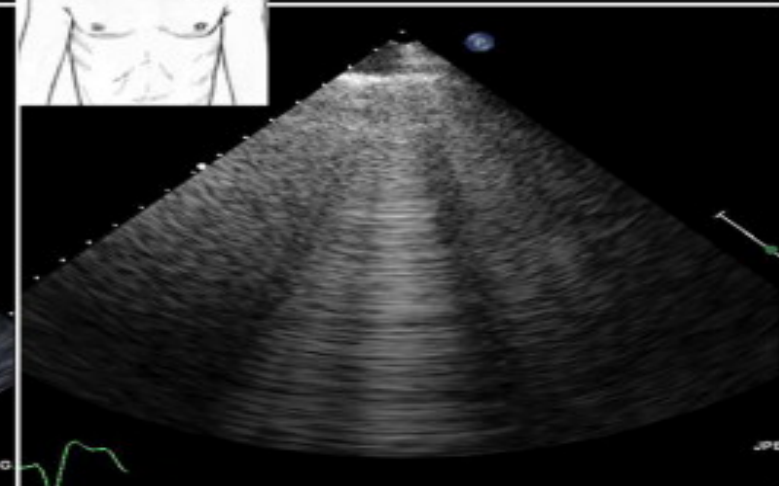
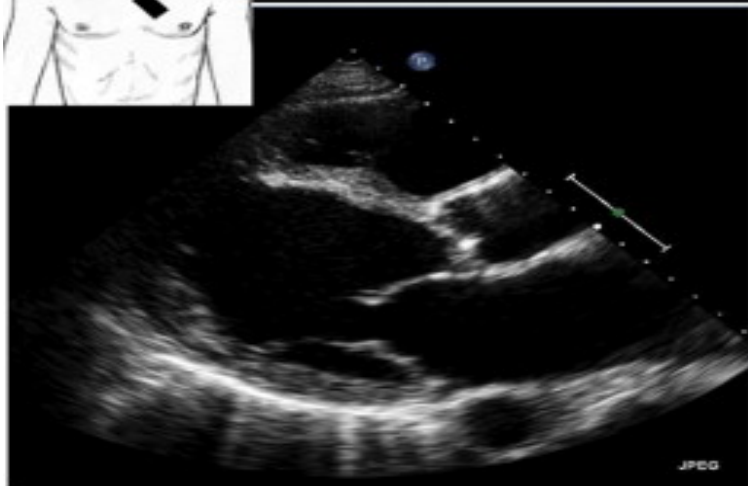
PLAX- LV, RV, valves

Subcostal- IVC

Lung



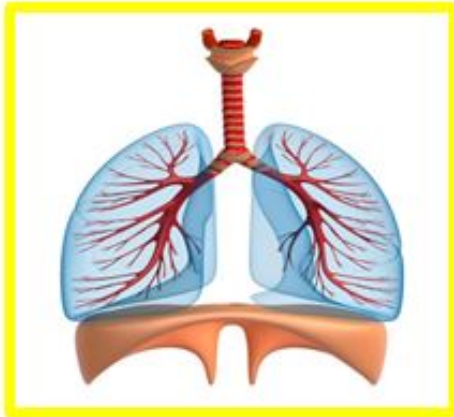
Normal



CHF

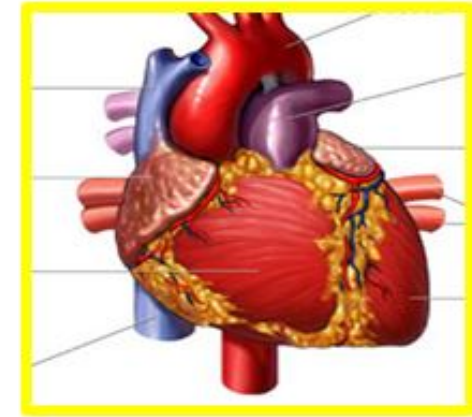
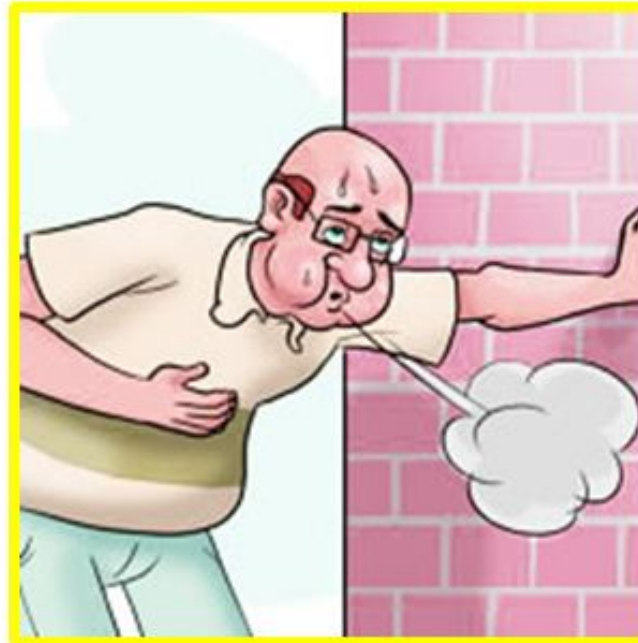
Clinical Integration:

