WELCOME TO THE ANESTHESIA RESIDENCY POCUS CURRICULUM!

We're excited to introduce you to Point-of-Care Ultrasound, starting with transthoracic ultrasound!

The goal of the POCUS curriculum is to teach Point-of-Care Ultrasound over the 3 years of your residency. Our hope is by the end of training, this longitudinal, comprehensive curriculum will provide you with a strong clinical skill set as you transition to the next phase of your career.

On your perioperative rotation, you will be spending 2 hours a day (10am-12pm), 3 days a week (Tuesday, Wednesday, Thursday) scanning patients with the POCUS attending. The goal will be to have you scan 15-20 patients over 2 weeks.

Basic TTE Ultrasound includes 5 basic views:

1. Parasternal Long-Axis
2. Parasternal Short-Axis
3. Apical 4-Chamber
4. Subcostal 4-Chamber
5. Subcostal Inferior Vena Cava

At the end of 2 weeks, you should be able to find all 5 views and identify the following cardiac structures:

1. Left atrium
2. Left ventricle
3. Right atrium
4. Right ventricle
5. Aortic valve
6. Mitral valve
7. Tricuspid valve
8. Pulmonic valve
9. Pericardium/Presence of pericardial effusions
10. Inferior vena cava

Included in this e-mail are the following:

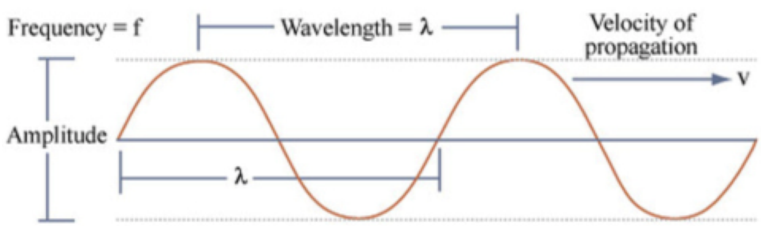
1. A powerpoint for your perusal, which describes how to obtain each view.
2. Introduction to physics for clinical ultrasonography, including terms we will use to describe our images
3. A "TTE Quick Guide" for you to carry around

Please keep a log of all of the TTEs you performed on MedHub. This will help us track how many TTEs you have completed, and will come in handy in the future, as certification in POCUS is likely in the upcoming future!

Thanks!
Lindsay and Marianne

Basic Physics of Clinical Ultrasound

1. Echocardiography uses **ultrasound waves** to create an image in real time.
   - Clinical ultrasound generally utilizes a range of frequencies (*f*)>1MHz. Higher frequencies allow better **resolution** (i.e. higher frequencies = decreased wavelength, λ; smallest distinguishable structure at any frequency is λ/2)



2. The echo probe has a **transducer** that acts as both the **transmitter** of the ultrasound sound impulse and the **receiver** of the reflected impulse.
   - The transducer has **piezoelectric crystals** that are vibrated by an electric current, thereby converting electric signals into ultrasound waves
   - When the sound waves are reflected back, they vibrate the piezoelectric crystals and produce discrete electric impulses.

3. Ultrasound is **reflected at interfaces between changes in tissue density** (ie., between tissue of different densities, or between tissue and fluid, etc).
   - The strength of the reflected signal is related to the **angle of incidence** with the acoustic surface (i.e. reflection is greatest at 90°) and regularity of the surface (i.e. smooth surfaces, or "**spectral reflectors**" > irregular surfaces).
     - **Scattering:** sound waves which bounce back in direction not directly toward source
   - **Strong reflectors** reflect most/all the ultrasound impulses.
     - Results in an area of **echo "drop-out"** or "shadowing" beyond that structure/interface.
     - Examples of strong reflectors include bone, metal.
   - Although some of the ultrasound impulse is reflected, some of the impulse passes through these interfaces to deeper structures.
   - **Attenuation** is the weakening of sound energy as the wave passes through tissue. Each type of tissue has a theoretical amount of attenuation associated with it.
     - **Absorption:** energy absorbed to tissue, usually through heat.
     - **Refraction:** path of sound wave is 'bent' as it travels between interface of two different densities

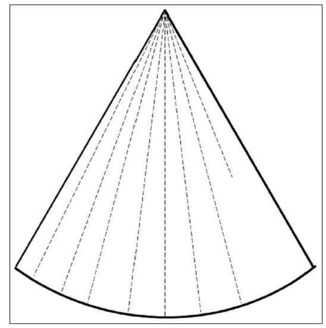
4. Ultrasound waves are conducted by vibrating the molecules of the tissue medium.
   - Good **conductors** of ultrasound have closely spaced, mobile molecules (i.e. fluids, soft tissues). Poor conductors have more distantly spaced molecules (i.e. gases, air).

5. The **time** it takes for the impulse to return to the transducer is **converted into a distance** from the transducer (based on the speed of sound) and a dot is produced at that point in space. All of these dots are summarized to create an image.

- The transducer intermittently produces sound waves and has a "listening period", during which it listens to the echo that returns.

6. An **image sector** is created by multiple **scan lines** across the field of view producing a planar, fan-shaped image.

- Each piezoelectric element sends out an ultrasound pulse along one **scan line**.
- The reflected impulses allow for creation of a 2D image, with objects near the transducer appearing at the apex of the sector.
- This sector is created over and over again over time creating a **2-D image** over time to show motion.



7. Back to **Resolution…** or the ability to differentiate between two objects in space

- **Axial Resolution:** ability to differentiate objects depending on depth. This is better with higher frequency.
- **Lateral Resolution:** ability to differentiate objects which are 'side by side'. This is dependent on the width of the ultrasound beam, as well as the number of crystals in the ultrasound probe
- **Temporal resolution:** ability to track moving objects over time. Related to number of frames/sec. Higher frame rate allows for smoother image acquisition

8. Other ultrasound terms:

- **Echogenic/Hyperechoic:** refers to tissue which appears brighter than surroundings
- **Hypoechoic**: refers to tissue which is darker than surroundings
- **Anechoic:** Appears black (such as in a simple fluid)
- **Homogenous:** uniform in echogenicity
- **Heterogenic:** not uniform in echogenicity