SPACE MEDICINE
& Medical Operations Overview

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Medical Operations
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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

INNER RADIATION BELT
(Protons)

SOLAR PARTICLE EVENT
(Protons to Iron Nuclei)

OUTER RADIATION BELT
(Electrons)

SOUTH ATLANTIC ANOMALY
(Protons)

GALACTIC COSMIC RADIATION (GCR)
(Protons to Iron Nuclei)

OUTER RADIATION BELT
(Electrons)

Magnetic Axis

Spin Axis

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)
Vertical Pursuit Tracking With Head and Eye

L - 10

R + 0
Astronaut Health

- Physical training and rehabilitation
Perspective

Earth

Venus

Mars

Mercury

Pluto
Sun  Sirius  Pollux  Arcturus

Jupiter is about 1 pixel in size

Earth is invisible at this scale