

HANDHELD POINT-OF-CARE ULTRASOUND (POCUS) TECHNOLOGY: AN *EMERGING* TOOL FOR CLINICAL DECISION MAKING



National Commission on Correctional Healthcare
Spring Conference, Atlanta, GA April 11, 2022

Presenters

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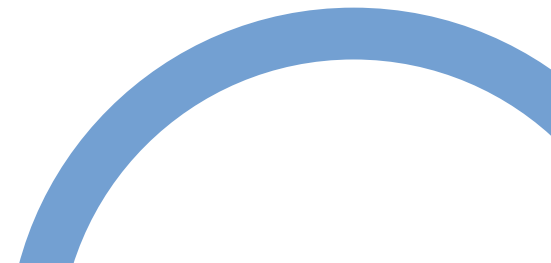
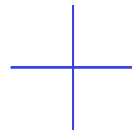
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A Special Thank You



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Disclosure

“There are no financial conflicts of interest to disclose.”



Learning Objectives

1. Review common POCUS procedures in the correctional medicine setting.
1. Identify potential innovations for POCUS procedures in corrections.
1. Explain common high-impact POCUS procedures.



Image:

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Presentation Outline

1) Review POCUS development, applications and research (John May, MD)

2) Implementation and training of POCUS in the correctional medicine setting (Johnny Wu, MD)

3) Kansas DOC POCUS pilot (Paige Dodson, MD, MPH)

4) Demonstration of common POCUS procedures (Dacia Jordanov and Penny Hall)



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CORRESPONDENCE

PSEUDO MEDICAL HOCUS POCUS

January 27, 1936.

Editor, *New England Journal of Medicine*,

A colleague of mine, being somewhat bewildered, referred the following letter to me for interpreta-

tion. It concerns a young patient of his with a rash who was somehow referred to the so-called Research Department of a suburban hospital. The contents of the letter were so remarkable that I thought they might be worthy of publication. With omission of names and with my own parenthetical observations, the communication reads exactly as follows:

"These tests show that Miss C. is a pituitary type with a dysfunction of the mineral-metabolizing hormone and of the carbohydrate metabolizing hormone. (God help the poor already overburdened pituitary!) This anterior pituitary dysfunction is the cause of her dermatitis (!!), of her low resistance and would in later life be the cause of grave disturbances of the pancreas and the ovarial function. (P-l-lease, doctor!)

"We suggest respectfully to submit Miss C. to a Tuberculin test and to have her chest examined to rule out TBC, since the high phosphorus level in the blood may have some bearing on it.

"We suggest a dietary regime to correct the faulty metabolism and to increase the resistance to infections. The diet must contain large amounts of C.H.,

iron, calcium, and must be especially rich in all

MEDICAL HOCUS POCUS

Several questions suggest themselves: Is it advisable for the Massachusetts Medical Society to take cognizance of such fancy quackery since the harm which must inevitably result is probably greater by far than that performed by well-recognized quacks? Secondly, does not this report written by a "Ph.D." and suggesting various therapeutic procedures constitute the practice of medicine without a license?

POCUS

The NEW ENGLAND JOURNAL of MEDICINE

CURRENT CONCEPTS ; REVIEW ARTICLE

N Engl J Med 2011;364:749-57.

Point-of-Care Ultrasonography

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

- Ultrasound is safe and effective, used by physicians for more than half a century to aid in diagnosis and guide procedures.
- Over the past two decades, ultrasound equipment has become more compact, higher quality, and less expensive, which has facilitated the growth of point-of-care ultrasonography (POCUS). Many hand-held machines matched the imaging quality of large machines.
- In 2004, American Institute of Ultrasound in Medicine (AIUM) concluded that “the concept of an ‘ultrasound stethoscope’ is rapidly moving from the theoretical to reality.”
- Some medical schools are now beginning to provide their students with hand-carried ultrasound.



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POCUS

- Point-of-care ultrasonography (POCUS) is defined as the acquisition, interpretation, and immediate clinical integration of ultrasonographic imaging performed by a treating clinician at the patient's bedside rather than by a radiologist or cardiologist.
- Complements, does not replace, conventional diagnostic pathways
- Assists with clinical uncertainty in real time.



