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Medical Training Simulator for Central Venous Catheterization

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Central Venous Catheterization Procedure
- Used to deliver drugs to the heart in trauma cases
- Catheter inserted into the subclavian or jugular vein (Figure 1)
- Risky due to the proximity to major veins and arteries
- Students often practice on patients since current training simulators are inaccurate and expensive

Features of our simulator to overcome current simulator inadequacies
- Accurate anatomical landmarks
- Patent pending ultrasonic bone-mimetic cross-linked hydrogel
- Portable manikin and platform

The 2010 Affordable Care Act set many financial incentives for increasing quality of care as well as major disincentives for medical errors. Medicare has also eliminated hospital reimbursement for hospital-acquired conditions. Our goal is to create a safe, affordable, effective Central Venous Catheterization training simulator in order to improve care and reduce medical errors.

VASCULATURE
- Allows for ultrasound guided catheter insertion (Figure 2)
- Resistance to leaking
- Elastic arteries that simulate pulsatile flow created via hand pump and veins that expand with pressure created (Figure 3)

BONES
- Inclusion of all bony landmarks
  - Inclusion of two clavicles, the first and second rib, and the sternum (Figure 4)
  - Realistic use of palpable landmarks to locate for insertion
- Cost effective bone production method
  - 3D printed bones
  - Durable material allows for reuse
  - Single piece including all necessary bones does not require assembly

TISSUE ANALOG
- Mechanical Properties
  - Mechanical properties at a wide range of temperatures
  - Extended shelf life
  - Opacity hides internal anatomy for realistic training (Figure 5)
  - Can be punctured multiple times with minimal damage and does not clog needle (Figure 6)
  - Skin analog prevents dehydration and extends shelf life

- Ultrasoundability
  - Realistic echo texture (Figure 7)
  - Shows pulsatile flow in arteries with Doppler ultrasound
  - Visualization of expansion of veins during Valsalva (Figure 8)

- Platform
  - Inclination of 15 degrees to mock the Trendelenburg position (Figures 9 & 10)
  - Eliminates need for hospital beds and allows for easy clean-up

- Manikin
  - Represents upper torso
  - Mimics natural rotation of human head

- Tissue analog
  - Accurate anatomical landmarks
  - Ultrasoundability
  - Mechanical properties at a wide range of temperatures
  - Extended shelf life

- Ultrasoundability
  - Realistic echo texture
  - Shows pulsatile flow in arteries

- Ultrasoundability
  - Vision of expansion of veins during Valsalva

- Mechanical Properties
  - Mechanical properties at a wide range of temperatures
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- Ultrasoundability
  - Realistic echo texture
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- Ultrasoundability
  - Visualization of expansion of veins during Valsalva

REFERENCES