

Surgical Simulation Technology at the National Capital Area Medical Simulation Center

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Introduction

- Surgical simulation laboratory
- Motivation – why simulators?
- Types of simulators
- Future directions
- Discussion

Surgical Simulation Laboratory

- Application of simulation technology to
 - Training
 - Validation
- Simulator development

Why simulators?

- Limitations of cadavers and anesthetized animals (wet models)
- Education by opportunity
 - Lesson taught depends on patient encountered
 - Pathological/rare cases hard to find

Types of simulators

Current	Planned
Human patient	Triage
Bronchoscopy	Laparoscopy
Intravenous catheterization	Needle thoracostomy
Ultrasound	Central line
Vascular anastomosis	Cricothyrotomy
Diagnostic peritoneal lavage	
Pericardiocentesis	

Human patient simulator



Ultrasound simulator



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Bronchoscopy simulator



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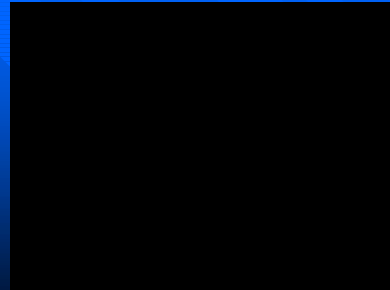
Bronchoscopy simulator



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Bronchoscopy simulator



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Hand immersive environment



Image courtesy of ReachIn Technologies Inc.
www.reachin.se

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Hand immersive environment

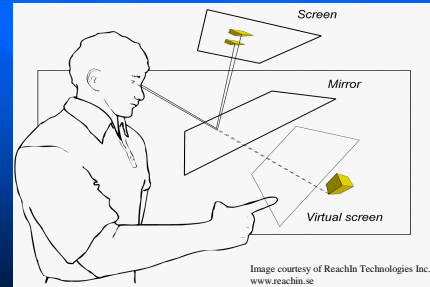


Image courtesy of ReachIn Technologies Inc.
www.reachin.se

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Cricothyroidotomy simulator

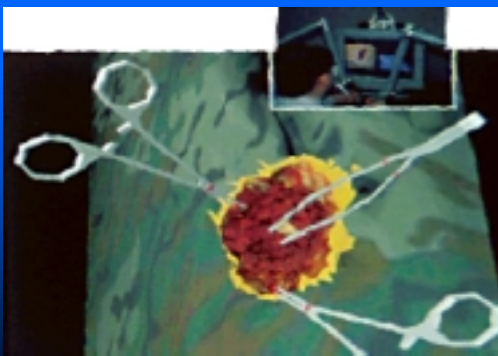


Images courtesy of ReachIn Technologies Inc.

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Vascular anastomosis



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Computer-based needle-procedure trainer

- 3 dof orientation sensor (pitch/yaw/depth)
- 1 dof passive haptics
 - variable resistance to pushing/pulling



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Intravenous Catheterization



Source: <http://www.immersion.com/medical>

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Needle-based procedures

- Pericardiocentesis
- Diagnostic peritoneal lavage
- Needle thoracentesis
- Central line insertion
- Subclavian line insertion

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Pericardiocentesis

- Performed to correct cardiac tamponade
 - Fluid buildup between the heart and the pericardium
 - Prevents the heart from functioning correctly
- The condition is life threatening and must be corrected quickly
- Initial treatment
 - Insert a needle between the pericardium and heart
 - Aspirate the accumulated fluid

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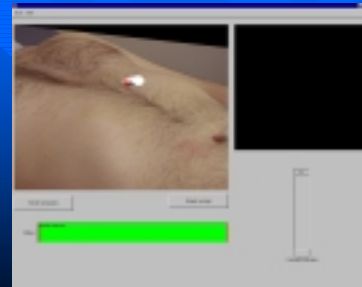
Pericardiocentesis – Challenges

- Rarely performed
- Must be done quickly
- Must be familiar with
 - Point of entry
 - Angle of insertion
 - Depth of insertion

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Pericardiocentesis



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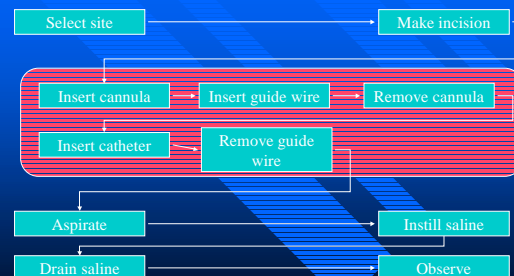
Diagnostic Peritoneal Lavage

- A diagnostic procedure to determine the presence of intra-abdominal bleeding
- Used when
 - Other diagnosis methods are unavailable
 - Patient cannot be moved
 - Not enough time

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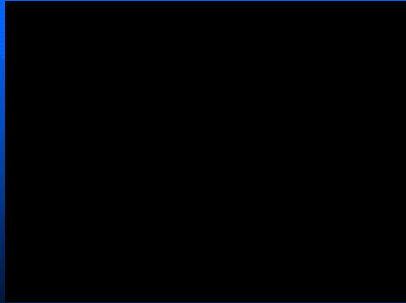
Diagnostic Peritoneal Lavage



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Diagnostic Peritoneal Lavage



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Future directions

- State of the art
 - Equivalent to flight simulation technology in the 1950s
- Focus
 - What should a simulator teach?
 - » How realistic does it need to be (fidelity)?
 - » What cues need to be accurate?
 - Acceptance

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Acceptance

- Versatility
- Understandability
- Simplicity
- Ease of verification
- Cost
 - Cost of a Phantom > \$20k (and rising)

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Goal

- Low cost, high volume simulators
 - Needle-based procedures
- Leverage on existing technology
- Look to off-the-shelf components
 - Display
 - Haptics

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Low cost shutter glasses

- 3D stereo glasses
 - cost per pair \$30
 - <http://www.vrex.com>
- Compatible with standard and stereo-capable graphics hardware
 - Interlaced
 - Frame sequential



Picture from vrex website

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Low cost haptic interfaces

- Force feedback joysticks and mice



Source: www.thrustmaster.com

Source: www.logitech.com

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