Attention All Participants
To Receive CME Credit
Text Code: CD31B
To: 336-793-9317
*MyAHEC account is required for credit
For more instructions visit: www.nwahec.org/textreg

Ultrasound Research Symposium
Sept 20, 4:30 PM – 6:00 PM
Disclosure Statement
9/20/21

Dr. Aarti Sarwal is a consultant for Lungpacer Inc. In addition, she receives other financial or material support from the Society of Critical Care Medicine, Neurocritical Care Society and the American Association of Physical Therapy.

Dr. Noreen Kelly is on the speaker’s bureau for Abbott Labs.

All conflicts have been mitigated.

None of the other presenters, planning committee members or staff have any relevant conflicts.
Attention All Participants To Receive CME Credit
Text Code: CD31B
To: 336-793-9317
*MyAHEC account is required for credit
For more instructions visit: www.nwahec.org/textreg

Ultrasound Research Symposium
Sept 20, 4:30 PM – 6:00 PM
Ultrasound: The Sounds of Innovation, Education, and Research
Vivek Tayal, MD FACEP, FAIUM

Professor of Emergency Medicine
Chief of the Division of Emergency Medicine Point-of-Care Ultrasound

Department of Emergency Medicine
Carolinas Medical Center at Atrium Health

- Chairman, Research Director, and Ultrasound Director of the Department of Emergency Medicine at Wilford Hall Medical Center, San Antonio, Texas
- ACEP Emergency Ultrasound Section Chair
- ABEM Clinical Ultrasonography Task Force
- AIUM Board Member
- Chair of the Clinical Ultrasound Accreditation Program
- 50+ referred articles, letters and chapters, including the majority of ultrasound guidelines and policies in Emergency Medicine and the ultrasound management textbook
- NCCEP President
- Director of Quality Assessment for CMC EM
- Reviewer for 10 national medical journals

Wake Forest School of Medicine
Atrium Health
Ultrasound at Legacy Atrium
The Sounds of Innovation, Education and Research
Vivek Tayal, MD, FACEP, FAIUM
History of Clinical Ultrasound Leadership and Support at WF and CMC
Ultrasound in Clinical Medicine in Atrium Legacy
US Across the Spectrum

• Traditional Imaging
• Clinical Specialties
• Empowering the clinician at the bedside
• Complementary but not replacement of physical examination
• Uses in Clinical Medicine

Figure 1. ACEP 2016 Emergency US Guidelines Scope of Practice

- Resusitative
- Diagnostic
- Procedural Guidance
- Symptom or Sign-Based
- Therapeutic
Clinical Use

*Medical Specialists*

- Addiction psychiatry
- Adolescent medicine specialist
- Allergist (immunologist)
- Anesthesiologist
- Cardiac electrophysiologist
- Cardiologist
- Cardiovascular surgeon
- Colon and rectal surgeon
- Critical care medicine specialist
- Dermatologist
- Developmental pediatrician
- Diagnostic radiologist
- Emergency medicine specialist
- Endocrinologist
- Family medicine physician
- Forensic pathologist
- Gastroenterologist
- General practitioner
- Geriatric medicine specialist
- Gynecologist
- Gynecologic oncologist
- Head surgeon
- Hematologist
- Hematopathologist
- Hepatologist
- Hyperbaric physician
- Infectious disease specialist
- Interventional cardiologist
- Medical examiner
- Medical geneticist
- Medical oncologist
- Neonatologist
- Nephrologist
- Neurological surgeon
- Neurologist
- Nuclear medicine specialist
- Obstetrician
- Occupational medicine specialist
- Ophthalmologist
- Oral surgeon (maxillofacial surgeon)
- Orthopedic surgeon
- Otolaryngologist
- Pain management specialist
- Pathologist
- Pediatrician
- Pediatrician
- Physical therapist
- Plastic surgeon
- Preventive medicine specialist
- Psychiatric
- Pulmonologist
- Radiation oncologist
- Rheumatologist
- Reproductive endocrinologist
- Rheumatologist
- Sleep disorders specialist
- Spinal cord injury specialist
- Sports medicine specialist
- Surgeon
- Thoracic surgeon
- Urologist
- Vascular surgeon

*Wake Forest*
School of Medicine

*Atrium Health*
Transition During the Last 25 Years
US System Leaders –
Established Imaging Specialties

CharlotteRadiology®

Atrium Health
Sanger Heart & Vascular Institute

Obstetrics and Gynecology

Wake Forest School of Medicine

Atrium Health
US System Leaders – Emergency Ultrasound - Charlotte area POC
Innovation Leaders
Clinical US Milestones

- 1990s – increased use by Obstetrics and EM
- 1996 – EM established 1st POC US program outside of traditional imaging
- 1997 – Residency training
- 1998 – POC US research -1st paper
- 2001- US Credentialing
- 2005 – US fellowship (post-graduate) established at CMC
- 2006- US workflow software -1st in USA
- 2009 – System-wide credentialing in EM and other clinical specialties
- 2012 – Annual CME courses within Legacy Atrium
- 2013 – CLIC Medical School Curriculum with UNC with embedded US curriculum
- 2015- CMC Dept of EM receives national ED US Program Accreditation through CUAP
- 2016 – Multicenter EM Research Study on PE created by Anthony Weekes, MD
- 2018 – AHQR Grant R01 for multicenter Pulmonary Embolism Study
- 2005-2020 – Training for Nurses, Medics, Physicians, and Military Teams
- 2021- US Fellowship Accreditation pending through ABEM/ABMS/ EUFAC
US Education at CMC

- Medical School
- Residency
- Fellowship
- Preceptorships
- Nursing
- Medics
- Military surgical teams
US Research
CMC Scholarship - Depth and Breadth
Translation of Ultrasound to Practice

- New way to diagnosis/treat
- Proof of concept
- Diagnosis or treatment
- Effective care
- Clinical outcomes
- Effective & timely care to the right patient
- Population level outcomes
- Benefit to society

Courtesy of Anthony Weekes, MD
Family Descent - Atrium and WF
Collaboration
Casey Glass, MD

Associate Professor of Emergency Medicine
Director of Ultrasound Education, CEAL
Course Director, Ultrasound Integrated Curriculum
Advanced Emergency Medicine Ultrasound Fellowship Program Director