Differentiating the typical symptom of Heart Failure: Dyspnea

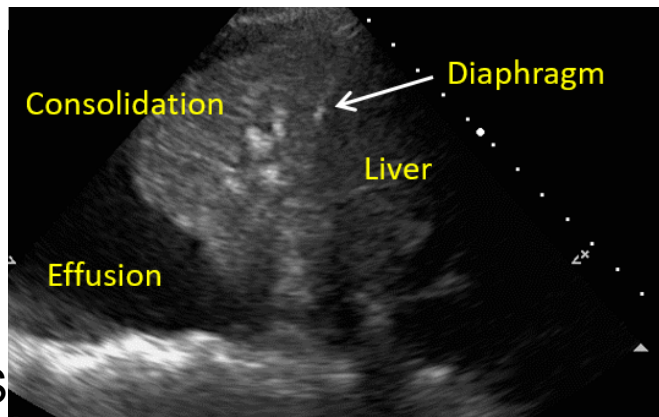


- **Pneumonia**
- **Pulmonary Embolism**
- COPD

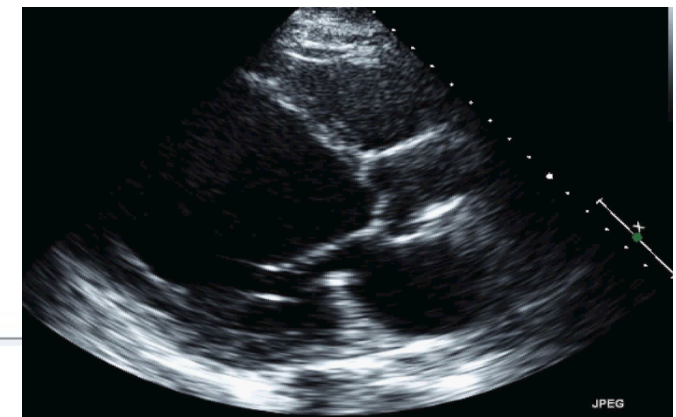
