ADUM

ADVANCED DIAGNOSTIC ULTRASOUND IN MICROGRAVITY

wyle laboratories

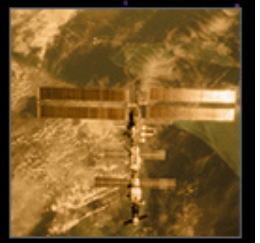
Henry Ford HEALTH SYSTEM

NASA

HUMAN RESEARCH FACILITY NASA - JSC







EXPERIMENT OVERVIEW | ULTRASOUND IMAGERY | EXERCISES




OPE

QUIT ESC VOLUME - +

SKIP S

ADUM: Advanced Diagnostic Ultrasound in Microgravity

- PI: Dr. Scott Dulchavsky, Henry Ford Hospital, Detroit, MI
- Co-I: Dr. Douglas Hamilton, Dr. Ashot Sargsyan, Wyle, Houston, TX
- Project Manager: Shannon Melton, Wyle, Houston, TX

- Conducted on Expeditions 8-11
- Used the HRF Ultrasound Hardware

ADUM Research Goals

Determine accuracy of ultrasound in novel clinical conditions

Determine optimal training methodologies

Determine microgravity associated changes in physiology

Develop catalog of anticipated organ position size changes

CLINICAL PROTOCOLS INVESTIGATED

Ultrasound Protocols: ADUM
83 Hours of Scan Time

- Cardiac
- Abdominal
  - Spleen
  - Liver
  - Gallbladder
- Retroperitoneal
  - Kidneys
  - Pancreas
  - Abdominal Aorta
  - IVC
- Genitourinary
  - Bladder
  - Prostate
- Musculoskeletal
  - Rotator Cuff
  - Knee, Ankle, Elbow
- Thyroid
- Dental
- Sinus
- Eye
- Peripheral Vessels
  - Carotid/Jugular
  - Maneuvers
  - DVT R/O

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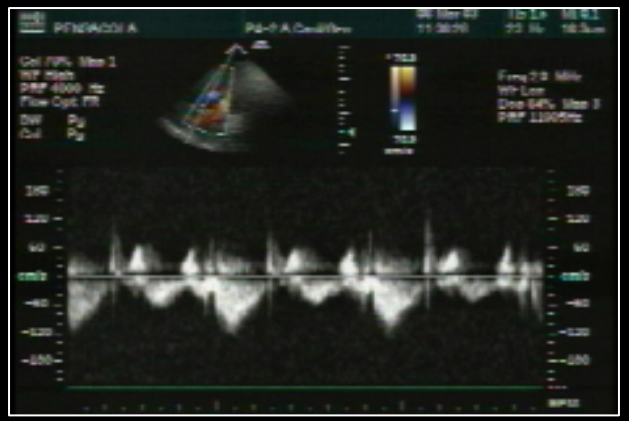
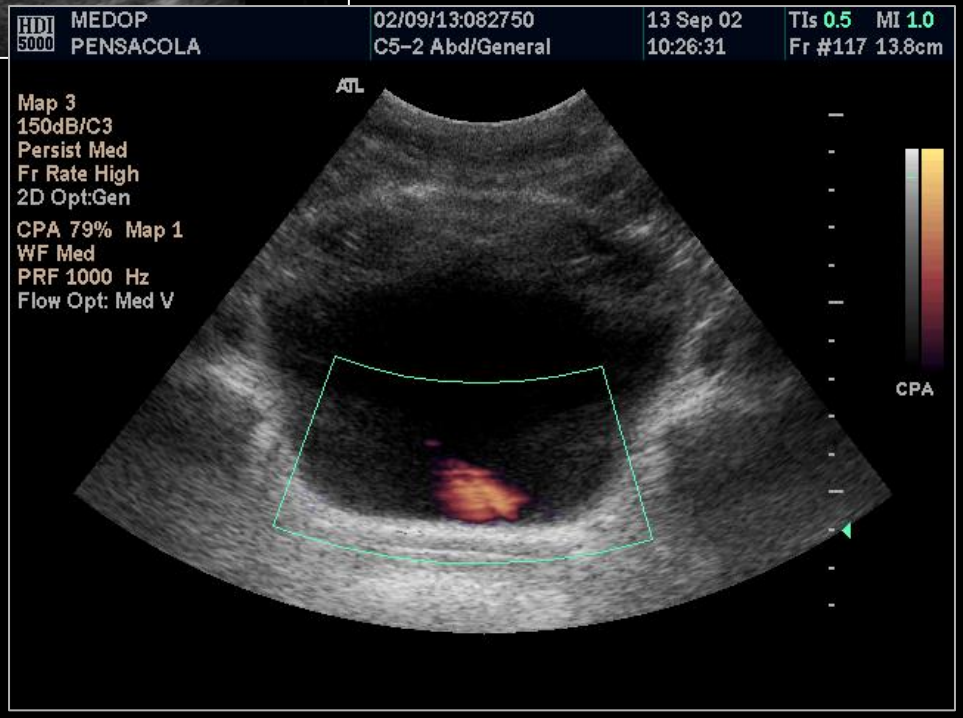
Echocardiography