Department of Emergency Medicine
Atrium Health Wake Forest Baptist

- 15 years of teaching ultrasound at Wake Forest
- Ultrasound Mini-Fellowship Director
- Assistant and Emergency Ultrasound Director
- Assistant Residency Program Director
Ultrasound in the Enterprise
Ultrasound Everywhere

- Ultrasound Integrated Curriculum
- PA Studies Program
- Clinical Bedside Ultrasound Programs
  - Emergency Medicine
  - Critical Care Service Line
  - Neonatal ICU
  - Internal Medicine / Hospitalist
  - Family and Community Medicine
  - Anesthesia
- Allied Health
- Ultrasound CME Provider
12,000 Learner Encounters

FY20-21
Ultrasound IV Training

Center for Experiential and Applied Learning
Enterprise-wide Ultrasound IV Training

Flipped Classroom with Direct Observation Lab

**Online Lecture**
- Machine Use
- Ultrasound Safety
- Infection Control
- In-plane needle guidance
- Out of Plane Needle Guidance

**Skills Lab**
- Knobology
- Needle Manipulation basics
- US IV procedure details
- In-plane and Out of plane practice

**Assessment**
- 10 observed successful IV placements in phantoms

**Bedside Application**
- Unit Specific
- Flexible to comply with hospital bylaws
- Nurse leadership driven
Comfort with US IV (Comfortable, Very Comfortable)

15%  →  50%

Has participated in Successful US IV in last month

26%  →  62%
Acknowledgements

Bridget Francis, RDMS
Staff Sonographer
Center for Experiential and Applied Learning

JaNae Joyner, Ph.D.
Associate Vice President & Assistant Dean
Curriculum Experience & Support
Butterflies in my brain
Neuroultrasound: Innovation, Education, and Research

Department of Neurology
Introduction: Ultrasound credentials

- Aarti Sarwal, MD, FAAN, FNCS, FCCM, FANA, RPNI
- Professor, Neurology
- Section Head & Medical Director, Neurocritical Care
- Co-Director, Ultrasound Curriculum, WFSOM
- Assistant Director, POCUS MSIV Elective, WFSOM
- Course Director, Neurovascular Ultrasound Course, WFSOM
- Course faculty/speaker CME courses/Annual Congress
  - Neurocritical Care Society
  - American Thoracic Society
  - Society of Ultrasound in Medical Education
  - American Association of Physical Therapy
  - World Interactive Network Focused on Critical Ultrasound- WINFOCUS
- Board of Directors, American Society of Neuroimaging – Neurovascular ultrasound
History

- William M. McKinney Frontier Neurosonologist
- Wake Forest is the world’s first Center for Medical Ultrasound established in 1963 - Ward A. Riley Ultrasound Center
- Dr. Ward Arthur Riley Jr- Pioneer for the use of B-mode ultrasound carotid
- Fredrick Kremkau – gold standard textbook in Ultrasound physics
Development of a Homemade Spinal Model for Simulation to Teach Ultrasound Guidance for Lumbar Puncture

Madison Odom1, Jonathan R. Gomez2, Kerry Ann Danelson3 and Aarti Sarwal2

1 Wake Forest School of Medicine, 2 Wake Forest School of Medicine, 3 Wake Forest School of Medicine

© 2019 Springer Science+Business Media, LLC, part of Springer Nature and Neurocritical Care Society
Education
Neurovascular Ultrasound Course

• One week Neurosonology Course twice yearly since 1974 - Dr. William Markley McKinney and One week Neurovascular Interpretation Course yearly since 1992 –Dr. Charles Tegeler
  • >3500 physicians, sonographers & researchers
  • >300 international scholars
• McKinney-Avant Chair in Neurosonology
• Neurosonology Research Fellowship - 10 international and one local scholar
• ASN Neurosonology certification exam
Aarti,
As a personal note, I want to thank you so much for serving as faculty. I know the course would not have been nearly as good without you. You are a tireless educator, and a world expert in critical care ultrasound. Your enthusiasm invigorated not only the attendees, but also the faculty, who all loved learning neuro-ultrasound. You were one of the faculty mentioned by name by attendees approaching me to comment positively on the course faculty. You are one of the best ultrasound/echo teachers I have had the privilege to work with.

Sincerely,

Michael Lanspa, MD, FASE, ATSF
Co-director and Co-chair,
Critical Care Ultrasound and Echocardiography I and II
American Thoracic Society

SECTION III: MONITORING APPLICATIONS

Ultrasound-Driven Approach to Patients in Shock
Sarah Bain, MD

Ultrasound-Driven Approach to Patients With Acute Respiratory Failure
Badi Shaabab, MD; Aditi Jain, MD; Alberto Geoff, MD

Failure to Wean From Mechanical Ventilatory Support
Silvia Mongodi, MD, PhD, MSc; Francesco Mojoli, MD; Rémi Rodon, MD, PhD

Extracorporeal Membrane Oxygenation Support
Shawn L. Thompson, MD; Daniel W. Johnson, MD

Neuroradiology
Aarti Sarwal, MD, FMCS, FAAN

The Extended Focused Assessment With Sonography
Thomas Corver, MD, FACS

Acute Coronary Syndrome
Sumit Kapoor, MD, FCCP; Anne-Sophie Beraud

Assessment of Valvular Heart Disease in Critical Illness
James A. Nelson, MBBS, Brandon M. Wiley, MD

Wake Forest School of Medicine
Atrium Health
Brain ultrasonography: methodology, basic and advanced principles and clinical applications. A narrative review

Chiara Robba1, Alberto Goffi2, Thomas Greco1, Danilo Cardim1, Gabriele Va3, Marek Czosnyka2, Soojin Park1, Aarti Sarval1, Llewelyn Padyayachi2, Frank Rasulo1 and Giuseppe Citerio1

Neurocritical Care (2020) 12:502–511
https://doi.org/10.1111/1523-1  

Brain Ultrasonography Consensus on Skill Recommendations and Competence Levels Within the Critical Care Setting