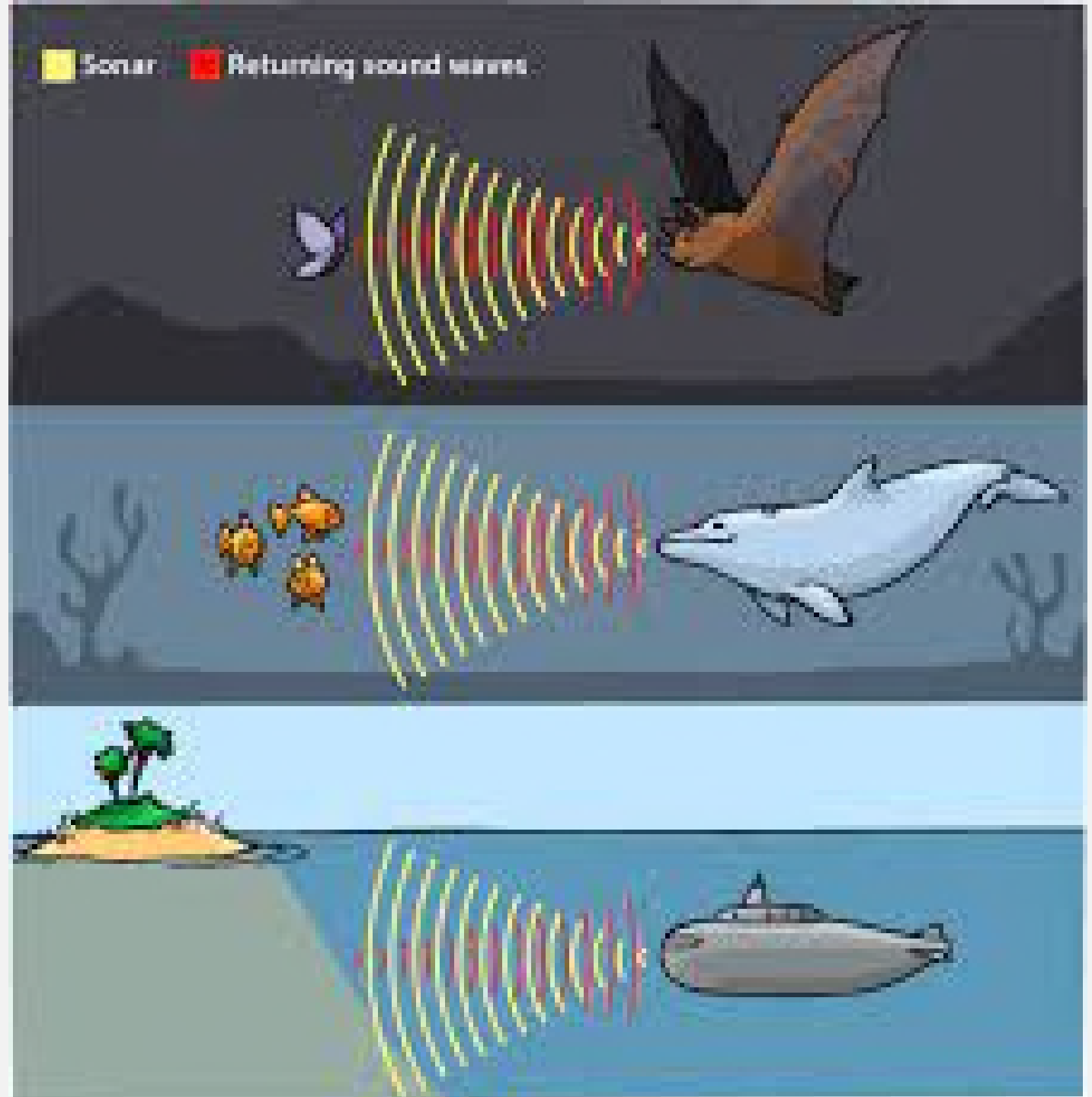
ACP STATEMENT IN SUPPORT OF POINT-OF-CARE ULTRASOUND IN INTERNAL MEDICINE

- The American College of Physicians is formally acknowledging the important role of point-of-care ultrasound (POCUS) in internal medicine. Specifically, ACP plans to:
 - establish clinical guidelines regarding the appropriate use of point-of-care ultrasound by all internal medicine physicians including general internists and subspecialists
 - define the educational curriculum needed to train residents and internists in the appropriate use of POCUS in internal medicine
 - collaborate with Society of General Internal Medicine and other professional internal medicine societies to establish a roadmap for implementation of POCUS education and training
 - expand ACP's POCUS training programs to enable more internists to attain competency in POCUS

2021: ACP suggests that clinicians may use point-of-care ultrasonography in addition to the standard diagnostic pathway when there is diagnostic uncertainty in patients with acute dyspnea in emergency department or inpatient settings

HOW DOES A SONAR WORK?

- SONAR (“sound navigation and ranging”) works by sending out sound waves and measuring how long it takes for the echo to return
- Ultrasound is similar principal. It is defined as a frequency above that which humans can hear, or more than 20,000 Hz (20 kHz).



