The NASA Clinic System

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June 2, 2009
NASA Medical Care

Underwater...

..on the ground...

...through the air...

...and into space
Authority for NASA Health Care: Occupational Health

5 USC 7901

- The head of each agency of the Government of the United States may establish, within the limits of appropriations available, a health service program to promote and maintain the physical and mental fitness of employees under his jurisdiction.

- A health service program is limited to
  1. treatment of on-the-job illness and dental conditions requiring emergency attention;
  2. pre-employment and other examinations;
  3. referral of employees to private physicians and dentists; and
  4. preventive programs relating to health.
Authority for NASA Health Care: Astronaut Health

◆ 31 USC 1301(a)
  – Appropriations shall be applied only to the objects for which the appropriations were made except as otherwise provided by law.

◆ US General Accounting Office, Principles of Federal Appropriations Law (the GAO Red Book)
  – The “Necessary Expense Doctrine”
Comprehensive Health Care for NASA Employees

- Federal Employees Health Benefits Program – administered by the US Office of Personnel Management
  - Health
  - Vision
  - Dental
  - Flexible spending accounts
  - Long term care

- TRICARE
  - Department of Defense personnel detailed to NASA
NASA Occupational Exposures (Ground Based)

- Noise
- Fuels
- Solvents
- Paints
- Pyrotechnics/explosives
- Pressure changes
- Closed spaces
- Office ergonomics
- Heat/cold
- Heights
- Radiation, etc.
NASA Occupational Health Services (Ground Based)

- Occupational Medicine
  - Emergency care
  - Preventive health care
  - Occupational health monitoring
  - Limited treatment of occupational injury/illness
- Industrial Hygiene
- Employee Assistance Program
- Workers’ Compensation Program
NASA launch site uses DoD helicopters, ambulances and medical staff to cover visitors as well as the astronauts
NASA Medical Launch and Landing Support (Space Shuttle)
NASA Medical Launch and Landing Support (Space Shuttle)

KSC uses DOD helicopters and ambulances to cover visitors as well as the astronauts
Hurricane Katrina

The 2005 hurricane season will long be remembered both for the record-breaking number of early storms and the emergence of a powerful Category 5 hurricane in the central Gulf of Mexico—Hurricane Katrina.

Seventeen days after Katrina flooded New Orleans, much of the city is still under water. In this pair of images, the affected areas can clearly be seen. The flooded parts of the city appear dark blue, and the areas that have dried out appear light blue-gray.

Hurricane Katrina strengthened into a powerful Category Five hurricane with sustained winds of 180 mph. The floods came just hours after Katrina reached Category 4, with winds of 145 mph, as it gathered energy from the warm water of the Gulf of Mexico. Here it continues on its path towards the Louisiana-Mississippi coastline.
The Space Environment

- Temperature extremes
- Vacuum
- Isolation & confinement

- 49,000,000 km
- 22 minute 1-way communication
- Circadian rhythms

- Microgravity ($\mu g$)

- 1 yr

- Water & food availability
- New geo-ecosystem
- Reduced gravity
- Fuel & oxygen
- Radiation

- Circadian rhythms
Physiology of Spaceflight

- Psychological
- Neurosensory & Neuromotor
- Musculoskeletal
- Cardiovascular/Pulmonary
- Endocrine/Immune/Hematology
- Musculoskeletal
- Fluid Shifting
- Radiation
- Psychosocial/cultural
- Microgravity
- Confinement

Radiation

Psychosocial/cultural
Johnson Space Center Flight Medicine Clinic

- Comprehensive health care for astronauts on active duty with NASA and limited health care for their dependents (space available basis)
- Longitudinal Study of Astronaut Health for all astronauts, active and former
  - Annual executive physical with examinations targeted to space exposures
  - Records of all episodes of health care
Medical Care in Space: Telemedicine Based
Delivery of Medical Care in Microgravity and Space
ISS004-E-8510 (11 March 2002) --- Astronaut Carl E. Walz, Expedition Four flight engineer, performs cardio-pulmonary resuscitation (CPR) on a jerry-rigged “human chest” dummy in the Destiny laboratory on the International Space Station (ISS).


Communications Challenges

- IMAGE DEGRADATION
- INTERRUPTIONS
- DELAY (>2 sec.)

Voice
Reference Files
Procedures

Voice
Real-time video (US)
Real-time video (other?)
Files (stills and cine)
Recorded Video

PRIVACY
Mercury
5-12 min.
57 million km

Venus
2-15 min.
26 million km

Mars
4-22 min.
49 million km

Jupiter
34-52 min.
391 million km

Saturn
71-88 min.
795 million km

Uranus
151-168 min.
1693 million km

Neptune
241-259 min.
2706 million km

Pluto
320-337 min.
3573 million km

* Mean distances from Earth
Self-replicating, self-repairing, & complex

Interconnected & autonomous

Smart & communicative

Human-centered

Human-assisted

Human-enabled

Information Technology
Future of Health Care in Space

From telecare to autonomy

Adaptive Automation
Multipurpose Tactile Interface
Biosensors for environmental and physiologic monitoring
Genetic profiling
Genetic diagnosis
Genetic vaccines
Tissue engineering

Biologically-Inspired Robots
Biotech based immunotherapy
Functionally-Adaptive Biomimetics
Nanomachines (self assembly)
Cell herding, genetic surgery
Biologically based nanocomputers
Artificial intelligence
Smart/haptic systems
Virtual physician
NASA On Site Medical Clinics

- NASA maintains on site occupational health clinics at all Centers and major facilities
- NASA maintains an on-site clinic that offers comprehensive health care to astronauts at the Johnson Space Center
- NASA deploys limited health care capability to space and extreme environments
- Focus is always on preventive health care