DYSPNEA



- **CHF**
- **Pericardial Effusion**
- Valvular Heart Disease



PLAPS

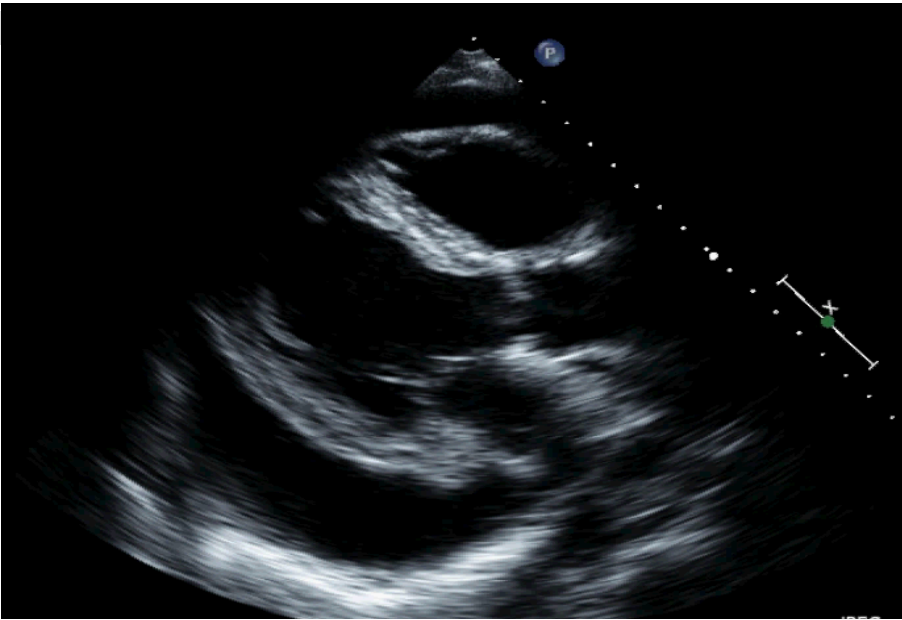
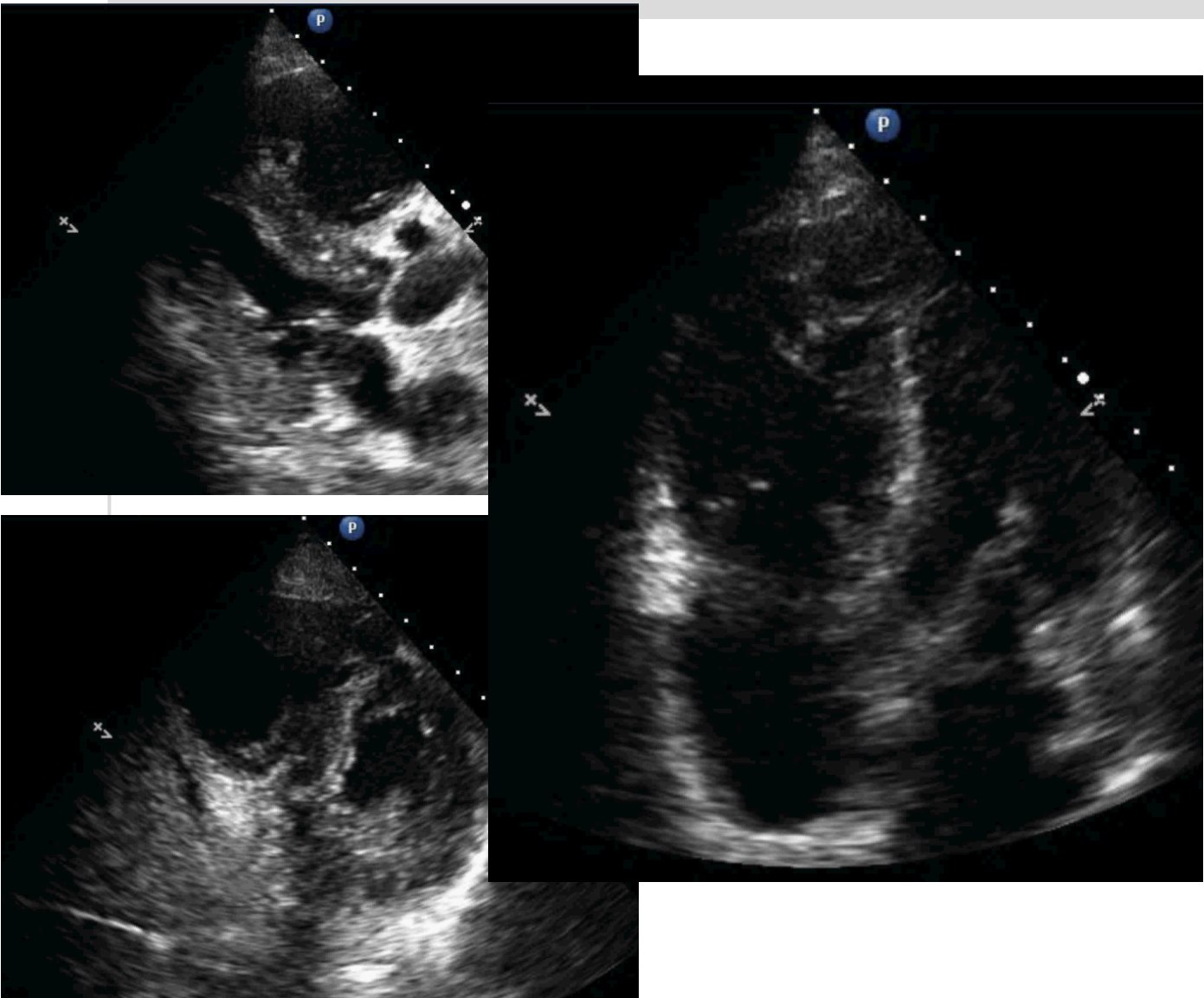