Chiara Robba1, Daniele Poole1, Giuseppe Citerio1, Fabio S. Taccone1, Frank A. Rasulo1 and the Consensus on brain ultrasonography in critical care group

Wake Forest School of Medicine
Atrium Health
Research

U.S. Study to Protect Brain Health Through Lifestyle Intervention to Reduce Risk (U.S. POINTER)
CUPID

- Cranial Ultrasound for Point-of-care Intracranial Hemorrhage Diagnosis
Roots, Fruits and Strategic Direction
Echocardiography in Emergency Medicine
Anthony J Weekes MD MSc

Echocardiography

• Goal Directed, Limited, Comprehensive
• Roots: Early work
• Fruits: Recent work
• Strategy: Next Steps
Roots: Early work

What can we do?
- Immediate availability
- Immediate interpretation
- Resuscitation & hypotension
- Does it help?
  - Timing to diagnosis
  - Timing to disposition
  - Timing to intervention
Left ventricular systolic function

- Yes, we can
- Visual estimation of LV ejection by EM providers
Pericardial effusion in cardiac arrest

- Identify correctable conditions
Undifferentiated hypotensive patients

- Early clinical use & interpretation
- Improves diagnostic certainty
Fruits: Recent work

What can we do better?

• Immediate clinical usefulness
• Critically ill
• What are we doing?
• Close monitoring
• Does it help?
  • Detecting acute changes
  • In response to interventions
  • Quantifying important features
Undifferentiated hypotensive patients

- Serial limited echo monitoring for acute changes
Collaboration
Point of care echo during cardiac arrest

Multi-center REASON study

Survival

Incorporation in Resuscitation

Wake Forest
School of Medicine

Atrium Health.
Central venous catheter placement
Procedural guidance with limited echocardiography

- Switch to right side of heart
- Focus on safety
- Procedural safety
- Potential impact on practice
  - limit Chest X-ray use
Acute right heart conditions

- Pulmonary embolism
# Pulmonary Embolism

**Logical steps: Visual assessments to measurements**

<table>
<thead>
<tr>
<th>Stage #1</th>
<th>Stage #2</th>
<th>Stage #3</th>
</tr>
</thead>
<tbody>
<tr>
<td>GDE</td>
<td>GDE</td>
<td>Comprehensive echo</td>
</tr>
<tr>
<td>All PE patients</td>
<td>All PE at ED</td>
<td>submassive PE patients at Atrium Health EDs</td>
</tr>
<tr>
<td>At CMC ED</td>
<td>Multiple EDs nationally</td>
<td>RV focused measurements</td>
</tr>
<tr>
<td>24/7</td>
<td>Develop prognostic model</td>
<td>Determine RV abnormalities of size function and pressure</td>
</tr>
<tr>
<td>Diagnostic accuracy</td>
<td></td>
<td></td>
</tr>
<tr>
<td>New Outcomes</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Inter- and intra-observer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>agreement</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Assessing right ventricle in pulmonary embolism
Strategy: Collaboration
PESCOR
Pulmonary Embolism Short-term Clinical Outcomes Registry
Pulmonary Embolism

Next steps: Early assessments Outcome driven PE research

- 6 academic ED in different states
- Started in 2016
  - AHRQ RO1 funding in 2018
    - 1.3 million over 3 years
- Enrolled 1800 patients with PE
<table>
<thead>
<tr>
<th>Condition</th>
<th>Score</th>
<th>Add</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suspected or confirmed systemic infection</td>
<td>No</td>
<td>0</td>
<td>Yes</td>
</tr>
<tr>
<td>GDE showing RV dilation or more</td>
<td>No</td>
<td>0</td>
<td>Yes</td>
</tr>
<tr>
<td>Abnormal Heart rate &lt;50 or &gt;100, bpm</td>
<td>No</td>
<td>0</td>
<td>Yes</td>
</tr>
<tr>
<td>CT RV:LV ratio ≥ 1.0</td>
<td>&lt; 1.0</td>
<td>0</td>
<td>Yes</td>
</tr>
<tr>
<td>Preceding episode syncope</td>
<td>No</td>
<td>0</td>
<td>Yes</td>
</tr>
<tr>
<td>Creatinine &gt; 2.0 mg/dL</td>
<td>≤ 2.0</td>
<td>0</td>
<td>Yes</td>
</tr>
<tr>
<td>Medical or social reason for hospitalization</td>
<td>No</td>
<td>0</td>
<td>Yes</td>
</tr>
<tr>
<td>Systolic BP &lt; 100 mmHg</td>
<td>≥100</td>
<td>0</td>
<td>Yes</td>
</tr>
<tr>
<td>Dysrhythmia</td>
<td>No</td>
<td>0</td>
<td>Yes</td>
</tr>
</tbody>
</table>
Collaboration
More to come
Implementation of a Remote Collaboration Solution to Perform Echocardiograms during the COVID-19 Pandemic

Noreen P. Kelly MD MBA FASE
Director, SHVI Echocardiography Laboratory

Dermot Phelan MD PhD FACC FASE
Director, SHVI Cardiovascular Imaging

Geoffrey A. Rose MD FACC FASE
President, SHVI
Echocardiography During the COVID-19 Pandemic

Balancing Safety with Optimal Patient Care

• Guidelines emphasized problem-focused examinations with minimum possible scan time
• Employed a remote collaboration solution (Philips Collaboration Live Feature on EPIQ Ultrasound Machines [CL])
• Hypothesized that CL would significantly reduce examination time and image acquisition number, while maintaining diagnostic quality
The Results

Key Study Results

- 101 limited echocardiograms performed using CL
- All diagnostic
- Statistically significant reduction in examination time and image acquisition number with CL, compared with historical controls
- 42.6% of the CL cohort was COVID+ or PUI, average examination time was 7:59 minutes.