ULTRASOUND

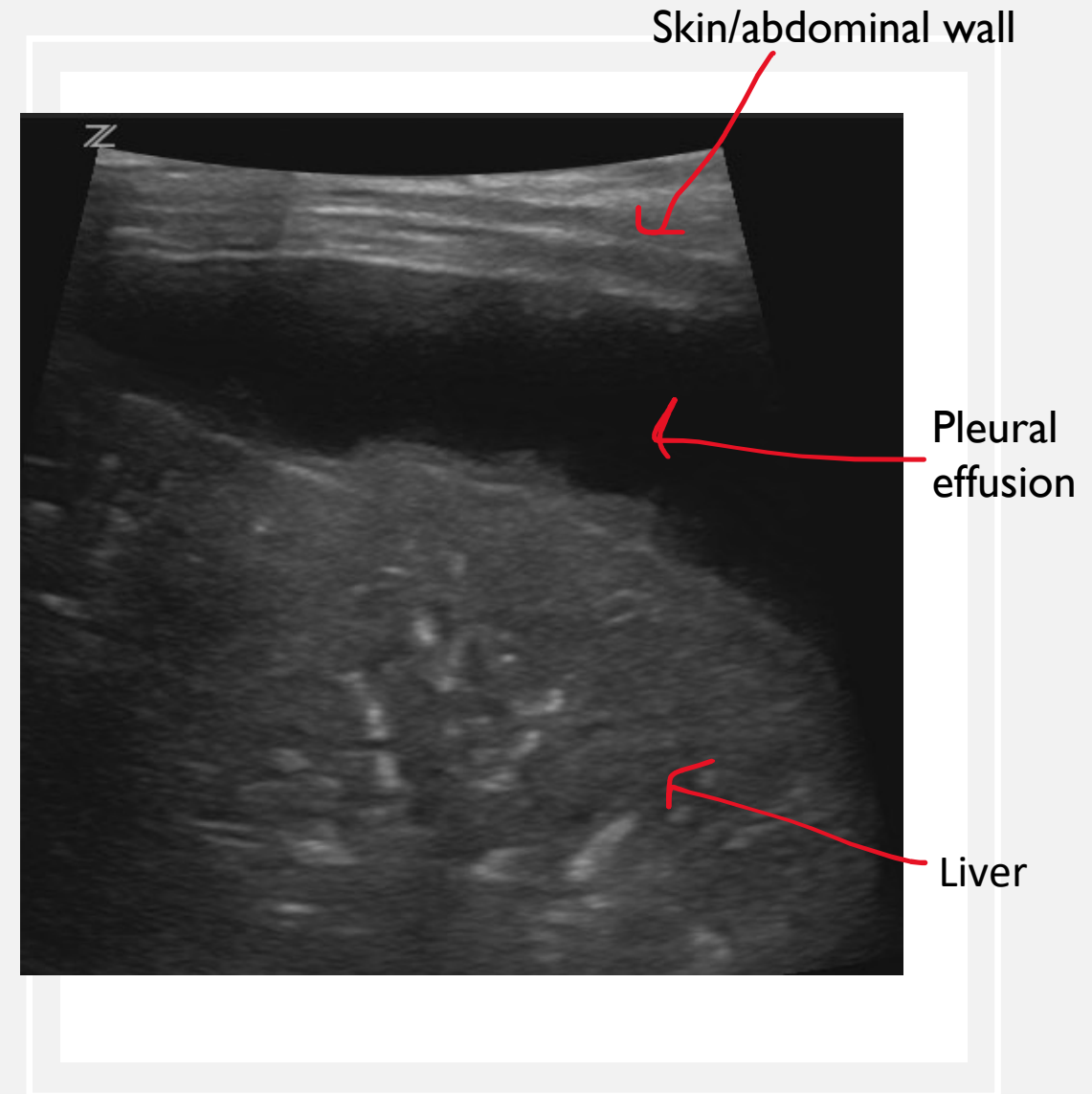
Ultrasonography uses a “crystal” that generates a sound wave when an electric current is applied. When the sound wave returns, the material in turn generates a current. The crystal thus both transmits and receives the sound.

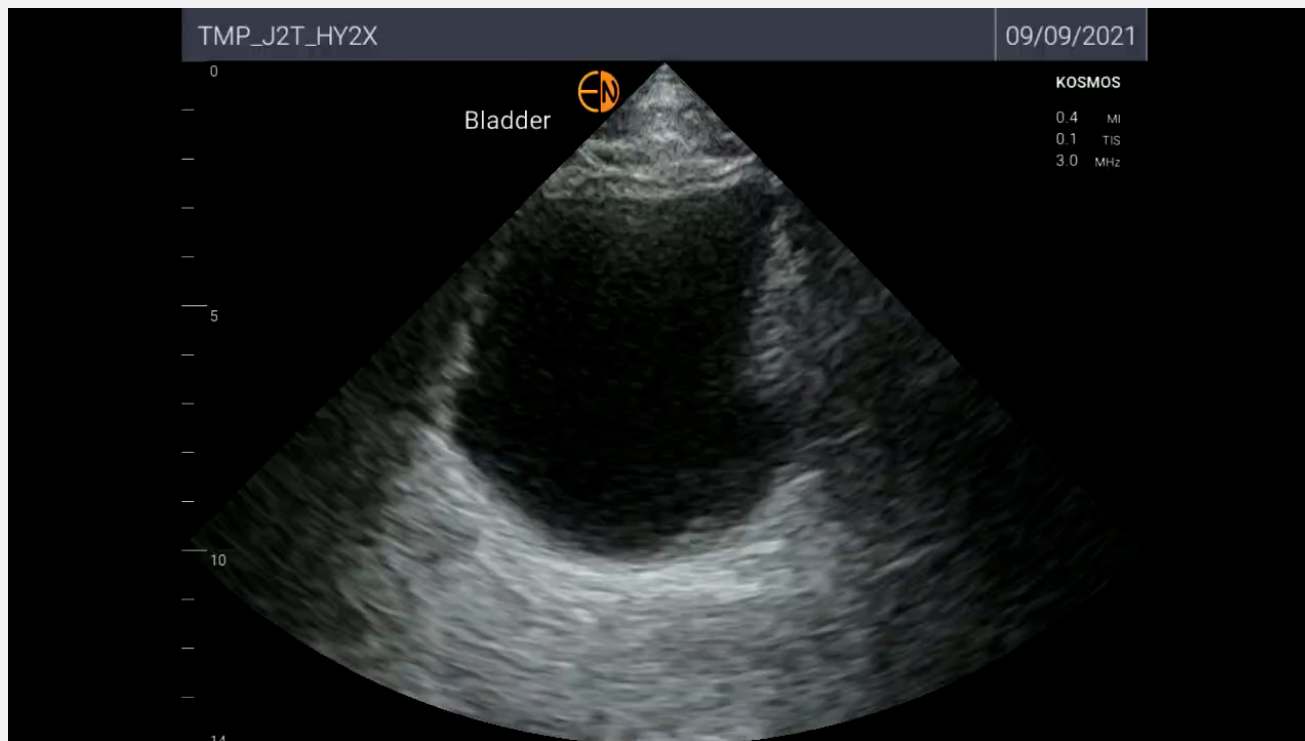


ULTRASOUND BASICS

Ultrasound penetrates well through fluid and solid organs (e.g., liver, spleen, and uterus); it does not penetrate well through bone or air, limiting its usefulness in the skull, chest, and areas of the abdomen where bowel gas obscures the image.

