Human Factors in Medicine
Perspectives from 1-g and micro-g

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The Articles


A Thought Exercise…

What are some of the human factors issues associated with using a thermometer to take a patient’s temperature?
Factors in Medical Error

- Vast information recall
- Multiple alarms (33 in one ICU)
- Long work hours
- Complex interfaces
- Communication breakdown between doctors and nurses (2% of staff comm)

- High stress levels
- Complex technologies
- Often reactive rather than proactive
- Intermittent contact with high patient volume

- Doctors’ handwriting…
“Although it allegedly calls for Isordil, the pharmacist filled it as Plendil. The jury's $450,000 judgment, finding both the cardiologist and pharmacist negligent, is believed to be the first of its kind nationwide to focus solely on bad handwriting.” – American Medical News, 1999
Reducing Clinical Error

• Clinical error rates may be as high as 50%
  – Inter-clinician variability
  – Internal inconsistencies
  – Nonstandard use of medical terminology

“Standardization of clinical decisions is needed not only for clinical practice but also for rigorous clinical research.”
Computerized Protocols

- Standardize clinical decisions
- Lead to uniform implementation of clinical interventions
- Aids in both clinical practice & research
Not Perfect…

What sorts of issues would you expect a tool like this to introduce to the problem?
Time to think again…

What are some of the unique challenges for diagnosis and treatment in microgravity?
Some Complicating Factors

- Organs and sites of pain can shift in micro-g, making diagnosis quite a challenge
- Many crews lack doctors & crew medical training is limited to <60 hrs (usually only 16!)
- Even trained physicians don’t get much practice on a long mission
- An unscheduled medical evacuation would cost around $500 million
Telemedicine

“Utilizes information and telecommunications technology to transfer medical information for diagnosis, therapy and education”

- images
- audio and video
- patient medical records
- output data from medical devices
Long-distance bills...

But... communications lags on a Mars mission could be as high as 40 minutes round-trip...

And an emergency return to the Earth could take up to a year...
3 Levels of Care

- Data Acquisition by CMO with Real-Time Guidance & Analysis Provided by the Ground
- Independent Data Acquisition by CMO with Expert Analysis Provided by the Ground
- Independent Assessment, Analysis, and Action by CMO

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Crew Health Care System (CHeCS) for ISS

- **Environmental Health System**
  - Monitors radiation, air & water quality, and surface microbes

- **Countermeasure System**
  - Provides exercise, fluid loading, drugs, etc. to help fight the deconditioning effects of micro-g

- **Health Maintenance System**
  - Prevention, diagnosis, and treatment of ISS crew
Considerations for Medical Hardware & Care Kits

- Mass, volume, and power requirements
- Shelf life of components
- Simplicity of use and maintenance
- Modular
- Safe and effective in reduced gravity
Trauma Sonography

- Blunt trauma is one of the most likely serious medical events in space
- FAST sonography can be used to detect trapped fluid or air
- Ultrasound is harmless, portable, and already available on ISS
Looking Forward

- Expert medical systems
- Minimally-invasive surgery
- Robotic surgery
- Mandatory appendectomy for space travelers?

http://roborapiens.mit.edu/davinci.htm
Discussion Point

How can we take advantage of the microgravity environment in developing medical care, rather than fighting against it?