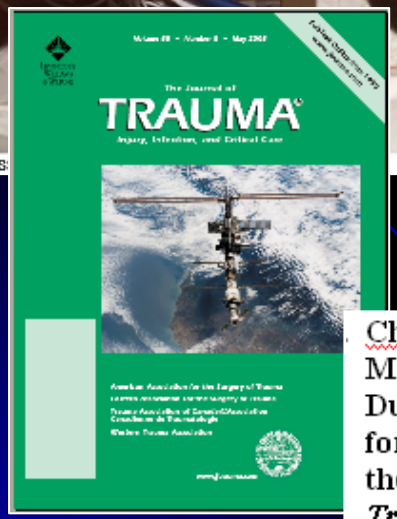
Abdominal and Genitourinary
Renal Stones / Ureter Patency



Musculoskeletal Ultrasound

Fincke EM, Padalka G, Lee D, van Holsbeeck M, Sargsyan AE, Hamilton DR, Martin D, Melton SL, McFarlin K, Dulchavsky SA. Evaluation of shoulder integrity in space: first report of musculoskeletal US on the International Space Station. *Radiology*. 2005 Feb;234(2):319-22. Epub 2004 Nov 8.

Ocular Ultrasound

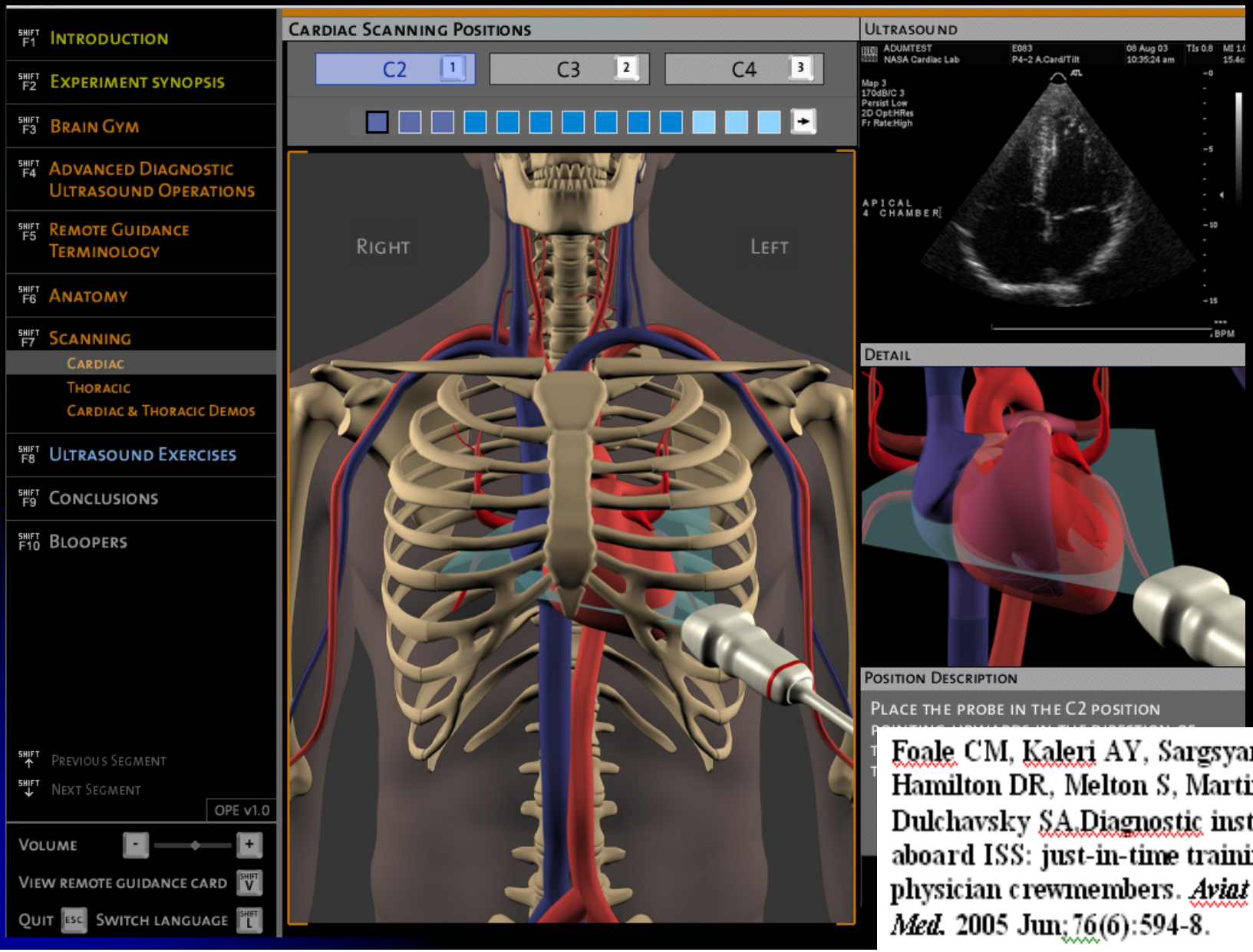


Chiao L, Sharipov S, Sargsyan AE, Melton S, Hamilton DR, McFarlin K, Dulchavsky SA. Ocular examination for trauma; clinical ultrasound aboard the International Space Station. *J Trauma.* 2005 May;58(5):885-9.