PLAX

POCUS in the differential diagnosis of Dyspnea

Pulmonary Embolism

Pericardial Effusion



Validation & Reliability

A growing literature indicates that POCUS:

- provides more accurate diagnosis than physical exam for majority of common CV abnormalities, including CHF
- results in less downstream testing; potentially reducing overall cost for patients being evaluated for a CV diagnosis
- predicts mortality outcomes in discharged hospitalized patients
- may reduce readmissions in CHF patients

Marbach JA et al. Ann Intern Med. 2019;171:264-272

Razi R et al. J Am Soc Echocardiogr 2011;24:1319-24

Kobal S et al. Am J Cardiol 2005; 96: 1002-1006

Mehta M et al. J Am Coll Cardiol Img 2014;7:983–90

Wooten J Ultrasound Med 2019; 38:967–973.

Garibyan J UltrasoundMed 2018; 37:1641–1648

Gordon, M et al. ACEP Sept, 2019

LUNG US findings:

- more accurate than CXR for dx Pulm Edema
- predict early and late mortality

Figure 1. Ultrasound scan from a patient with a discharge diagnosis of pulmonary edema. The B-line arrow points to vertical lines extending from the pleura to the edge of the visualized field and indicates the presence of pulmonary edema.

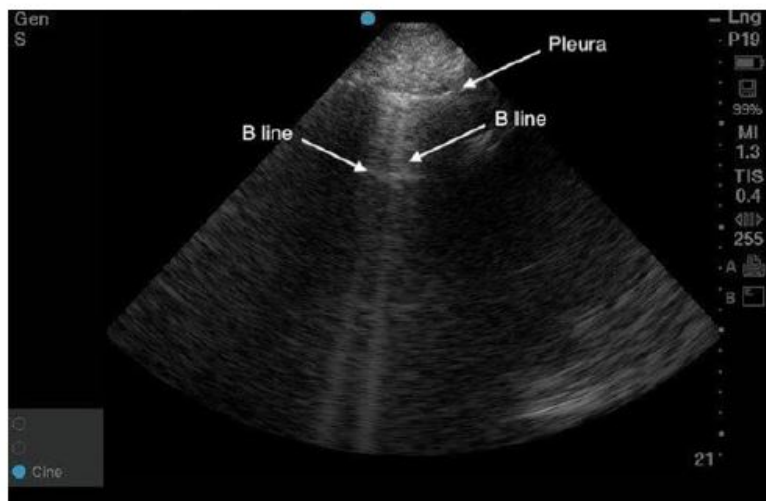


Figure 2. Ultrasound scan from a patient discharged without a diagnosis of pulmonary edema. The A-line arrow points to multiple repeating horizontal lines distinct from the pleura and seen in lungs without edema.

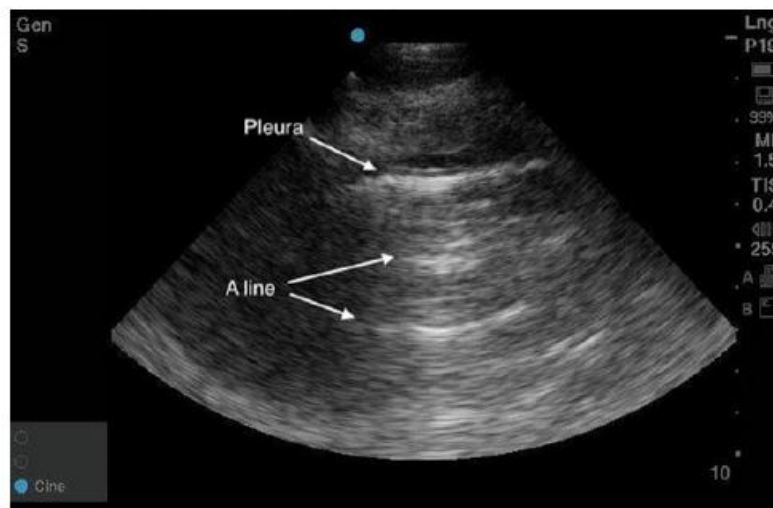
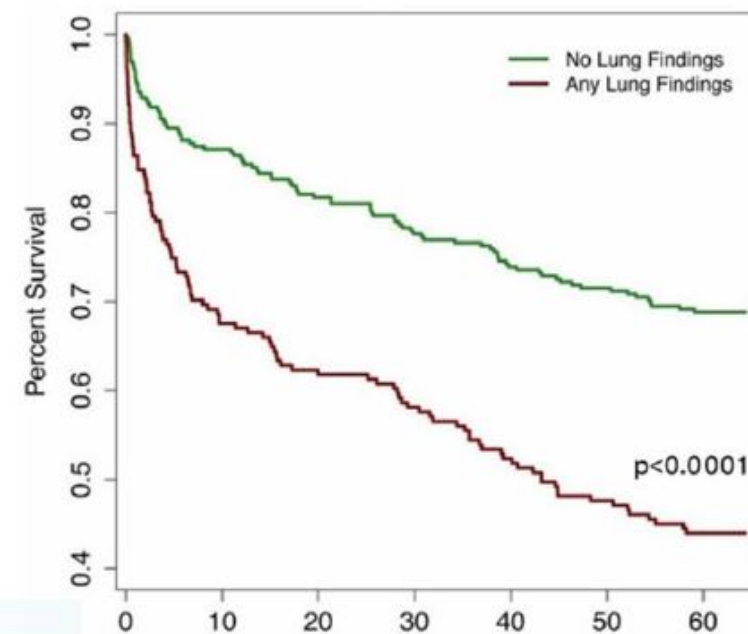