<table>
<thead>
<tr>
<th></th>
<th>No-CL Cohort</th>
<th>CL Cohort</th>
<th>p</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Duration in Minutes</strong></td>
<td>n (%)</td>
<td>n (%)</td>
<td></td>
</tr>
<tr>
<td><strong>Mean (SD)</strong></td>
<td>12.5 (±5.7)</td>
<td>7.1 (±4.4)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td><strong>Median (Min-Max)</strong></td>
<td>11 (3-28)</td>
<td>6 (2-21)</td>
<td>&lt;0.0001</td>
</tr>
<tr>
<td><strong>Number of Images</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Mean (SD)</strong></td>
<td>37.2 (±12.8)</td>
<td>30.1 (±12.7)</td>
<td>0.0001</td>
</tr>
<tr>
<td><strong>Median (Min-Max)</strong></td>
<td>37 (12-78)</td>
<td>27 (10-83)</td>
<td>&lt;0.0001</td>
</tr>
</tbody>
</table>
Future Directions

Expanding Use of CL Technology
• Continue to serve COVID-19 patients
• Provide consultative services during cardiothoracic surgery and structural heart procedures
• Education and training of satellite echocardiography laboratories
Why Was NMUS Needed?

Cardiac evaluation – electrophysiology and imaging
Why Was NMUS Needed?

Seizure evaluation – electrophysiology and imaging
Why Was NMUS Needed?

Nerve evaluation – electrophysiology and NO imaging

A

2 mV

B

5 mV

C

1 mV

100 ms
The Development of NMUS

• 1978 – Muscle imaging in England
• 1988 – Nerve imaging in France
• 1990 – Muscle fasciculations imaged by Dr. Walker at Wake Forest
The Development of NMUS

• McKinney + Walker + Technology
The Development of NMUS

• 2002 – AAN Award for NMUS for CTS
• 2004 – First Workshop at AANEM
• 2004 – First Workshop at Wake Forest
• 2006 – Funding from MDA for Reference Values (> 200 citations)
• 2009 – AANEM Position Statement
The Development of NMUS

• 2011 – First Textbook on NMUS
The Development of NMUS

• 2012 – First NMUS Clinical Practice Guideline (> 200 citations, in National Guidelines Clearinghouse)
• 2012 – ISPNI formed in Rome
• 2013 – Dr. Walker becomes AANEM President
• 2014 – Publication on CTS in Poultry Workers
• 2018 – Work on Chemotherapy-induced neuropathy
• 2020 – ISPNI names award after Dr. Walker
The Real Power of NMUS

• Collaboration – Neuro Onc, Family Med, Ortho, Plastics, Epidemiology, Biostats, ENT, students, residents, fellows

• Policy – OSHA slowed down poultry processing rates

• Patients – We use NMUS multiple times per day in the EMG lab
Patient

• 12 year old boy presents with elevated CK
• Exam shows very mild proximal weakness
• EMG of IP and quad – normal
• NMUS
Patient
Patient

• Biceps biopsy → glycogen
• Genetic testing → Pompe disease
• Now on Lumizyme to maintain strength and prevent cardiomyopathy
• Diagnoses are improved daily because of NMUS
Thank You!
POCUS in Family and Sports Medicine

Anthony Martin, MD, CAQSM
Brent Messick MD, CAQSM
Point of Care US In Family Medicine

**Why**
- Decreased time to diagnosis and treatment
  - POCUS study in rapid response teams
    - POCUS group 15 min
    - Control group 34 min (p<0.001)\(^1\)
  - Similar accuracy in diagnosis to MRI in specific settings, ie MSK\(^2\)
    - Sensitivity 92% in MSK US diagnosis of full thickness cuff tear
    - Sensitivity 94 % with MRI
  - Possible reduction in cost (less X-Ray/CT/MRI)?
  - Limits radiation exposure

---

Arnold, MJ; Jonas, CE; Carter, RE. Point of care ultrasonography. American Family Physician. 2020
Point of Care US In Family Medicine

Sought after by most medical students matriculating to residency

• Developing a curriculum
  • Barriers\(^3\)
    • Lack of trained faculty
    • Limited access to equipment
    • Discomfort with interpreting images without radiologist review
  • Solutions
    • Select a champion
    • Dedicated coursework/conferences
    • Teach the teachers

---

Hall, JW et al. Point of Care Ultrasound in Family Medicine Residencies 5-year Update. Fam Med. 2020
Proposed Curriculum

Multiple Settings

• Hands on didactics teaching every other month with several faculty
• Inpatient setting and outpatient residency clinics at 3 different sites
• Faculty and resident “champion”
• SonoSim
  • Scalable, Trackable, Gradable
  • Allows resident to visualize normal and abnormal pathology
  • On their own time!
Cabarrus PCSM Fellowship

SMART Statements

• After completing the Musculoskeletal Ultrasound (MSK US) module during fellowship year which will include a MSK ultrasound instructional course, AMSSM MSK modules, and reading an introduction to MSK PowerPoint, the fellow will be able to show that they can describe technical aspects of MSK US, machine controls, probe positioning and ultrasound physics by scoring greater than 80% on a written exam.

• After passing the initial exam and in the fourth quartile of fellowship, the fellow will demonstrate competence in ultrasound scanning of the musculoskeletal system. The fellow will be evaluated by a standard rubric which will be scored based on image quality, exam technique and accuracy of needle placement.
# MSK US Rubric

<table>
<thead>
<tr>
<th></th>
<th>Unacceptable</th>
<th>Needs Improvement</th>
<th>Pass</th>
<th>Honors</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Patient Positioning</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Optimizing Image Quality</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Quality of Saved and Properly Identified Images</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
One Hand and One Eyesight Real-Time Ultrasound Guidance
The Use of Computer Assist Design and 3D Printing for Development of New Tools to Improve Vascular Access

Department of Anesthesiology
Luiz Maracaja MD

- Cardiothoracic Anesthesiologist
- Clinical Associate Professor
- Computer Assist Design

Conflict of Interest related to this presentation

Founder of Pneumocyte
Inventor of ultrasound accessories.
Real Time Ultrasound Guidance

• Definition
  • Continuous imaging of anatomic target and the needle during its trajectory through the tissues.