ADUM Training

- ~4 hours of pre-flight training 6-8 months prior to flight
- Just –in-time training on-orbit 2-3 days prior to session
- Remote guidance during session

Just-in-Time Training :On-board Proficiency Enhancer



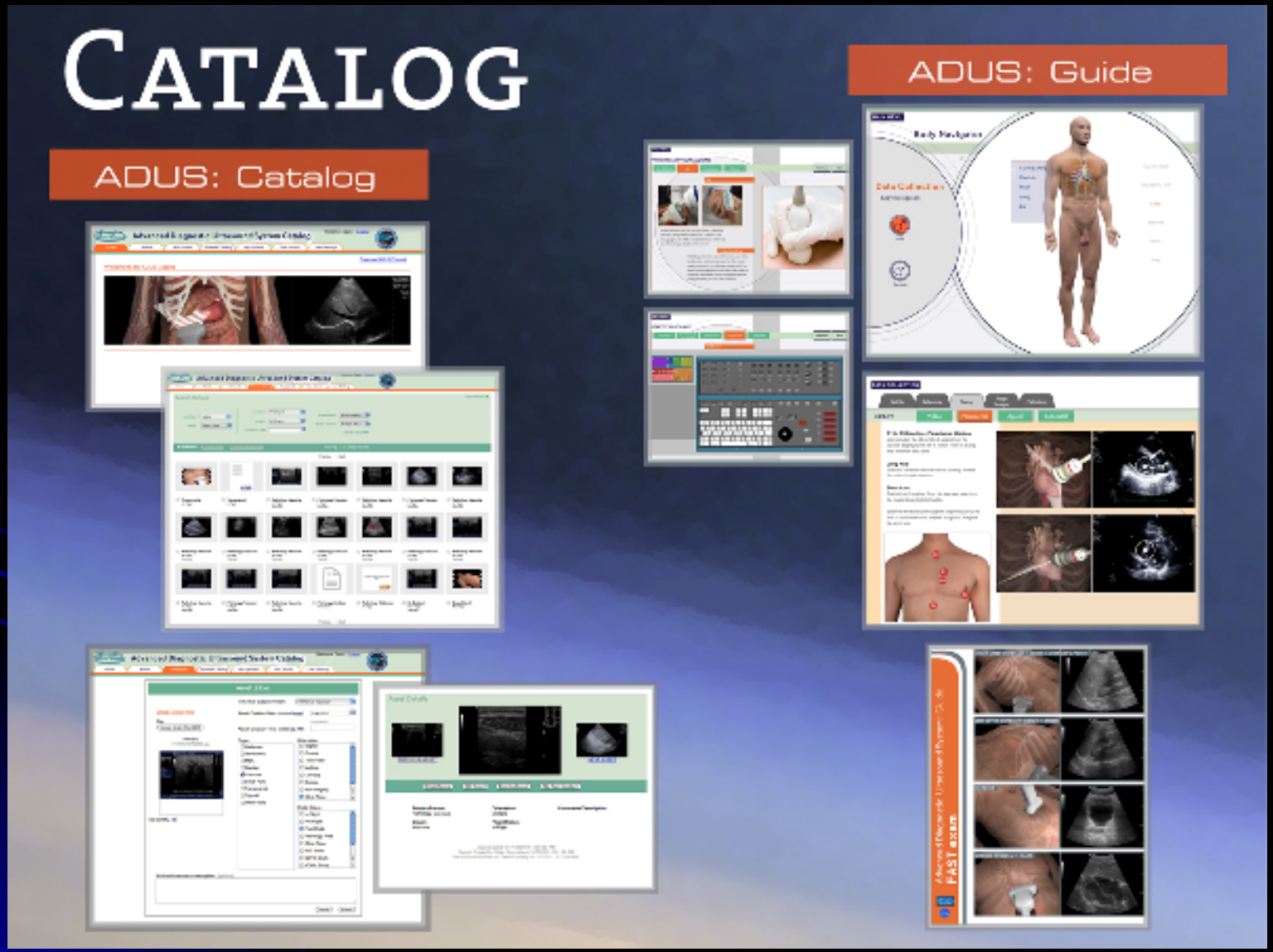
Foale CM, Kaleri AY, Sargsyan AE, Hamilton DR, Melton S, Martin D, Dulchavsky SA.Diagnostic instrumentation aboard ISS: just-in-time training for non-physician crewmembers. *Aviat Space Environ Med.* 2005 Jun;76(6):594-8.