Figure 3. Kaplan-Meier mortality graph of abnormal lung findings versus no lung findings. Curves are significantly different ($P < .0001$).



	0 Months	12 Months	24 Months	36 Months	48 Months	60 Months
No Lung Findings	295	254	239	226	211	203
Any Lung Findings	191	128	118	104	92	84

Table 3. Diagnostic Performance of Chest Radiography and Bedside US Using the Discharge Diagnosis as a Reference Standard

Parameter	Radiography	US	P
Overall			
Sensitivity	33/51 (65) 51-76	49/51 (96) 86-100	<.001
Specificity	46/48 (96) 85-100	43/48 (90) 77-96	.26

Wooten *J Ultrasound Med* 2019; 38:967-973.

Garibyan *J Ultrasound Med* 2018; 37:1641-1648

POCUS - Advantages

- Real time imaging
- Portable
- Noninvasive
- Widely available
- No ionizing radiation
- Inexpensive
- ***Extension of physical exam***

POCUS - *Insonation*: The Fifth Pillar Of the Modern Physical Examination



“It is time to add a fifth pillar to the armamentarium of modern physical examination, *insonation*, with a miniaturized, portable handheld device.”

Narula J, Chandrashekar Y, Braunwald E. JAMA Cardiol 2018

Limitations

- Poor penetration of bone
- Poor imaging behind bones or air-filled regions (shadowing)
- Mechanical (breakability/power source); Cost
- Infection Control; Billing; Archiving
- ***SKILL REQUIRED = TRAINING***
 - acquisition
 - interpretation
 - integration

Online learning and hands-on experience (simulators, patients)





CAUTION
THIS MACHINE
HAS NO BRAIN
USE YOUR OWN



Seek proper training! Know your limitations!



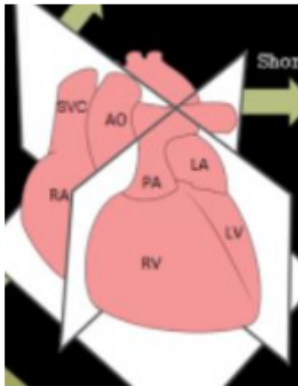
Cardiovascular POCUS for the Medical Student and Novel User

ASE POCUS TASK FORCE - released October 2018 – FREE access



Courses / Cardiovascular Point-of-Care Imaging for the Medical Student and Novice User

<https://aseuniversity.org/ase/lessons/47>



Cardiovascular Point-of-Care Imaging for the Medical Student and Novice User

Standard: Free

[Access Content](#)

Cardiovascular Point-of-Care Imaging for the Medical Student and Novice User introduces basic cardiac point-of-care ultrasound concepts for all stages of medical school. The curriculum is **modular** in format, allowing **educators** and **learners** to select the components needed to either enhance their existing ultrasound programming, or to use the modules as a **starting point to deliver cardiovascular point-of-care education**. Modules include anatomy, integration with the physical exam, pathology, 'teach the teacher', and testing themes.

The *Cardiovascular Point-of-Care Imaging for the Medical Student and Novice User* is endorsed by ASE's partners WINFOCUS and the Canadian Society of Echocardiography.