• Advantages of the Portable systems

• Challenges for adoption in Clinical practice
  • Display placement
  • Redundant cable
  • Sterility
# Proposal and essential design features

<table>
<thead>
<tr>
<th>One</th>
<th>Two</th>
<th>Three</th>
<th>Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mount the smartphone (display) directly on the top of the ultrasound transducer.</td>
<td>Lightweight, weight distribution, stability, cable containment.</td>
<td>Fit into a sterile cover and feasibility to manipulate the display through the cover.</td>
<td>Positioning system will not interfere with scanning, improve ergonomics and hand-eye coordination.</td>
</tr>
</tbody>
</table>

![Image of smartphone mounted on ultrasound transducer](image1.png)

![Image of hand holding a smartphone](image2.png)

![Image of smartphone inside a sterile cover](image3.png)

![Image of a surgeon using a smartphone during surgery](image4.png)
Improvement

• procedural site, ultrasound image, needle, syringe, and probe all in one view.

• Eliminate changes in the field of gaze between procedural site and ultrasound display (short interruptions related to inadverted movement of proceduralist).
The procedural field is an exciting realm for portable ultrasound systems.

The use of computer-assisted design and 3D printing allows tool customization for processes newly adopted in clinical practices.

Putting procedural site and ultrasound image in a single frame gives more stability and precision for procedural guidance.

Imaracaj@wakehealth.edu
Evaluation of Success in Spinal Block Placement between using Palpation of Landmarks versus Pocket-Size Handheld Ultrasound Method in Cesarean Delivery

J. Pan MD, J.K Chadha MBBS, V H Ross, MD, L. Harris BSN, P. Pan MD, J. Booth MD

Department of Anesthesiology at Wake Forest School of Medicine
Learning Objectives

• Review Using Palpation of Landmarks for Lumbar Neuraxial Block Placement

• Review Technique for Ultrasound (US) Guided Lumbar Neuraxial Block using Traditional Ultrasound and Pocket Size US with 2D and 3D Navigator

• Does such US device improve spinal block placement in obese parturient undergoing cesarean delivery?
  • Procedural Time
  • Patient Satisfaction
Dedicated Pocket Size Ultrasound devices (Accuro) for Neuraxial Blocks

- Software designed to image around bony structures and Preset for imaging Neuraxial block
- Utilizes a piston US transducer instead of linear or phase array → improves image quality around bony structures
- Uses bone specific beam-forming image processing
- Real time Pattern Recognition algorithm with a 2-D and 3-D Overlay Navigator for midline, spinous process, vertebral body, and intervertebral/ interlaminar spaces
Accuro Ultrasound (By Rivanna Medical)

Start above gluteal cleft, scan from sacrum upward, using 2D/3D navigator line up midline, interlaminar space.

Remember the angle of the US probe – same angle of needle insertion.

Accuro Locator Needle Guide - Skin Marker to mark site of needle insertion.

Wake Forest* School of Medicine

International Health.
Does Accuro (3-D Assisted Pocket-Size Ultrasound) clinically improve Spinal block for obese parturient?

- Limited clinical data and Lack clinical RCTs on US device with 3D Navigator for SAB placement in obese parturient.

- We hypothesize Accuro Ultrasound device may:
  1. Reduce time
  2. Reduce Attempts
     for successful placement of SAB versus traditional Palpation of Landmark method in obese parturient undergoing spinal anesthesia for cesarean delivery.
Results

62 Subjects enrolled
- BMI >30
- Undergoing SAB for Cesarean Delivery

Randomized into one of two groups
2 Excluded for Protocol Violation

- 1 subject excluded for CA2+ performed the SAB
- 30 subjects in Palpation guided group
- 30 subjects in US guided group
- 1 subject excluded for mistakenly assigned to the US group
## Demographics

<table>
<thead>
<tr>
<th></th>
<th>Palpation Group ( n = 30 )</th>
<th>Ultrasound Group ( n = 30 )</th>
<th>P - Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>32.4 ± 5.8</td>
<td>29.8 ± 4.8</td>
<td>0.06</td>
</tr>
<tr>
<td>BMI (kg/m2)</td>
<td>38.9 ± 6.0</td>
<td>36.3 ± 5.4</td>
<td>0.08</td>
</tr>
<tr>
<td>EGA (days)</td>
<td>267.4 ± 11.1</td>
<td>269.7 ± 13.0</td>
<td>0.45</td>
</tr>
<tr>
<td>Gravida</td>
<td>3 [2 – 4]</td>
<td>2 [2 – 3]</td>
<td>0.03*</td>
</tr>
<tr>
<td>Parity</td>
<td>1 [1 – 2 ]</td>
<td>1 [1- 1 ]</td>
<td>0.02*</td>
</tr>
</tbody>
</table>

Data expressed and compared as Mean±SD or Median [IQR] as appropriate.
# RESULTS - Technique

<table>
<thead>
<tr>
<th></th>
<th>Palpation Group (n = 30)</th>
<th>Ultrasound Group (n = 30)</th>
<th>P - value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Passes (Number)</td>
<td>Median [IQR] (Mean±SD)</td>
<td></td>
<td>0.005*</td>
</tr>
<tr>
<td></td>
<td>2 [ 1 – 4 ] (2.9 ± 2.3)</td>
<td>1 [ 1 – 2 ] (1.9 ± 2.1)</td>
<td></td>
</tr>
<tr>
<td>Re-Direc. (Number)</td>
<td>Median [IQR] (Mean±SD)</td>
<td></td>
<td>0.02*</td>
</tr>
<tr>
<td></td>
<td>3 [ 1 – 6 ] (4.1 ± 3.5)</td>
<td>2 [ 0 – 3 ] 2.2 ± 2.6</td>
<td></td>
</tr>
<tr>
<td>1 Pass 0 Re-Direc. Suc.</td>
<td>(%)</td>
<td>13.3 %</td>
<td>0.21</td>
</tr>
<tr>
<td>1 Pass Any # Re-Direc. Suc.</td>
<td>(%)</td>
<td>33.3 %</td>
<td>0.005*</td>
</tr>
<tr>
<td></td>
<td></td>
<td>60.0 %</td>
<td></td>
</tr>
</tbody>
</table>
# RESULTS – Timing