ADUM Major Results

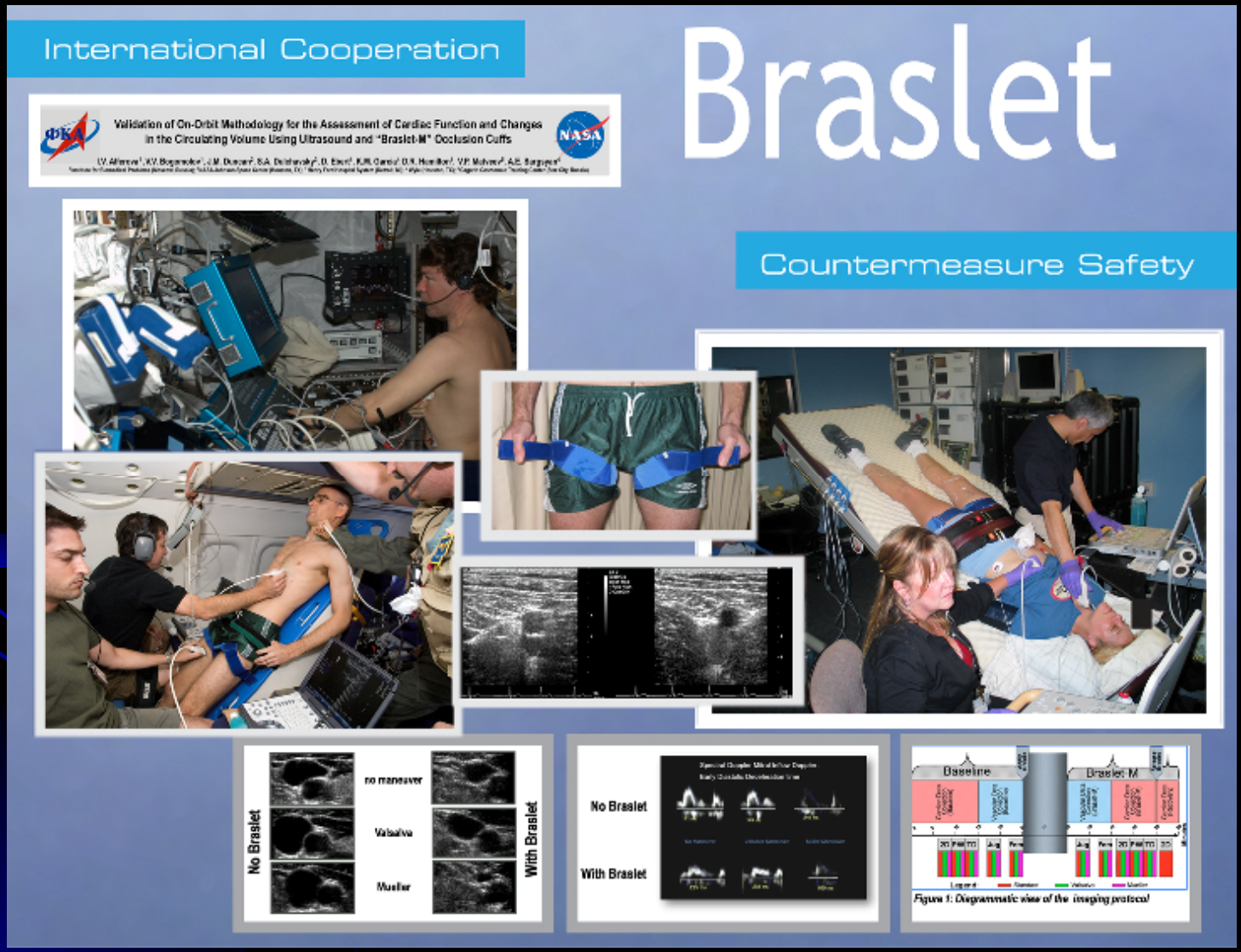
- Demonstrated that minimal crew training, just-in-time training and remote expert guidance, can be successfully used to complete complex diagnostic ultrasound exams.
- Ultrasound was rapidly and accurately performed by all crewmembers in a number of organ specific applications which have direct operational relevance
- Demonstrated that this approach could provide direct, important medical information to impact the diagnosis and treatment of inflight medical conditions
  - Eye protocol for ADUM modified for operational use to capture changes associated with the Visual Impairment Intracranial Pressure (VIIP) issue and is used on every increment
- Minimal resources, training, or crew time were required to complete these complex tasks; this served as a successful model for future spaceflight experiments.
- Based on this model other novel uses of ultrasound were identified and evaluated