Fluid (e.g, blood, urine, bile, and ascites), which is completely anechoic, appears black on ultrasound images, making ultrasonography particularly useful for detecting fluid and differentiating cystic or vascular areas from solid structures.





- Bladder

COMMON APPLICATIONS OF ULTRASOUND

The FAST (Focused Assessment with Sonography in Trauma) examination looks for the presence of fluid

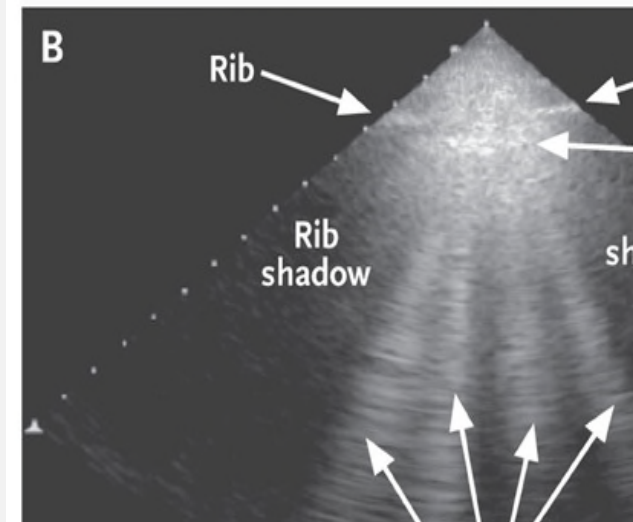
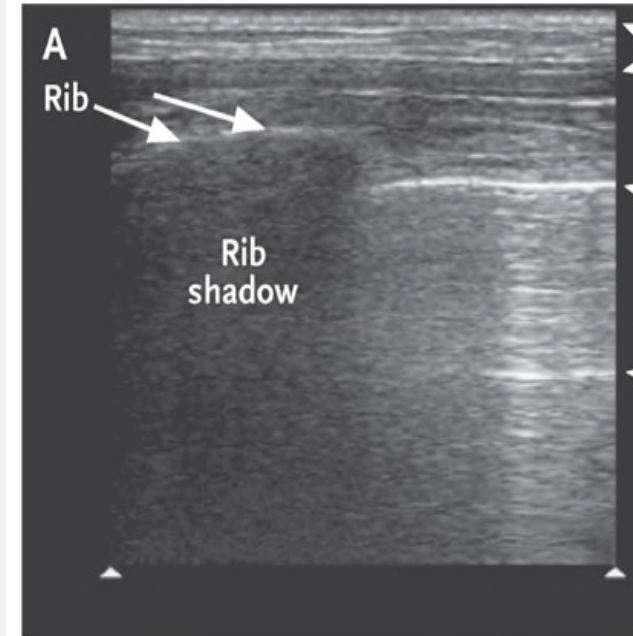
- Pericardial
- Perihepatic
- Perisplenic
- Pelvic
- E-FAST - pleural spaces for a pneumothorax or pleural effusion

Pulmonary assessments – pneumonia, CHF, pneumothorax, pleural effusion, pulmonary embolism