<table>
<thead>
<tr>
<th></th>
<th>Palpation Group (n = 30)</th>
<th>Ultrasound Group (n = 30)</th>
<th>P - value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinal Needle Insertion to CSF Time – Median [IQR] (Mean±SD)</td>
<td>122 [59 – 226] (161.3 ± 148.7)</td>
<td>50 [26 – 109] (85.8 ± 120.0)</td>
<td>0.003*</td>
</tr>
<tr>
<td>Palpating/US Scanning Time – Median [IQR] (Mean±SD)</td>
<td>23 [18 – 40] (27.6 ± 14.6)</td>
<td>33 [27 – 47] (43.1 ± 30.3)</td>
<td>0.03*</td>
</tr>
<tr>
<td>Palpate/US+Needle Insertion to CSF- Median [IQR] (Mean±SD)</td>
<td>158 [85 – 254] (189.0 ± 152.3)</td>
<td>82 [56 – 151] (128.8 ± 132.6)</td>
<td>0.04*</td>
</tr>
</tbody>
</table>
## RESULTS – Patient Experience

|                                   | Palpation Group  
|-----------------------------------|------------------|------------------|------------------|
|                                   | \((n = 30)\)      | Ultrasound Group  
|                                   |                  | \((n = 30)\)     | P-Value          |
| **Verbal Pain Score of SAB Procedure** | 4.2 ± 2.6        | 3.5 ± 2.6        | 0.32             |
| (0 – 10, 0 being none, 10 being severe) | Mean ± SD        |                  |                  |
| **Verbal Satisfaction Score of SAB Procedure** | 8.3 ± 1.7        | 9.4 ± 0.8        | 0.01*            |
| (0 – 10, 0 being not satisfy at all, 10 being very satisfy) | Mean ± SD        |                  |                  |
Results

Improved Verbal Satisfaction score *

50% Reduction of procedure time *

Twice as likely for one pass with # any redirections *

* Indicates significantly different
Conclusion:

- Results showed this pocket size Ultrasound device with 2D and 3D navigator shortens the time and decreases # of passes or redirections of spinal needle to successfully obtaining CSF return during spinal block in obese parturient for CD as compared to using Palpation of Landmark.

- While median US Scanning appeared to take 10 seconds longer than Palpation of Landmark, reduction in time to obtain CSF in US group was large enough to compensate for the increase in scanning time and Patients seemed to have higher overall satisfaction in their spinal block procedural experience.

- Larger RCTs at other institutions should be performed to confirm our findings.
Global Health Ultrasound & Regional Anesthesia in the ED

Dr. Denise Fraga, MD, MPA

Guatemala Partnerships
- Pediatric Residency (Escuintla)
- Emergency Medicine Residency (Guatemala City)

Regional Anesthesia in the Emergency Department
- Fascia Iliaca Block
- Erector Spinae Plane Block
- Superior Trunk Block
- General Nerve Block Data Collection

COVID-19 Lung Ultrasound
- Multi-center study
- Data collection on lung ultrasound characteristics & patterns in COVID-19 patients
- Published 2021
Global Health Ultrasound in Guatemala
Global Health Ultrasound in Guatemala

**Study:** Development & Implementation of an Intensive Pediatric Point-of-Care Ultrasound (PoCUS) Curriculum in Guatemala

- Single center observational study
- Pre/Post written test & OSCE
- **Participants:** pediatric residents, fellows, attendings
- **Surveyed Participants:**
  - All but three learners reported no or minimal formal ultrasound training prior to the course
  - Barriers to ultrasound
- **Data Collection:**
  - Test Scores
  - Ultrasound use
  - Changes in clinical management w/ PoCUS
### Global Health Ultrasound in Guatemala

**Applications and Pathology Taught During the Intensive Course**

<table>
<thead>
<tr>
<th>Ultrasound physics</th>
<th>Soft Tissue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pediatric Abdomen</td>
<td>Abscess</td>
</tr>
<tr>
<td>Basic anatomy</td>
<td>Cobblestoning</td>
</tr>
<tr>
<td>Appendicitis</td>
<td>Foreign body</td>
</tr>
<tr>
<td>Intussusception</td>
<td></td>
</tr>
<tr>
<td>Gall stones</td>
<td></td>
</tr>
<tr>
<td>Hydronephrosis</td>
<td></td>
</tr>
<tr>
<td>Bladder volume</td>
<td></td>
</tr>
</tbody>
</table>

**Lung**

- Lung sliding
- Pleural fluid
- Consolidation
- B-lines

**Trauma FAST**

- Free fluid

**Vascular Access**

- Peripheral venous access
- Central venous access

**Echocardiography**

- Ejection Fraction
- Pericardial effusion
- Basic cardiac anomalies
  - (ex. HOCM, Hypoplastic left heart, Tetralogy of Fallot)
Global Health Ultrasound in Guatemala

Results

- Intensive 4-day PoCUS training course paired with follow up training in a resource limited setting led to improved ultrasound knowledge & long term knowledge retention
- Over 22-month period since the project was initiated, 614 ultrasound studies documented
- 36.5% had change in clinical management when ultrasound was used w/ PTX most common diagnosis
- Pending Publication
Regional Anesthesia in the ED

**Study:** Efficacy of Performing Erector Spinae Plane (ESPB) & Serratus Anterior Plane Blocks (SAPB) for Rib Fractures in the Emergency Department

- Prospective Observational Study
- **Patients:** >=18 yo with 2+ rib fractures presenting to the ED

- **Aim 1:** Are EM providers able to safely & effectively perform ESPB or SAPB in the ED?

- **Aim 2:** Change in pain scores, IS, & cough score. Opioid reduction and complications.
Regional Anesthesia in the ED

**Phase 1 Results**

- 88% providers surveyed had either not performed or performed infrequently.
- Pre-test (March 2020) > Post-test (March 2020) > Follow up test (June) showed statistically significant score **increase**.

**Phase 2 Results**

- **31 blocks** performed in the ED for rib fx of which 97% ESPB.
- Success rate = 90.3%.
- Complication rate = 0%.