SPIN OFF RESEARCH

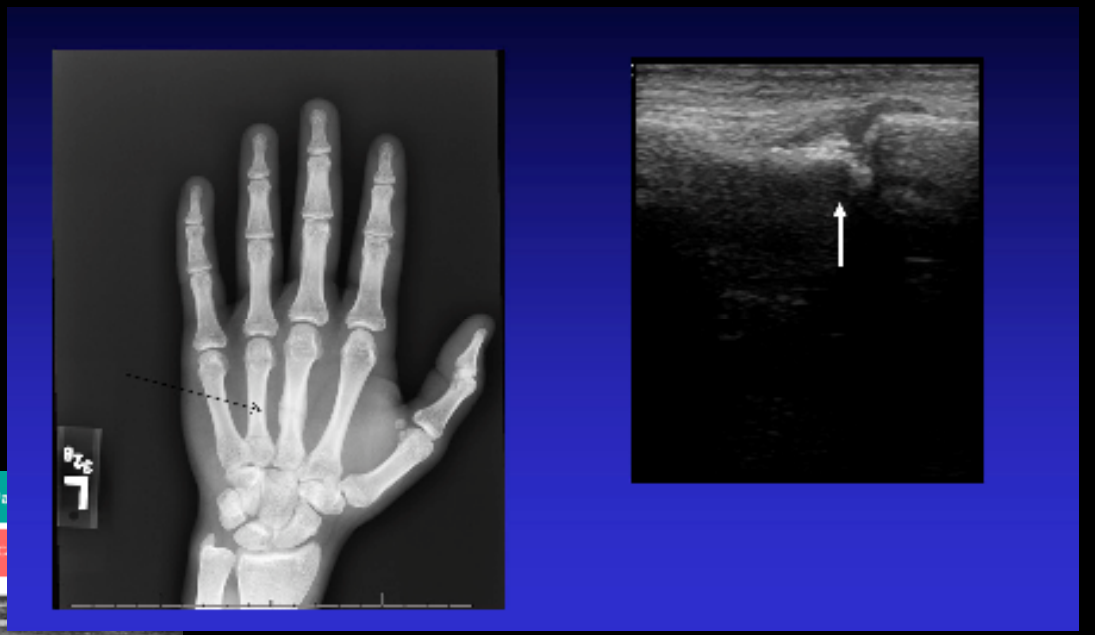
ULTRASOUND CATALOG

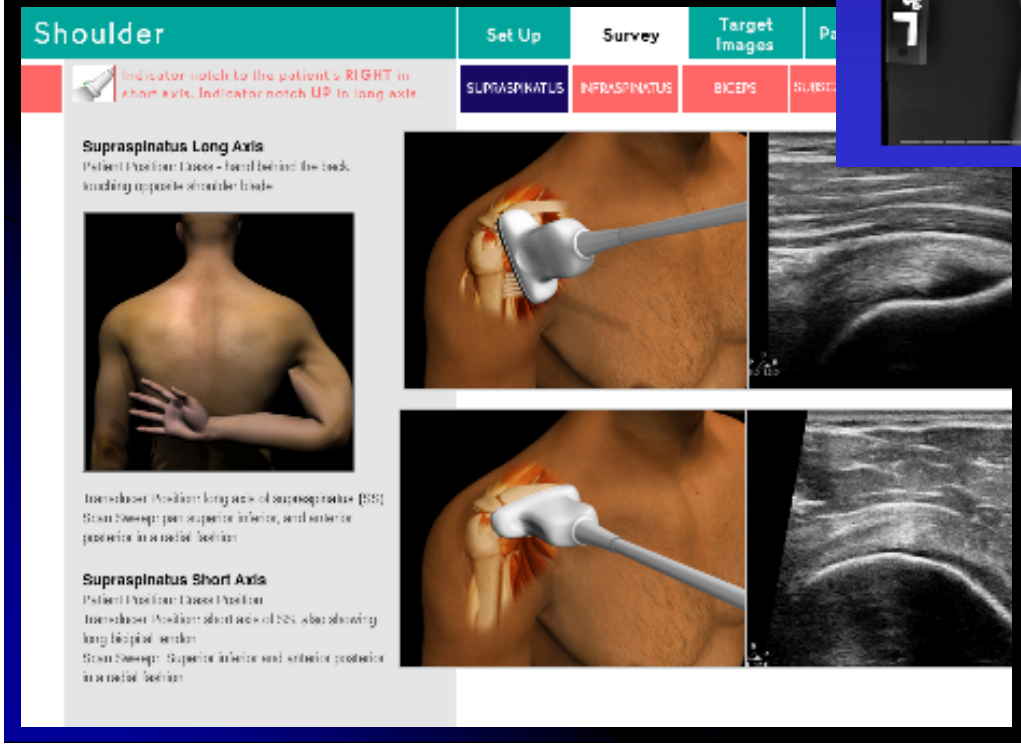


Braslet Investigative Grant/Braslet DTO



FRACTURE



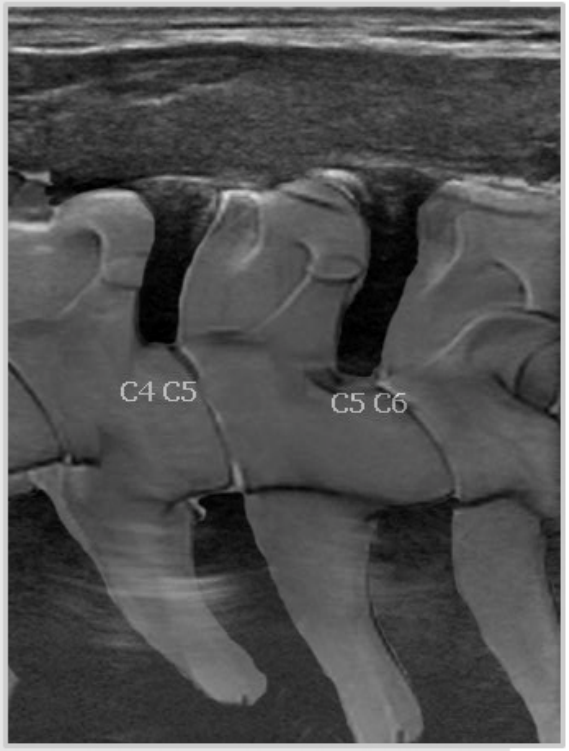

Shoulder
Set Up
Survey
Target Images
SUPRASPINATUS
INFRASPINATUS
BICEPS
Supraspinatus Long Axis
Supraspinatus Short Axis