- **Intro: Cardiac POCUS – Views, Correlation to Basic Anatomy**
- **Complete Cardiac POCUS Scan**
- **Integrated Cardiac POCUS and Physical Examination**
- **Pathology**
- **Teaching the Teacher - How and What to Teach Medical Students**
- **Standards and Testing**

Rectangular Snip

Cardiac POCUS: Training and Goals

GUIDELINES AND STANDARDS

Recommendations for Echocardiography Laboratories Participating in Cardiac Point of Care Cardiac Ultrasound (POCUS) and Critical Care Echocardiography Training: Report from the American Society of Echocardiography

James N. Kirkpatrick, MD, FASE, Richard Grimm, DO, FASE, Amer M. Johri, MD, FASE, Bruce J. Kimura, MD, Smadar Kort, MD, FASE, Arthur J. Labovitz, MD, FASE, Michael Lanspa, MD, FASE, Sue Phillip, RCS, FASE, Samreen Raza, MD, Kelly Thorson, MSRS, ACS, RDCS, RCCS, FASE, and Joel Turner, MD, FRCP, *Seattle, Washington; Cleveland, Ohio; Kingston, Ontario and Montreal, Quebec, Canada; San Diego and Palo Alto, California; Stony Brook, New York, Tampa and Naples, Florida; Salt Lake City, Utah; Baltimore, Maryland; Plano, Texas*

Keywords: Cardiac POCUS, Critical care echocardiography, Training, Echocardiography laboratory

Kirkpatrick JN et al. J Am Soc Echocardiogr. 2020; 33:409-22

CARDIAC POCUS

- Medical Student/Novice Curriculum
- $\geq 1-2$ weeks training
- Cardiac POCUS Portfolio
 - 30-50 proctored cardiac POCUS scans with image review and interpretation in comparison with full feature echo
- Cardiac POCUS Refresher
 - 10 proctored scans

Table 2 Sample objectives for cardiac POCUS

- 1) List the views that should be acquired as part of the cardiac POCUS examination.
- 2) Obtain all of the views that should be acquired as part of the cardiac POCUS examination.
- 3) Perform an interpretation of a cardiac POCUS examination to include interpretation of left and right ventricular function, left ventricular wall thickness, left atrial size, presence of pleural and/or pericardial effusion, IVC size and collapsibility.
- 4) Describe tamponade physiology findings as they will appear on cardiac POCUS.
- 5) Describe cardiac POCUS examination findings associated with pulmonary embolism.
- 6) Describe cardiac POCUS examination findings associated with heart failure with reduced ejection fraction.
- 7) Describe cardiac POCUS examination findings associated with heart failure with preserved ejection fraction.

IVC, inferior vena cava; *POCUS*, point of care ultrasound.