Soft tissue masses

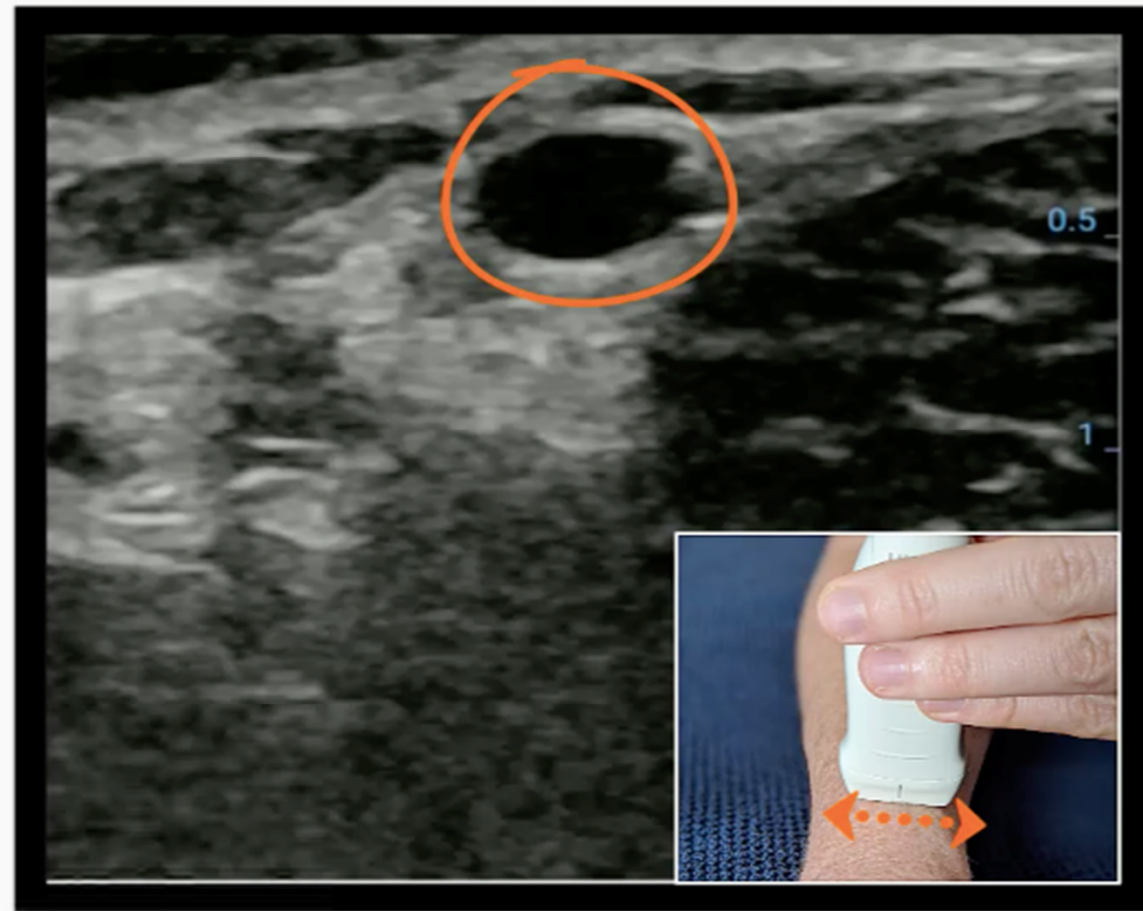
Phlebotomy / Line placements

Injection procedures



Imaging - Vein

Transverse View



Imaging – Vein with need

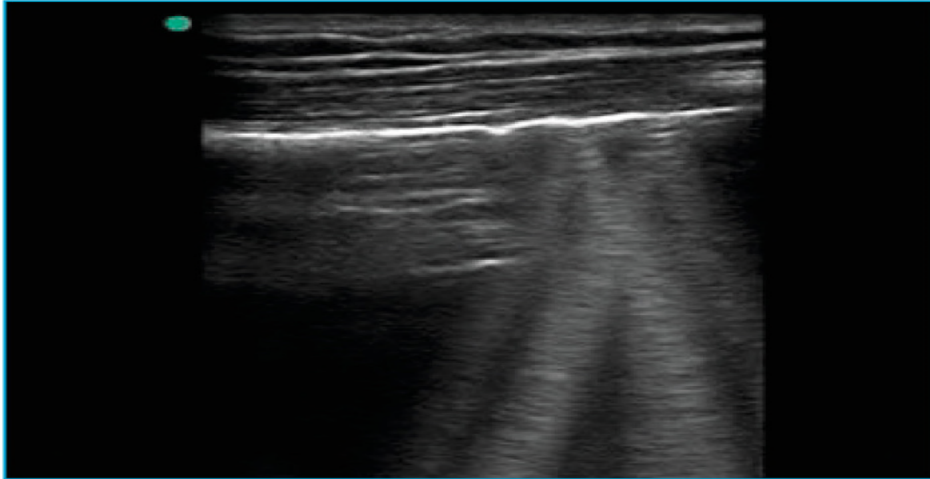
Transverse View



Acute Pulmonary Edema

Sensitivity: 88%

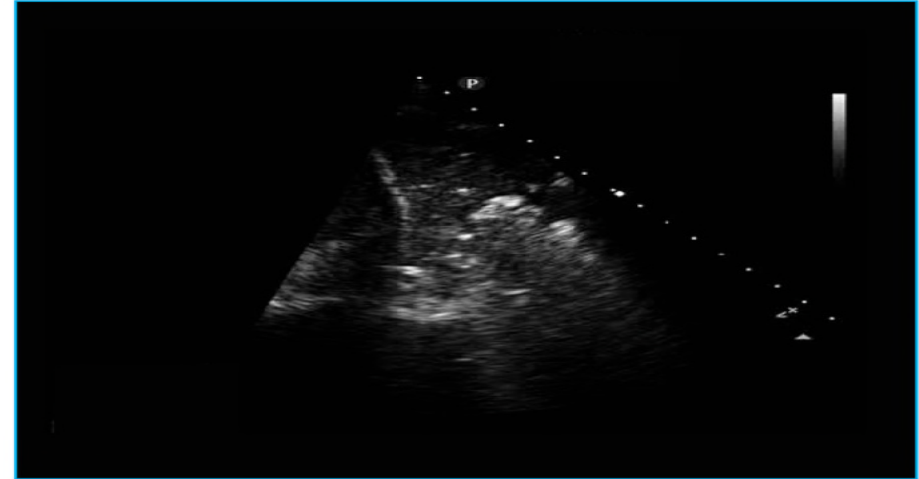
Specificity: 90%



Pneumonia

Sensitivity: 88%

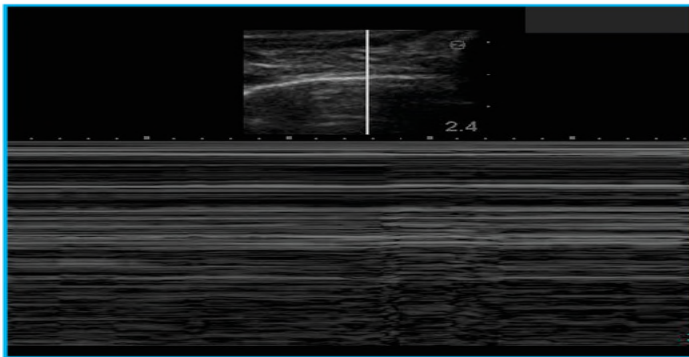
Specificity: 93%



Pneumothorax

Sensitivity: 81%

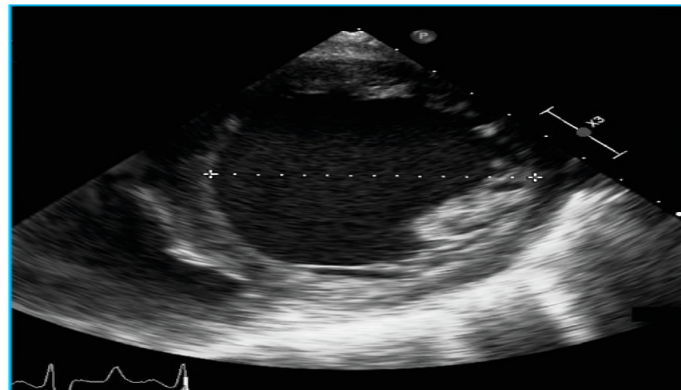
Specificity: 100%



Left Ventricular Dysfunction

Sensitivity: 69–94%

Specificity: 88–96%



Thoracoabdominal Trauma

Sensitivity: 74%

Specificity: 96%



WHAT DO THE STUDIES SHOW?

