Human Factors in Medicine

Perspectives from 1-g and micro-g

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HFES journal club
24 april 2002

The Articles

- Morris AH. Rational use of computerized protocols in the intensive care unit. Crit Care. 2001 Oct;5(5):249-54. Review.
- Williams DR. A Historical Overview of Space Medicine. McGill Journal of Medicine. 2001; 6(1): 62-65.
- Melton S, Beck G, Hamilton D, Chun R, Sargsyan A, Kirkpatrick AW. How to Test a Medical Technology for Space: Trauma Sonography in Microgravity. McGill Journal of Medicine. 2001; 6(1): 66-73.

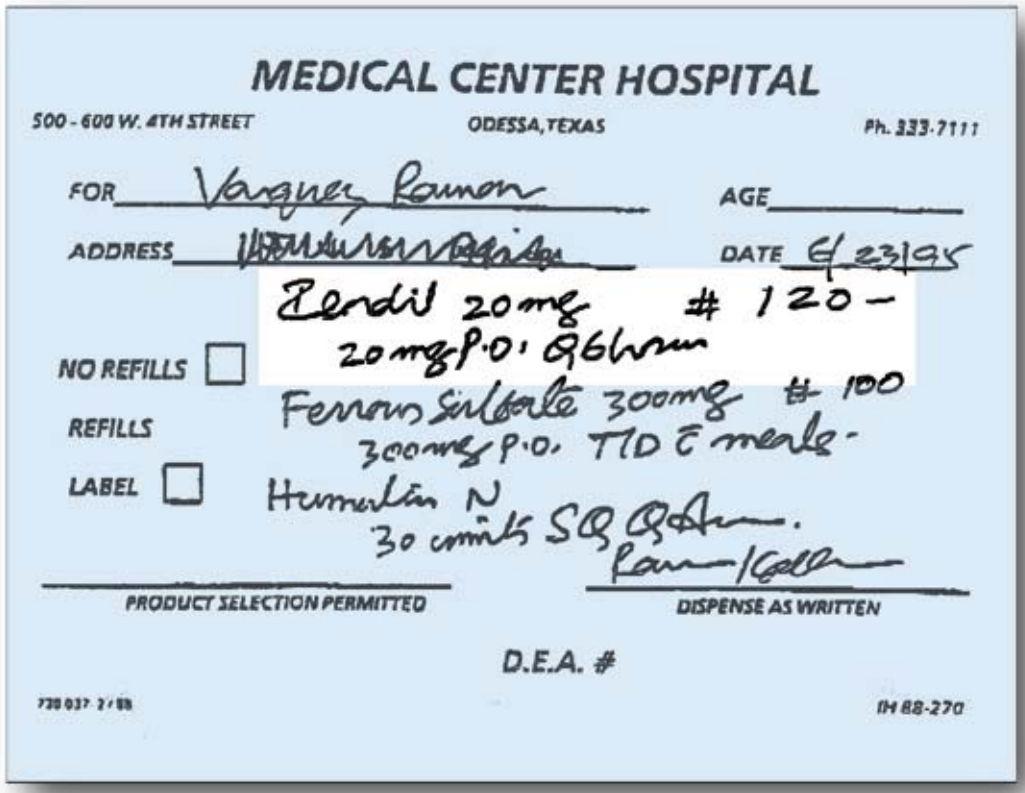
A Thought Exercise…

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…

Deadly Errors…



MEDICAL CENTER HOSPITAL

500 - 600 W. 4TH STREET ODESSA, TEXAS Ph. 333-7111

FOR Vazquez Ramon AGE

ADDRESS DATE 6/23/95

Rendil 20mg # 120 –
20mg P.O. Q6hrs

NO REFILLS ☐

REFILLS Ferrous Sulfate 300mg # 100
300mg P.O. TID c meals

LABEL ☐ Humulin N
30 units SQ QAM.

PRODUCT SELECTION PERMITTED DISPENSE AS WRITTEN

D.E.A. #

730 037 2/88 IH 88-270

"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

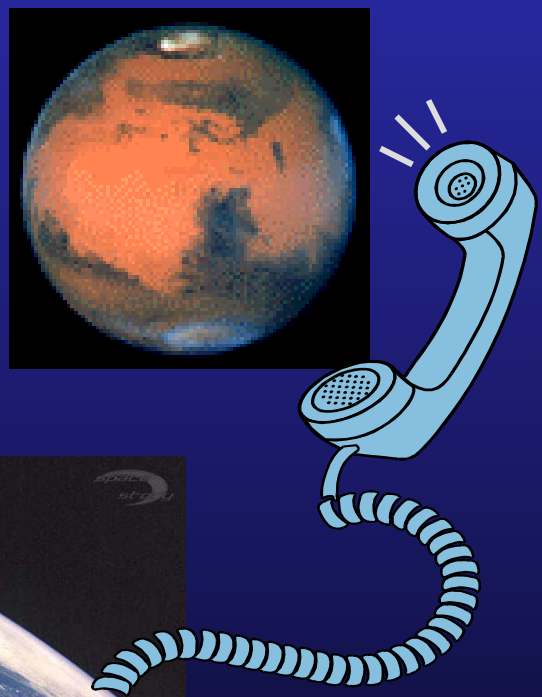
Telemedicine

"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

http://www.atmeda.org/about/aboutata.htm

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

Increasing Access to Information

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

Decreasing Interaction and Time

Crew Health Care System (CHeCS) for ISS

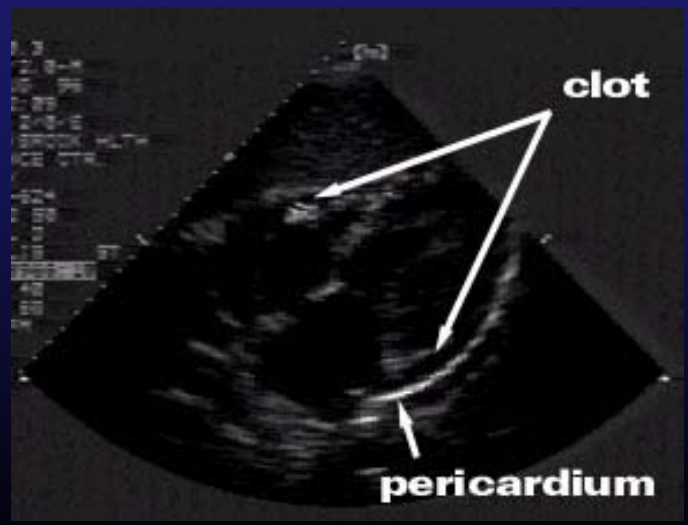
- Environmental Health System
  - Monitors radiation, air & water quality, and surface microbes
- Countermeasure System
  - Provides exercise, fluid loading, drugs, etc. to help fight the deconditioning effects of micro-g
- Health Maintenance System
  - Prevention, diagnosis, and treatment of ISS crew

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

http://robosapiens.mit.edu/davinci.htm

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

Discussion Point

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