SPINE

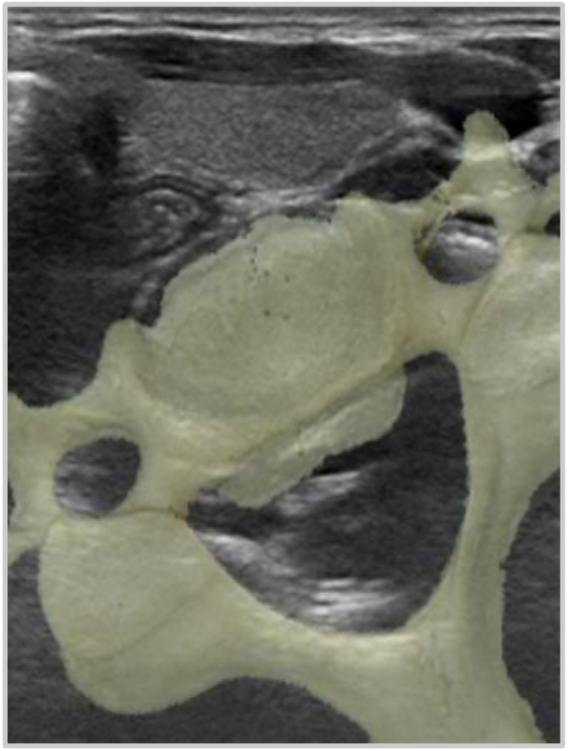
Cervical **Spine**

Set Up | Survey | Target Images

PAGE 1 | PAGE 2 | PAGE 3



Cervical ultrasound long axis
Mouse over to see the overlay of cervical spine bones.



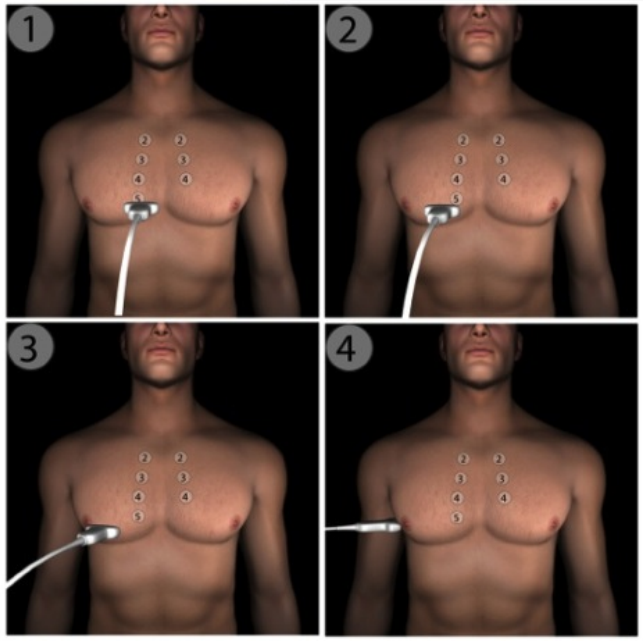
Cervical ultrasound short axis
Mouse over to see the overlay of cervical spine bones.

TERRESTRIAL APPLICAITONS

Terrestrial Applications


NAMEID
PENSACOLA
16 Jun 04
15:43:17
Fr #49
3.9 cm


SPACE BIOMEDICAL RESE
NSBRI
2008 Everest Lung
Cue Card


1
2
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CDN Everest 2008_2

UN Millennium Development Goals

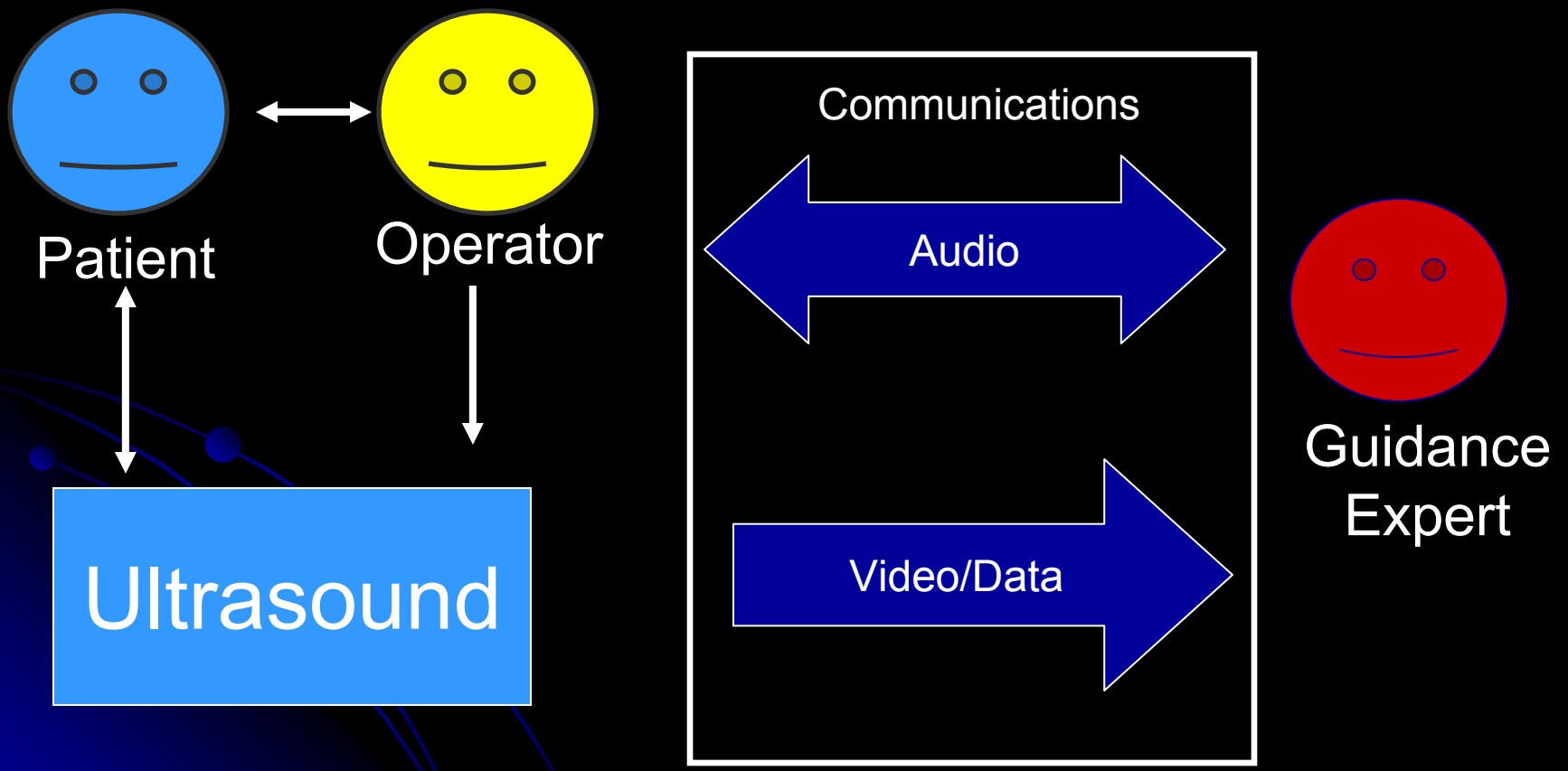
keep the promise
Millennium Development Goals
2015