- Retrospective study showed that the introduction of POCUS performed by intensivists led to a decreased number of comprehensive diagnostic echocardiographic studies overall, yet led to a recommendation to perform full diagnostic echocardiographic studies in 10%.
 - Alherbish A, Priestap F, Arntfield R. The introduction of basic critical care echocardiography reduces the use of diagnostic echocardiography in the intensive care unit. J Crit Care 2015;30(6):1419.e7-1419.e11.
- Study in low-income country setting showed that POCUS facilitated confirmation of the suspected clinical diagnosis in up to 50% of cases and supported a change in the initial diagnosis in 23% of cases.
 - Baker DE, Nolting L, Brown HA. Impact of point-of-care ultrasound on the diagnosis and treatment of patients in rural Uganda. Trop Doct 2021;51:291-296.

WHAT DO THE STUDIES SHOW?

Studies review, 2004 – 2020, of bedside POCUS done by students, residents, general internists, or intensivists in hospitalized or ED patients with acute dyspnea

Assess test accuracy in detecting congestive heart failure, pneumonia, pulmonary embolism, pleural effusion, or pneumothorax.

POCUS with standard pathway, sensitivity 79%-100%, specificity 63%-100%

Standard pathway alone, sensitivity 0%-83%, specificity 68%-100%

Appropriate Use of Point-of-Care Ultrasonography in Patients With Acute Dyspnea in Emergency Department or Inpatient Settings: A Clinical Guideline From the American College of Physicians. Qaseem, A., et al; for the Clinical Guidelines Committee of the American College of Physicians. *Ann Intern Med.* 2021;174:985–993. doi:10.7326/M20-7844

WHAT DO THE STUDIES SHOW?

Several studies indicate that POCUS is more cost-effective and time-efficient than traditional ultrasonography in obtaining data that may decrease the length of stay in the emergency department for

nephrolithiasis

uncomplicated biliary disease

early intrauterine pregnancy

soft tissue infection

1. Hilsden R, Leeper R, Koichopolos J, et al. Point-of-care biliary ultrasound in the emergency department (BUSED): implications for surgical referral and emergency department wait times. *Trauma Surg Acute Care Open* 2018;3(1):e000164-e000164.
2. Lin MJ, Neuman M, Rempell R, Monuteaux M, Levy J. Point-of-care ultrasound is associated with decreased length of stay in children presenting to the emergency department with soft tissue infection. *J Emerg Med* 2018;54:96-101.
3. Panebianco NL, Shofer F, Fields JM, et al. The utility of transvaginal ultrasound in the ED evaluation of complications of first trimester pregnancy. *Am J Emerg Med* 2015;33:743-748.
4. Metzler IS, Smith-Bindman R, Moghadassi M, Wang RC, Stoller ML, Chi T. Emergency department imaging modality effect on surgical management of nephrolithiasis: a multicenter, randomized clinical trial. *J Urol* 2017;197:710-714.

NEJM REVIEW ARTICLE: [POINT-OF-CARE ULTRASONOGRAPHY](#)