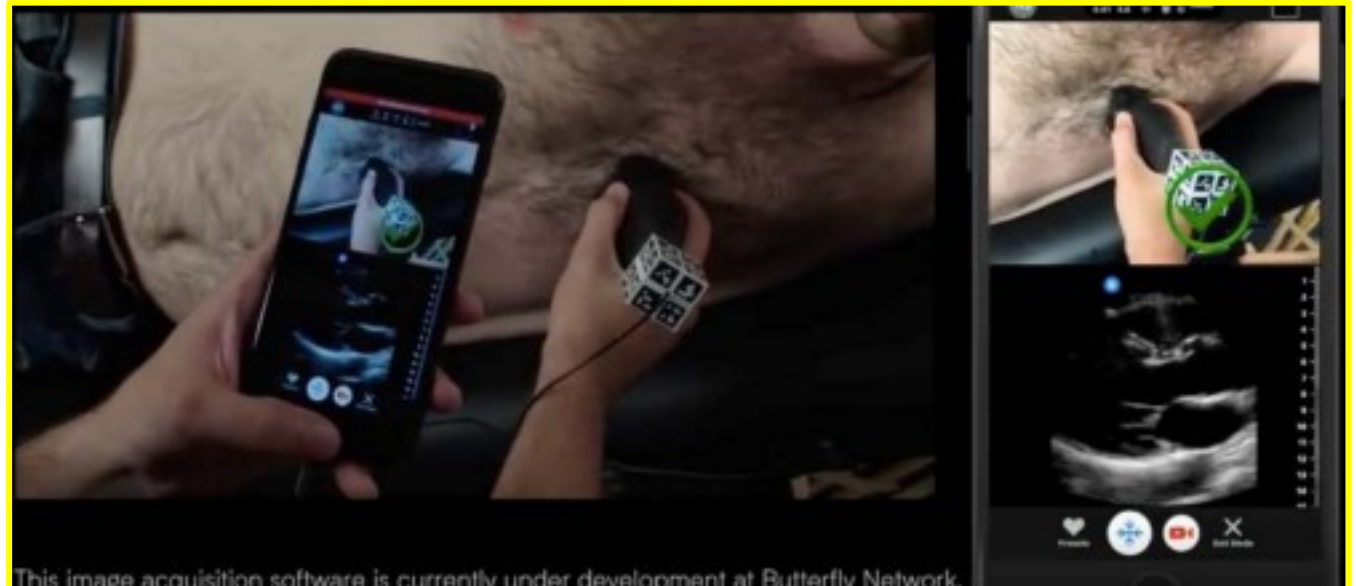
POCUS: CLOUD-BASED LEARNING & AI

- **Lumify: REACTS-** integrated “tele-ultrasound”
- **Butterfly: Augmented Reality Telemedicine Technology** “Tele-Guidance technology”



<https://www.usa.philips.com>

<https://www.youtube.com/watch?v=GpJYzfn1J5Y>



www.butterflynetwork.com

<https://www.youtube.com/watch?v=dIIOTFyKMVU>



POCUS and COVID19



ASE AMERICAN SOCIETY OF
ECHOCARDIOGRAPHY
Sound Saves Lives











ASE Statement on Point-of-Care Ultrasound (POCUS) During the 2019 Novel Coronavirus Pandemic

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Amer M. Johri, MD, MSc, FRCPC, FASE (Chair), Benjamin Galen, MD, FACP, James N. Kirkpatrick, MD, FASE, Michael Lanspa, MD, FASE, FCCM, Sharon Mulvagh, MD, FASE, FRCPC, Ritu Thamman, MD, FASE, *Kingston, Ontario, Canada; Bronx, New York; Seattle, Washington; Salt Lake City, Utah; Halifax, Nova Scotia, Canada; Pittsburgh, Pennsylvania*

J Am Soc Echocardiogr. 2020; in press

Table 1. ASE POCUS Protocol in Suspected or Confirmed COVID-19 Infection. A modified POCUS protocol to assist in the assessment of COVID-19 patients includes heart, chest and vessel views.

COVID19 POCUS Protocol	Structure Imaged	Assessment	Disease Associations
Cardiac    	Left Ventricle	Size, Global and Regional Function	Myocarditis ACS Cardiomyopathy Shock
	Right Ventricle	Size and Function; TR for PASP if available	PE Cardiomyopathy
	Pericardium	Effusion	Tamponade
	Valves	Gross Regurgitation or stenosis	Pre-existing CV disease
Lung    	8 or 12 point exam	B Lines (A lines, pleural sliding are normal)	Edema or Pneumonia
		Sub-pleural Consolidation Thickened Pleura	Pneumonia ARDS
		Lobar consolidation with air Bronchograms	Pneumonia ARDS
		Effusion	CHF
Vascular  	JVP or Subcostal IVC	Fluid Status	CHF, hypovolemia
	+/- Leg Veins*	2 point compression*	DVT

Take Home : POCUS and CHF management

- POCUS is a disruptive innovation that is here to stay
- Newer devices, less cost, interactive guidance
- Challenges our conventional CV approaches with potential for added value – immediate results, integrated into patient care
- Basic assessment: cardiac, lung, vascular (IVC)
 - rapid, repeatable
- CHF practice:
 - differential diagnosis of dyspneic patients
 - serial monitoring, dismissal timing
 - follow-up, Rx guidance
- *Requires appropriate training*

Additional POCUS Online Learning Resources

- <https://aseuniversity.org/ase/lessons/47>
- <http://www.susme.org/learning-modules>
- <http://www.sonomojo.org/complete-foamed-ultrasound-curriculum/>
- <http://imbus.anwresidency.com/core.html>
- <http://imbus.anwresidency.com/advanced.html>
- <http://pie.med.utoronto.ca/TTE/index.htm>
- <http://pocusjournal.com/>
- <https://sites.google.com/site/calgaryimus/home>

Thank You! Q & A

Submit your questions by clicking on the Q&A icon on your screen