LESSONS LEARNED THAT CAN BE APPLIED TO FACILITATE FUTURE RESEARCH

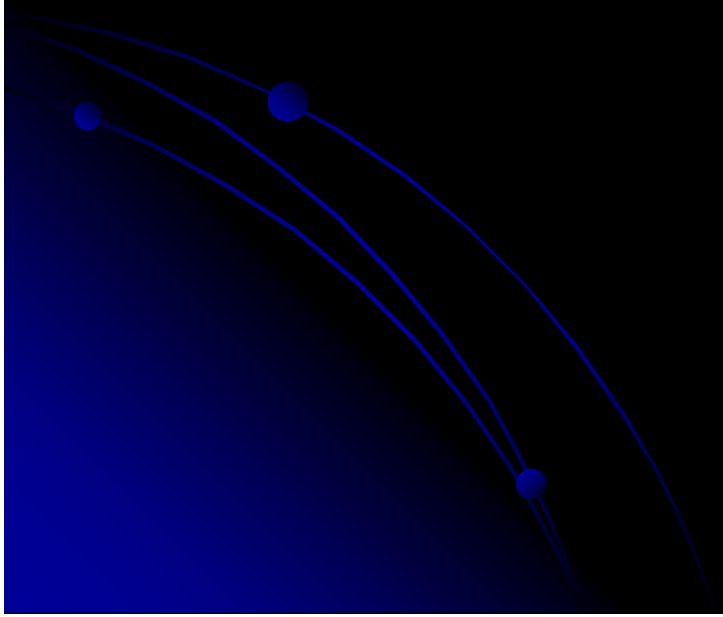
Training

- Crew time dilemma- not enough is still too much
  - Not enough crew time to train them to do what you want but you are asking for too much crew time
- Expertise on the ground
- Trade training time for remote guidance
- Just-in-time training