J.L. DÍAZ-GÓMEZ, P.H. MAYO, AND S.J. KOENIG

N ENGL J MED 2021; 385:1593-1602

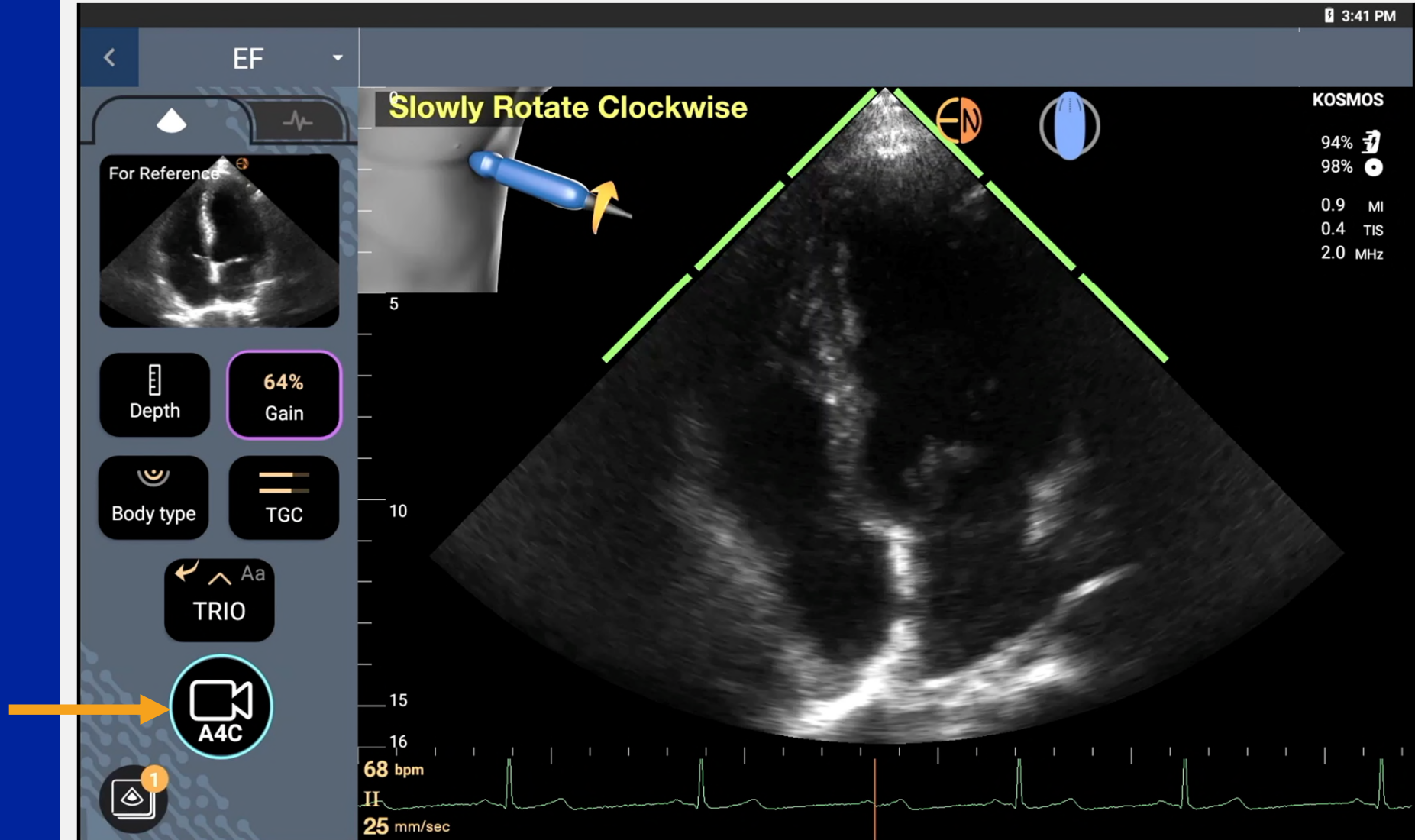
	POCUS performed by non-radiologists and non-cardiologists	Consultative ultrasoundography performed by radiologists and cardiologists
cope of practice	Combined with history taking and physical exam, POCUS performed directly by treating clinician	Clinician responsible for the care orders the test, performed by stenographer, and interpreted by radiologist or cardiologist
xamples of training requirements	ACGME core competency for general surgery, anesthesiology, critical care; Emergency medicine training and others	ACGME core competency for radiology, cardiology fellowship
ossible limitations	<ul style="list-style-type: none">- Inadequate training, lack of competency (potential false positive and false negative)- Heterogeneous documentation, quality assurance	<ul style="list-style-type: none">- Delay in performance, interpretation, communication of results- Consultants lack of knowledge of the clinical situation- Increased healthcare costs and lack of immediate availability

GROWTH OF POCUS

- The World Health Organization states that plain radiography and ultrasonography, singly or in combination, will meet two thirds of all imaging needs in developing countries.
- Digital storage, transmission, artificial intelligence continue to grow the field.

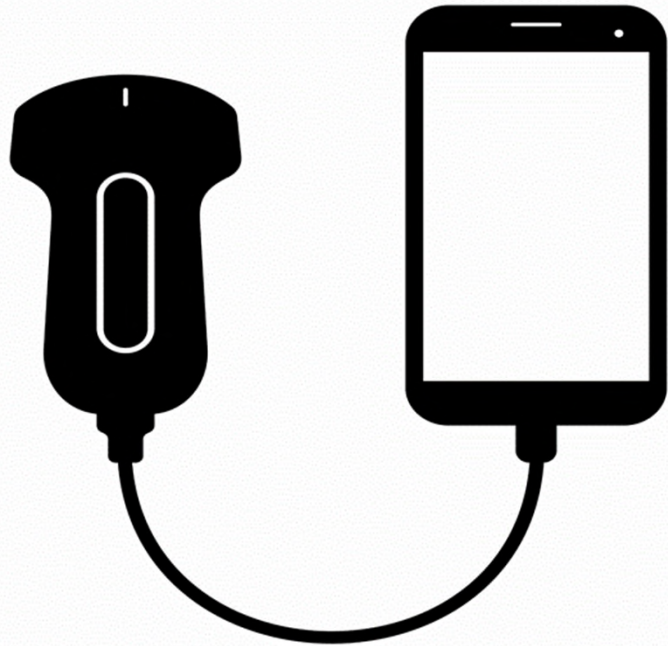


- AI-Driven Automated Systolic Heart Function



Optional Stand

Grab and Go!





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IMPLEMENTATION AND TRAINING



IMPLEMENTATION AND TRAINING



- Designation of superusers
- Virtual didactics and training videos
- CME course reimbursements
- Vendor onsite for 2 days of hands-on training
- Competency demonstrations









EXPERIENCE FROM THE FIELD

Paige Dodson, MD, MPH, Statewide Medical Director, Centurion of Kansas



ULTRASOUND PILOT

- 30 patient exams completed in 60 days at first pilot site
- Phlebotomy, IV placement, Knee, Gallbladder, Soft Tissue Mass, Trigger Finger Injection
- 50% avoided off-site trips
- Expanded to additional sites

PATIENT VIGNETTES

27 y/o female with Hep C (treated) and RUQ pain

- Physician suspected GB disease given symptoms
- Consultative ultrasound taking much longer due to COVID-19 restrictions
- POCUS showed stones 12/10/21
- Referred to surgeon without needing additional imaging
- Diagnosis of large distended GB with multiple stones
- Lap Chole 1/26/22

PATIENT VIGNETTES

44 y/o female with PTSD, personality disorder and persistent N/V

- Physician suspected GB disease given symptoms
- POCUS showed stones 12/10/21
- Referred to surgeon without needing additional imaging
- Diagnosis of large distended GB with multiple stones
- Successful Lap Chole 12/22/21

PATIENT VIGNETTES

36 y/o with Hep C

Treatment had not started because venous access to draw labs was so challenging

We considered permanent and central access (port or PICC lines).

