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Title: Implementation of Non-Invasive Point of Care Transient Elastography for Evaluation of Liver Disease in Pediatric Populations with Cystic Fibrosis

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Author Questionnaire

1. **Microscopy**: Does your protocol require the use of a dissecting or stereomicroscope for performing a complex dissection, microinjection technique, or something similar? **NO**

2. **Software:** Does the part of your protocol being filmed include step-by-step descriptions of software usage? **Yes**

   Videographer: Please record the computer screen for the shots labeled as SCREEN

3. **Filming location:** Will the filming need to take place in multiple locations? **No,**

Current Protocol Length
Number of Steps: 20
Number of Shots: 37 (17 SC)

Introduction

Videographer: Obtain headshots for all authors available at the filming location.

1.1. **Lauren Lazar:** This project aims to teach others how to use point of care transient elastography (POCTE) in the clinical setting with a focus on children with cystic fibrosis.
   1.1.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: 2.6.1*

What are the most recent developments in your field of research?

1.2. **Will Wood:** Recently published research has illustrated the importance of utilizing elastography for monitoring liver health in cystic fibrosis. The newest guidelines, published in 2023, recommend using elastography to monitor progression of disease in those persons with CF with CF hepatobiliary involvement.
   1.2.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: 2.4.3*

What are the current experimental challenges?

1.3. **Lauren Lazar:** Previous concerns have been that POCTE may not be well tolerated in children. Additionally, POCTE is not necessarily widely available, and its use is limited by the accessibility of devices for POCTE and provider training.
   1.3.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll:4.6.1*

What significant findings have you established in your field?

1.4. **Will Wood:** This project provides an example of a real-world implementation of POCTE in a pediatric CF center and supports the idea that this is a viable modality and technique for obtaining liver stiffness measurements.
   1.4.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll:5.1.1*

What research gap are you addressing with your protocol?

1.5. **Alexandra Pottorff:** This project helps disseminate a protocol for POCTE to make it more accessible for other clinics and care settings. This will provide real-world data to

compare with previous research results, increasing the validity of data surrounding POCTE.

1.5.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: 3.1.2*

Videographer: Obtain headshots for all authors available at the filming location.

Testimonial Questions (OPTIONAL):

Videographer: Please ensure that all testimonial shots are captured in a wide-angle format, while also maintaining sufficient headspace, given that the final videos will be rendered in a 1:1 aspect ratio.

How does the research community benefit from video publications as compared to standard text publications?

1.6. **Alexandra Pottorff:** People learn in different ways. Some learners find text "how-to" guides difficult to understand and implement, while a visual "how-to" may be more effective for other learners.

1.6.1. INTERVIEW: Named talent says the statement above in an interview-style shot, looking slightly off-camera. *Suggested B-roll: 3.1.2*

This project was IRB exempt given that it was deemed quality improvement

Video editor: This is not an ethics title card, but just statement that needs to be displayed after the interviews

Protocol

2. Selecting Probe and Positioning Patient for Point of Care Transient Elastography (POCTE)

Demonstrators: William Wood, Alexandra Pottorff, Lauren Lazar

2.1. To begin, prepare medium-sized probe to establish the intercostal space for the patient **[1]**. If the probe does not suit, switch to a small or extra-large size probe as needed **[2]**.
Added shot: 2.1.0
2.1.1. Talent placing a medium-sized probe on the patient's chest.
2.1.2. Close-up of Talent switching to a different probe size for better placement.
TXT: Thoracic perimeter (in pediatric patients):
<75 cm: Smaller probe
<45 cm: Smallest probe available

2.2. Have the patient lie on their back on an exam table with the right side of their body facing the operator **[1]**.
2.2.1. Patient being positioned on the exam table in the required posture.

2.3. Ask the patient to place their right arm behind their head and cross their right leg over the left leg **[1]**. Have the patient curve or abduct the right side of their body outward to make the right ribcage more prominent **[2]**. Remind the patient to remain still for accuracy **[3]**.
2.3.1. Talent instructing the patient and patient positioning their arm and crossing leg correctly.
2.3.2. Close-up of patient arching their body to make the right ribcage more visible.
2.3.3. Talent instructing the patient and patient staying still.

2.4. Take a seat on a chair next to the exam table, facing the patient and the point-of-care transient elastography or POCTE *(P-O-C-T-E)* screen **[1]**. Rest the right forearm on the exam table while holding the probe weight **[2]** and use left hand to control the probe direction and angle **[3]**.
2.4.1. Talent sitting in the correct position.
2.4.2. Talent adjusting the right forearm on the table while holding the probe weight.
AUTHOR'S NOTE: 2.4.1-2.4.2 were filmed together
2.4.3. Close-up of talent adjusting the probe using their left hand.