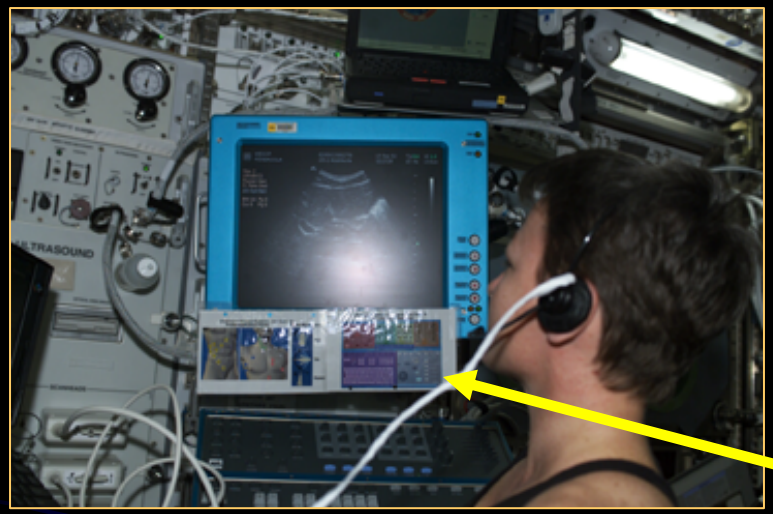
Remotely Guided Ultrasound

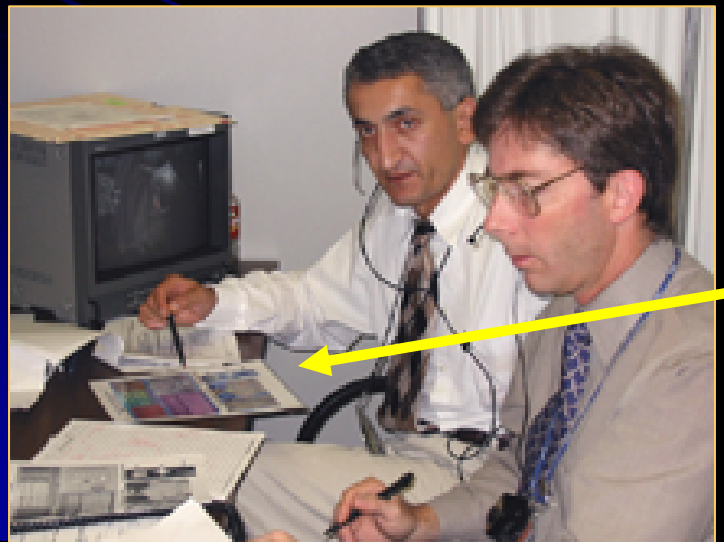


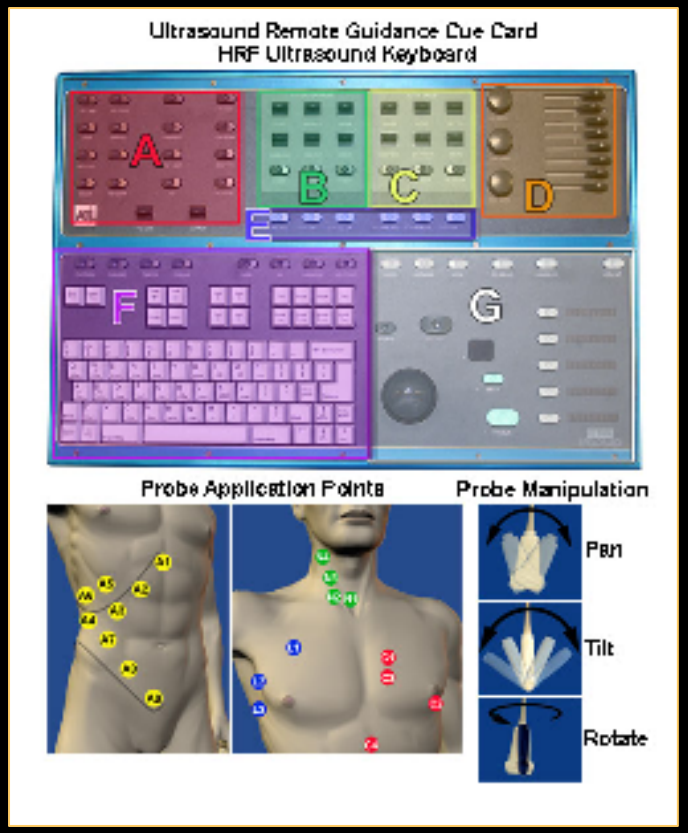
Remote Guidance Tools



Cue Card for Remote Guidance

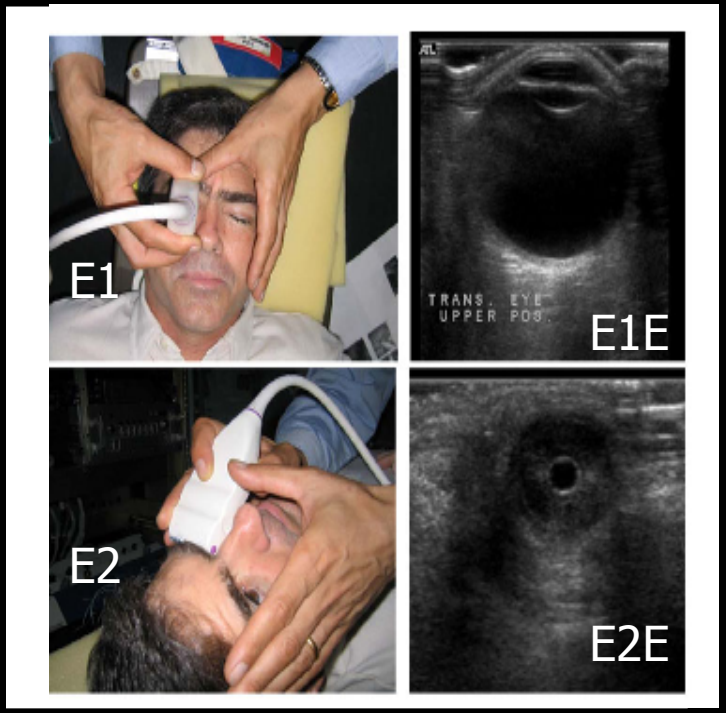






New Ultrasound with Overlay

Reference Images



Crew Participation in Science

- Include crew as vested part of experiment team
- Crew feedback after each on-orbit session through direct communications between investigative team and crew
  - Cue cards were a recommendation from the crew
  - Crew recommended efficiencies in procedures and positioning that resulted in modified protocols

Split Team Support

- Detroit PI directed scientific content
  - Provided clinical input and expertise for protocols.
  - Conducted crew briefings
  - Supported on-orbit sessions from Houston
  - Remote support from Detroit – ISS Audio and 2-way video connected to Detroit
- Wyle team in Houston handled day-to-day experiment activities
  - Developed requirements documents, ISS required documentation
  - Developed training materials and conducted crew training
  - Developed on-orbit procedures
- Allowed for rapid response for changing on-orbit schedules and other critical tasks that required in person

Summary: Lessons Learned

- Remote Guidance
- Specific Reference Tools
- Just-in-time training
- Get crew invested in science
- Be flexible – continuous evaluation of protocol
- Boots on ground with knowledge of ISS operations is valuable

Questions

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