Labs were drawn using POCUS

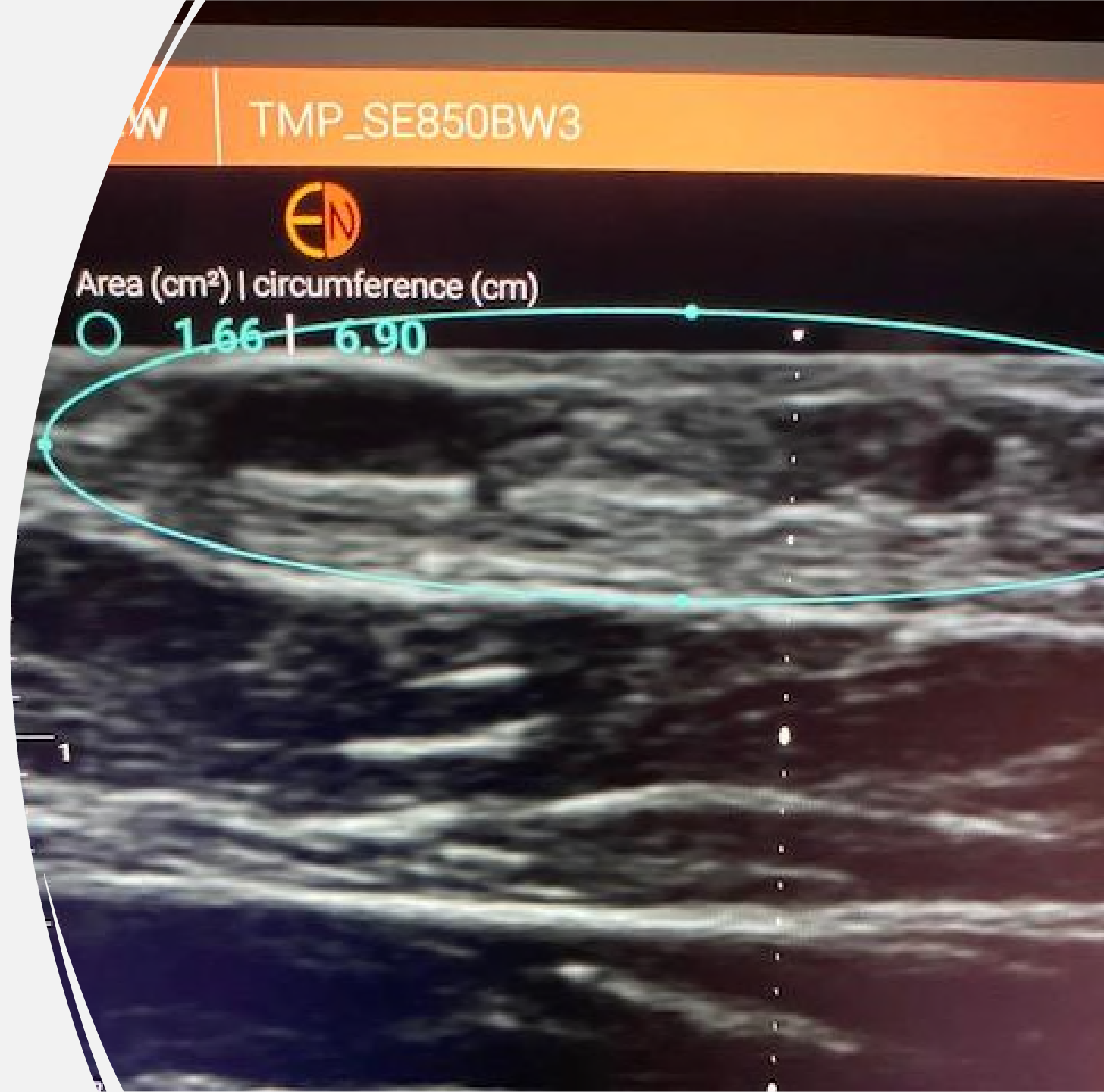
PATIENT VIGNETTES

39 y/o with hx of IDU, concern for Hep C, needed screening labs

- Patient reports previous lab draws have required as many as 16 attempts
- Lab draw successful with POCUS
- Hep C was confirmed with the testing accomplished that day

SOFT TISSUE EXAM

- Painful R plantar foot w/ standing
- Xray only reports artifact
- POCUS: Suspect plantar fibromatosis - U/S shows hypoechoic nodules along thickened plantar fascia which would be the striations just under the nodules.



EMAIL to Statewide Medical Director: I had a gentleman who needed a shoulder injection. We got the sono out and identified the space and accomplished the injection sono guided. IT WAS SO COOL! We could see the med go in the space. Prior to the injection, the patient asked to see his heart and we looked at veins too. He had almost no understanding of what his heart did, how it worked and that both sides of his body had both veins and arteries. It was a great opportunity for teaching and he was thrilled with the experience. Thanks again for the technology and the great training.





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