2.5. Place the probe in the intercostal space perpendicular to the patient, where the xiphoid intersects the mid-axillary line **[1]**. If this space is not ideal, move up or down one intercostal space **[2]**.

2.5.1. Talent positioning the probe perpendicular to the patient at the correct landmark. *Videographer: Please obtain multiple reusable shots for this step. It will be used again 4.7.2*

2.5.2. Close-up of talent adjusting the probe position up or down as needed.

2.6. Apply ultrasound gel to the patient at the probe placement site **[1]**.

2.6.1. Talent applying ultrasound gel to the patient's ribcage.

2.7. Open the patient profile or create a new exam profile by entering the patient's personal information **[1]**. After selecting the correct probe size mode on the machine **[2]**, press the **Play** button to start the exam **[3]**.

2.7.1. Talent operating the computer.

2.7.2. SCREEN: Ultrasound machine interface displaying probe size selection.

2.7.3. SCREEN: Ultrasound interface with the **Play** button being pressed.
Videographer: Please record the computer screen for the shots labeled as SCREEN

3. Point of Care Transient Elastography (POCTE) Data Collection

3.1. Once the probe is appropriately positioned, press the button on the probe to begin data collection **[1]**. The patient will feel a vibration coming from the probe **[2]**.

3.1.1. Close-up of talent pressing the button on the probe to start data collection.

3.1.2. Shot of slight vibrations from the probe.

3.2. Two large circles appear on the screen, one blue and one orange, each containing a check mark to ensure proper position and pressure of the probe in the liver space. Additionally, observe 4 green bars indicating appropriate pressure applied with the probe to the liver **[1]**. If unable to achieve proper positioning or pressure, attempt moving the probe to a different space **[2]**, adding more gel, adjusting the angle of the probe, or modifying the pressure applied to it **[3]**. NOTE: VO has been edited.

3.2.1. SCREEN: Ultrasound interface displaying an orange and blue circles Author's note: video timestamp 3.4.1, 1:00-1:10

3.2.2. Close-up of talent adjusting probe position for a better signal

3.2.3. Talent applying more ultrasound gel to enhance signal clarity.

3.3. Next, monitor the ultrasound TM-mode signal to ensure data collection **[1]**. If the signal does not follow a uniform, layered pattern, reposition the probe and apply gel as necessary **[2]**. Author's note: VIDEO TIME STAMP: 3.2.1-3.3.1, full video

3.3.1. SCREEN: TM-mode signal display with proper layering.

3.3.2. Talent adjusting probe position to remove signal disruptions.

~~3.4. Then, observe the scale measures above the ultrasound signal windows **[1]**. The scale above the TM-mode window tracks liver signal history, where green indicates a strong signal and black represents a weak signal **[2]**.~~
~~3.4.1. SCREEN: Color scale display showing real-time liver signal strength.~~
~~3.4.2. SCREEN: Cursor hovering over green and black indicators.~~

~~3.5. Now, if the probe pressure indicator shows a green signal, it represents optimal pressure **[1]**. Adjust probe pressure if the indicator moves out of the green range **[2]**.~~
~~3.5.1. SCREEN: Probe pressure indicator showing green (optimal pressure).~~
~~3.5.2. Close-up of talent adjusting probe pressure to maintain a green indicator.~~

Author's Note: Delete 3.4 – 3.5

3.6. Ensure appropriate probe placement by analysing the shear wave map. A parallel wave pattern is required for data collection **[1-TXT]**. Author's note: VIDEO TIME STAMP: 3.6.1, full video
3.6.1. SCREEN: Shear wave map displaying proper parallel wave patterns. **TXT: Reposition the probe to remove common errors such as A or E waves**

3.7. In total, collect ten valid measures to complete the data collection **[1]**. Ensure minimal variability with stiffness interquartile range under 30% **[2]**. Author's note: VIDEO TIME STAMP: 3.7.1-3.7.2, TIME 0:10=0:16
Videographer's Note: Use 3.2.2-3.2.3
3.7.1. SCREEN: System displaying data collection progress.
3.7.2. SCREEN: Stiffness (kPa) IQR displayed under 30%, confirming measurement consistency Author's note: VIDEO TIME STAMP: 4.6.1 full video

4. Reading and Interpreting the Point of Care Transient Elastography (POCTE)

4.1. The controlled attenuation parameter or CAP *(Cap)* is a measure of hepatic steatosis **[1]**. Report this value as the median of all collected data points, expressed in decibels per meter **[2]**. Author's note: VIDEO TIME STAMP: 4.1.1-4.2.1, full video
4.1.1. SCREEN: CAP measurement displayed in the system interface (blue box).
4.1.2. SCREEN: recording the median CAP value in dB/m in a sheet.

