SPACE MEDICINE
& Medical Operations Overview

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FIRST WORD FROM THE MOON
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Medical Operations Objective

To ensure the health, safety, and well being of the astronaut corps and ground support team during all phases of space flight
Mission Support

On-orbit Flight Control Room (FCR) Staffing

Surgeon Console - FCR
Physiological Issues

- Space Motion Sickness (SMS)
- Cardiovascular
- Neurovestibular
- Musculoskeletal
- Behavioral/Psycho-social
Space Motion Sickness (SMS)

- **Incidence**
  - Affects approximately 70% of crewmembers
  - 10% of cases severe

- **Symptoms** - From loss of appetite to nausea and vomiting

- **Time course** - Onset from MECO to 24 hours; peak symptoms 24 to 48 hours; symptoms resolve by 72 to 96 hours

- **Causes**
  - Neurovestibular - otolith mismatch, sensory conflicts
  - Fluid shift

- **Treatment**
  - Decreased activity
  - 1-G orientation
  - Medication (Phenergan IM)
Cardiovascular

Changes in redistribution of body fluids cause inability of the body to adapt to rapid circulatory changes, producing orthostatic symptoms postflight

- **Symptoms** - Dizziness, lightheadedness,
- **Time course** - From reentry to several hours postlanding
- **Causes**
  - Fluid shifts
  - Baroreceptor
- **Treatment**
  - Fluid loading
  - On-orbit exercise benefit
  - Liquid cooling garment
  - Medications
Neurovestibular

In-flight changes in neural feedback function that produce postural imbalance and loss of coordination postflight

- **Incidence** - All crewmembers are affected to some degree
- **Symptoms** - From vertigo and unstable gait to nausea and vomiting
- **Time course** - From landing to 48 - 72 hours postlanding
- **Causes** - Neurovestibular-otolith and proprioception readaptation
- **Treatment**
  - Avoid rapid head movements
  - Slow but progressive increase in activity
  - Medication (Phenergan, Antivert)
Behavioral/Psycho-Social

Changes in crew mood, morale, and circadian rhythm

• **Incidence** - Affects all crewmembers to some degree

• **Symptoms** - Fatigue and irritability, performance

• **Time course** - Depends on flight plan

• **Causes**
  – Work load
  – Sleep habits and facilities
  – Crew personalities, “crew space”, and cultural differences
  – Temperature
  – Noise
  – Odors
  – Atmosphere
  – Diet
  – Lack of family contact

• **Treatment** - Treat causes
Space Flight Environmental Issues

- Radiation
- Toxic products and propellants
- Habitability
- Atmosphere
- Medical events
Medical events in U.S. Space Program

- Apollo 8 crew – 1st Americans to report space motion sickness
- Apollo 9 - space motion sickness caused EVA to be rescheduled (1st timeline change due to medical cause)
- Apollo 11 – Type 1 DCS in command module pilot
- Apollo 13 – Kidney infection during mission
- Apollo 15 – Cardiac dysrhythmia (PVC, PAC, bigeminy) during lunar EVA
- Apollo Soyuz Test Project – Nitrogen Tetroxide chemical pneumonitis on reentry
Medical Events in Russian Space Program

- Events not resulting in mission termination or early return
  - Kidney Stone - 1982
  - Hypothermia during EVA - 1985
  - Psychological stress reaction - 1988
  - Spacecraft depressurization - 1997
  - Toxic atmosphere - 1997
The Space Radiation Environment

Representation of the major sources of ionizing radiation of importance to manned missions in low-Earth orbit. Note the spatial distribution of the trapped radiation belts.
Systems & Crew Training

KC-135
“Weightless Wonder, Vomit Comet”

Hardware Testing and Procedure Validation
Systems & Crew Training

Shuttle Orbiter Medical System (SOMS)
Systems & Crew Training

Health Maintenance System (HMS)
Defibrillator & Respiratory Support Pack (RSP)
Crew Medical Restraint System (CMRS)
Crew Contamination Protection Kit (CCPK)
Mission Support

- Extravehicular Activity (EVA) Monitoring
Upright dual arm and leg cycle exercise (ALE)

Semi-recumbent intermittent light exercise simulating astronaut tasks (ILE)
STS FLUID LOADING COUNTERMEASURES

Change in Plasma Volume (%)

Hypertonic Solution
Normal Saline
Water

Time Relative To Landing

-3 -2 -1 0 1 2 3 4
Vertical Pursuit Tracking With Head and Eye

L - 10

R + 0
Astronaut Health

- Physical training and rehabilitation
Jupiter

Saturn

Uranus

Earth

Neptune

Pluto
Jupiter is about 1 pixel in size
Earth is invisible at this scale