---

**Wake Forest**
School of Medicine

**Atrium Health**
# Covid-19 Lung Ultrasound

## Study Details

- **International multicenter observational study**

- **Aim 1**: Describe dx accuracy of the combination of **LUS probability patterns** (HighLUS, IntLUS, AltLUS, LowLUS) & **clinical phenotypes** (mild, severe, mixed) in predicting COVID-19

- **Aim 2**: Test an online training to implement a standardized LUS approach for COVID-19 in centers w/ different level of LUS expertise

- **Hypothesis**: std LUS exam is **feasible & reproducible**, and can be useful for **early prediction** of RT-PCR results in pts suspected of COVID-19

---

![Lung ultrasound images](image-url)
Covid-19 Lung Ultrasound

### Results

1. **HighLUS & IntLUS sen of 90.2%** (95% CI 88.23–91.97%) in identifying pts with + RT-PCR
   - **mixed** (sen: 94.7%) & **severe** (sen: 97%)

2. **HighLUS spec of 88.8%** (CI 85.55–91.65%)
   - higher **spec in mild ph** (94.4%; CI 90 – 97%)

3. Multivariate analysis: **HighLUS was strong indep predictor of RT-PCR +** (odds ratio 4.2, confidence interval 2.6–6.7, p < 0.0001)

### Conclusions

- In patients suspected for COVID-19, lung ultrasound **patterns of probability** integrated with **patients’ characteristics** allow to rule in or rule out COVID-19 pneumonia at bedside with high accuracy.

- This approach could support and expedite patients’ management during a pandemic surge.
Ultrasound In Pediatric Emergency Care

Lindsey Chaudoin, MD

Department Learners
- EM and Pediatric residents
- US and PEM fellows

Ongoing Research
- Intussusception
- Testicular Torsion
# Intussusception

## Study #1

- Prospective multicenter enrollment of patients suspected of intussusception
- Assessing accuracy of POCUS and RadUS
- 256 patients, 22% with intussusception
- **Accuracy**: 97.7% **POCUS** (CI 95% 94.9-99%)  
  99.3% **RadUS** (CI 95% 96.8-99.9%)
- Pending Publication
Intussusception

Study #2

- Comparison of image interpretation of 100 intussusception studies
- Expert vs Novice POCUS users
- **Hypothesis:** Interrater reliability of POCUS for detection of intussusception is high among both expert and novice POCUS users
Testicular Torsion

Emergency Medicine-Urology Collaboration

• Prospective Observational Study
• Patients 11-18 yo presenting to the Children’s ED being evaluated for testicular torsion

• **Aim 1:** Accuracy of POCUS when compared to RadUS/OR findings
• **Aim 2:** To evaluate resource utilization measures among patients
Ultrasound in Undergraduate Medical Education:
Fourth Year POCUS Elective Experience

Dr. Joshua Zavitz, DO
Assistant Professor of Emergency Medicine
Director, POCUS MSIV Elective
Wake Forest School of Medicine
Why the need for a POCUS course?

Medical student demand for POCUS
- Historically requesting special elective
- Residency feedback and interview season
- Additional skill set
- Applicable to multiple specialties
- Hands-on learning
- Dedicated time to focus on POCUS
Going from the ultrasound lab to patient care

- Pretest probability with POCUS impact on differential Diagnosis
- Clinical Decision making
- Safety of procedural US guidance
- Normal → Pathology
- Learning excellent patient care!
Curriculum

• Progression from general to subspecialist over ~4 weeks
• Scanning logs of normal and pathology
• Ultrasound research report
• Clinical case report
• Simulator experience
• Power-point presentation
• Ultrasound modules quizzes
• Direct Observation testing
## Curriculum

### Student weekly scanning schedule

<table>
<thead>
<tr>
<th>Week One</th>
<th>Week Two</th>
<th>Week Three</th>
<th>Week Four</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Adult Emergency Medicine</td>
<td>• Neuro Critical Care</td>
<td>• Medical Critical Care</td>
<td>• Vascular</td>
</tr>
<tr>
<td>• Pediatric Emergency Medicine</td>
<td>• Neurology</td>
<td>• <strong>Internal Medicine</strong></td>
<td>• Adult Cardiology</td>
</tr>
<tr>
<td>• Community Medicine</td>
<td>• Pediatric Cardiology</td>
<td>• Sports Medicine</td>
<td>• Simulation</td>
</tr>
</tbody>
</table>

**schedule varies which week**
# Survey Data

<table>
<thead>
<tr>
<th>Year</th>
<th>Number of Students</th>
<th>Quality of Education (Strongly Agree %)</th>
<th>Effective Teaching (Strongly agree %)</th>
<th>Respect and cooperation of faculty (Strongly agree %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2017-18</td>
<td>10</td>
<td>89</td>
<td>56</td>
<td>86</td>
</tr>
<tr>
<td>2018-19</td>
<td>18</td>
<td>81</td>
<td>75</td>
<td>88</td>
</tr>
<tr>
<td>2019-20</td>
<td>20</td>
<td>59</td>
<td>53</td>
<td>71</td>
</tr>
<tr>
<td>2020-21</td>
<td>26</td>
<td>96</td>
<td>91</td>
<td>96</td>
</tr>
<tr>
<td>2021-22</td>
<td>22</td>
<td>86</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

**2021-22 average 123 scans per student**
Interdepartmental Collaboration

Teamwork

• 10 Specialties
• Clinic, Inpatient, ED, and Community settings
• General and subspecialists
• Technicians, Attending physicians, Fellows and Resident educators
• Strength of our institution
Virtual COVID POCUS Curriculum

- 141 students
- Innovative 2 week curriculum
- Daily needs assessments
- Utilized cell phone simulated scanning techniques
- Live scanning sessions with family members
- Video conferencing software
- Significant improvement pre 58% to 88% post scores
Scanning with a Purpose

Clinical focused video series

- Jennifer Mroz, Dr. Dillon Casey and Dr. Kristy Ford
- 15 live cases recorded
- Adult and pediatric
- Goal to share with students and residents
- Image acquisition → Interpretation → Implementation and clinical decision making

**In production currently**
Mr. Scan presents today with pain in his right side.
Pilot Research Project

Pediatric Cardiology

- Dr. Brandon Hays and technicians
- Started April 2021
- Student taught how to evaluate for coarctation
- Independently perform two on patients
- Direct observation testing
- Clinical utility: expedite diagnosis and life saving treatment!
Coarctation Ultrasound views