4.2. Look for hepatic steatosis when CAP values exceed 250 dB/m **[1]**.
4.2.1. SCREEN: cursor hovering over CAP values above 250 dB/m, indicating potential steatosis. Author's note: VIDEO TIME STAMP: 4.1.1-4.2.1, full video

4.3. Measure liver stiffness or elasticity in kilopascals **[1-TXT]**.
4.3.1. SCREEN: Cursor hovering over Stiffness measurement in kPa displayed in the system interface (pink box). **TXT: Report the median of all data points collected**

4.4. Measure wave speed to determine liver stiffness **[1]**. ~~Report wave speed in meters per second as the median of all collected data points **[2]**.~~

4.4.1. SCREEN: Shear wave speed measurement being highlighted in system interface (purple box). Author's note: VIDEO TIME STAMP: 4.4.1, full video

~~4.4.2. Talent performing some calculations on the computer.~~

Videographer's Note: 4.4.2 was omitted

NOTE: The author deleted 4.5 and 4.6 in latest revision.

~~4.5. Interquartile range or IQR represents the interval around the median where 50% of all valid measurements fall **[1]**.~~

~~**Videographer's Note: Use 4.6.1 for 4.5.1**~~

~~4.5.1. SCREEN: System display highlighting IQR values (blue, pink, and purple boxes).~~

~~4.6. Divide the IQR by the median and express it as a percentage **[1]**. If the ratio exceeds 30%, repeat the test **[2]**.~~

~~4.6.1. SCREEN: IQR/M value being calculated.~~

~~4.6.2. *Reuse 2.5.1*~~

Results

5. Results

5.1. Ten or more measures were collected for patients that were appropriate in quality with interquartile range to median ratio of less than 30% **[1].**

5.1.1. LAB MEDIA: Table 1 *Video editor: Highlight the column "Stiffness (E) IQR/Median (%)"*

5.2. Patient three has elevated CAP, stiffness, and shear wave speed at levels that are concerning for advanced cystic fibrosis-associated liver disease **[1]**. Patient four also has elevated features on POCTE but is more consistent with cystic fibrosis with hepatobiliary involvement **[2]**. Patients one and two do not appear to have remarkable findings on their POCTE **[3]**.

5.2.1. LAB MEDIA: Table 1 *Video editor: Highlight the row with patient "3"*

5.2.2. LAB MEDIA: Table 1 *Video editor: Highlight the row with patient "4"*

5.2.3. LAB MEDIA: Table 1 *Video editor: Highlight the row with patient "1 and 2"*

Pronunciation Guide:

1. Hepatobiliary

- **Pronunciation link:** https://www.merriam-webster.com/medical/hepatobiliary
- **IPA:** /ˌhɛp.ə.toʊˈbɪl.iˌɛr.i/
- **Phonetic Spelling:** HEP-uh-toh-BIL-ee-air-eemerriam-webster.com+6merriam-webster.com+6merriam-webster.com+6

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2. Xiphoid

- **Pronunciation link:** https://www.merriam-webster.com/dictionary/xiphoid
- **IPA:** /ˈzaɪ.fɔɪd/
- **Phonetic Spelling:** ZAI-foidmerriam-webster.commerriam-webster.com

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3. Intercostal

- **Pronunciation link:** https://www.merriam-webster.com/dictionary/intercostal
- **IPA:** /ˌɪn.tərˈkɒs.təl/
- **Phonetic Spelling:** IN-ter-KOS-tuhlmerriam-webster.com+4merriam-webster.com+4merriam-webster.com+4

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4. Shear Wave

- **Pronunciation link:** https://www.merriam-webster.com/dictionary/shear%20wave
- **IPA:** /ʃɪr weɪv/
- **Phonetic Spelling:** SHEER wavemerriam-webster.com+4merriam-webster.com+4merriam-webster.com+4

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5. Steatosis

- **Pronunciation link:** https://www.merriam-webster.com/medical/steatosis
- **IPA:** /ˌsti.əˈtoʊ.sɪs/
- **Phonetic Spelling:** STEE-uh-TOH-sismerriam-webster.com+6merriam-webster.com+6merriam-webster.com+6