POCUS Pediatric Coarctation Direct Observation Test

<table>
<thead>
<tr>
<th>View</th>
<th>Points</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Suprasternal Notch 2D</td>
<td>0</td>
<td>1 2 3</td>
</tr>
<tr>
<td>Suprasternal Notch Doppler</td>
<td>0</td>
<td>1 2 3</td>
</tr>
<tr>
<td>Subcostal Abdominal 2D</td>
<td>0</td>
<td>1 2 3</td>
</tr>
<tr>
<td>Subcostal Abdominal Doppler</td>
<td>0</td>
<td>1 2 3</td>
</tr>
</tbody>
</table>
## POCUS Elective Feedback

<table>
<thead>
<tr>
<th>Challenges</th>
<th>Successes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheduling</td>
<td>Clinical impact</td>
</tr>
<tr>
<td>Consistency</td>
<td>Scanning numbers</td>
</tr>
<tr>
<td><em>Central coordinator improved</em></td>
<td>Collaboration</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Future</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 week mandatory course all MSIVs</td>
</tr>
<tr>
<td>Hand held US machines</td>
</tr>
</tbody>
</table>
“To continue to captivate we will need to insonate evaluate and collaborate to continue to innovate.”
Ultrasound in Medical Student Education: The Charlotte Experience for UNC SOM

Margaret Lewis, MD FACEP
Associate Professor of Emergency Medicine
Atrium Health Carolinas Medical Center
Margaret.Lewis@atriumhealth.org
# Evolution of an Ultrasound Curriculum

**Charlotte Campus, UNC SOM**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>- CLT Longitudinal Integrated Curriculum (CLIC)</td>
<td>- Increase CLIC students to 8</td>
<td>- All CLT campus students in CLIC for 6 months</td>
<td>- COVID-19 virtual ultrasound elective offered with UNC</td>
</tr>
<tr>
<td>- 6 students chosen for novel approach</td>
<td>- US curriculum continued for CLIC</td>
<td>- Longitudinal US curriculum offered to all MS3</td>
<td>- Socially-distanced US education &amp; game learning</td>
</tr>
<tr>
<td>- Longitudinal Ultrasound Curriculum Developed – 1(^{st}) in UNC system</td>
<td>- Self-Guided, Simulation-based US curriculum for Traditional students offered</td>
<td>- Students participate in research and national US events</td>
<td>- Learning through Social Media</td>
</tr>
<tr>
<td>- 4(^{th}) Yr US elective</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Ultrasound in UME Curriculum - Charlotte

- Physics & Knobology
- FAST Exam Aorta
- OB
- US OSCE

- Clinical Experience
- Lectures
- Simulation

- Cardiac Thoracic DVT
- Renal Biliary
- US-Guided Procedures
Development and Evaluation of a Longitudinal Integrated Ultrasound Curriculum for Third Year Medical Students
Margaret R. Lewis, MD FACEP; Lisa Howley, PhD; Patricia White, MD; Celeste Colcord, MBA; Bryant K. Allen, MD.

Evaluation of Self-Guided, Simulation-Based Ultrasound Education Versus Traditional Ultrasound Education for Third Year Medical Students
Jannach Lindsey¹, Anderson William E², Colcord Celeste², Lewis Margaret R²

A National Point-of-Care Ultrasound Competition for Medical Students
Creagh Boulger, MD
Department of Emergency Medicine, The Ohio State University Wexner Medical Center, Columbus, Ohio USA
Rachel B. Liu, MD
Department of Emergency Medicine, Yale University School of Medicine, New Haven, Connecticut USA
Giuliano De Portu, MD
Department of Emergency Medicine, University of Florida College of Medicine, Gainesville, Florida USA
Nik Theyyanni, MD
Department of Emergency Medicine, University of Michigan Medical School, Ann Arbor, Michigan USA
Margaret Lewis, MD
Department of Emergency Medicine, Carolinas Medical Center, Charlotte, North Carolina USA
Resa E. Lewiss, MD
Department of Emergency Medicine, Thomas Jefferson University, Philadelphia, Pennsylvania USA
Zachary P. Soucy, DO
Department of Emergency, Dartmouth-Hitchcock Medical Center–Geisel School of Medicine, Hanover, New Hampshire USA
Ultrasound in UME - The Charlotte Experience

• Fostering life-long learning through innovative approaches
Future Directions

Collaboration to Improve Ultrasound Innovation, Education, and Research
- Radiology
- Cardiology
- Obstetrics
- Emergency Medicine
- Internal Medicine
- Critical Care Medicine
- Anesthesiology
- Sports Medicine
- Neurology
- Surgery
- Pediatrics
POCUS Education for Internal Medicine Residents

- Improve skills and Knowledge
- Learn how to teach POCUS
- How to incorporate POCUS into bedside rounds

Start of New Academic Year

POCUS Champion
Rising PGY2s and PGY3s selected to be new POCUS champions

Intern POCUS Boot Camp

POCUS Champions

Champions teach Mentees

Workshops / Sim Lab sessions

POCUS Focus Noon Report case presentations

POCUS Elective

Self directed learning

Optional

Academic Half Day Lectures

Gen Med rounds w/ POCUS trained Attendings

Gel Rounds

POCUS Champion Redcap Application (April)
### Administrative

<p>| |</p>
<table>
<thead>
<tr>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Standardize Workflows</td>
</tr>
<tr>
<td>Template Documents</td>
</tr>
<tr>
<td>Equipment Purchasing</td>
</tr>
</tbody>
</table>
Research
CONNECT!
Ultrasound Research
Thursday, October 14; 4:00-5:30pm

- Find/meet new collaborators
- Spark new or interdisciplinary research ideas
- Connect informally with other researchers and learn about their work
### Hospital POCUS Committee

- System Wide Ultrasound Events
- Introductory Courses
- Administrative Coordination
- Foster Research Collaboration
<table>
<thead>
<tr>
<th>Atrium Research</th>
</tr>
</thead>
<tbody>
<tr>
<td>More Patients</td>
</tr>
<tr>
<td>More Resources</td>
</tr>
<tr>
<td>More Ultrasound Experts</td>
</tr>
</tbody>
</table>
Attention All Participants
To Receive CME Credit
Text Code: CD31B
To: 336-793-9317
*MyAHEC account is required for credit
For more instructions visit: www.nwahec.org/textreg