Healthcare of ESA Astronauts in Space and on Earth

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The ESA Space Medicine Office is responsible to maintain the health and well-being of the ESA astronauts.

The WHO defines health as:

- Status of complete physical, mental and social well-being and not only absence of disease or infirmity.
Space Medicine Tasks

Astronaut Selection, Certification and Re-Certification
Flight Clinic
Preventive Health Program
Fitness
Nutrition
Radiation
Human Behaviour & Performance Program
Family Physician
Operational Research
Groundsegment development and implementation
Communication Infrastructure, IT and Telemedicine
Medical Training for Crew
Medical support to training events, scientific activities and hazardous operations
Mission Support
The Team

Physicians / Nurse

Biomedical Engineers

Projects, IT, Education

Fitness Team / Psychologist

Management, Administration
Launch to Space...
human spaceflight

Weightlessness
Types of Medical Risks

- Medical risks related to technical systems
  - mitigate risk through technical measures
- Medical risks related to the space- and microgravity environment
  - mitigate risk through countermeasures, monitoring
- Medical risks related to the biological system
  - mitigate risk through selection and preventive medical program
- In case of an incidence:
  - Provision of adequate on-board and terrestrial medical resources and capabilities
Technological & Environmental Challenges (LEO)

★ habitable Atmosphere
★ pressure & gas composition
★ temperature & humidity
★ Potable Water & Waste Water
★ Electrical Systems
★ Toxicology
★ propellants (Hydrazine)
★ cooling agents (Freon, Glycol)
★ off-gassing products
★ Noise
★ Nutrition
★ Microbiology
★ Radiation
★ about 0.1-0.5 mSv/day
Physiological Challenges in Microgravity

Explanation of Physiological Challenges:
- **Neurovestibular**: Perturbations in balance and orientation.
- **Cardiovascular**: Changes in blood flow and pressure.
- **Bones**: Loss of bone density.
- **Muscles**: Atrophy and decreased muscle mass.

**VIIP** stands for Very Important Information Panel.
Medical Challenges due to Space Environment

- Visual Impairment & Intracranial Pressure
- Eye Injuries (foreign bodies)
- Genito-Urinary Tract (Urolithiasis)
- Dermatologic Infections
- Hypothermia (EVA)
- Infections
- Radiation induced impairments
- Psychiatric/Psychological Issues
Risks due to limited Resources and Capabilities

- extended diagnostic or therapeutic measures necessary
- on-board medications and supplies used up
- pharmacology
- medical skill maintenance
- ethical aspects: treatment vs. resources
Medical Risk Assessment & Incidence Probabilities (ISS)

★ The terrestrial risk of a significant disease or injury requiring ER evaluation or hospitalisation is at approx. 6-7 % per person/year
★ The terrestrial risk of a significant disease or injury requiring intensive care is at approx. 1-2 % per person/year
★ for a 6-person Crew: 5.5 years per evacuation
★ based on data
★ US and Russian Space Medicine
★ US Navy submarines
★ polar analogues
★ NASA and US Air Force data
★ FUTRON study 2001
★ NASA Medical Risk Study 1996
★ Major Events:
★ Medical Emergency
>3 in 15 years or 1 evacuation in 5.5 years
★ Radiation Event
25% in 15 years or 1 evacuation in 60 years
★ Micro-meteorite or debris
7% in 15 years or 1 evacuation in 214 years
★ System Malfunction/Failure
2% in 15 years or 1 evacuation in 750 years

source: NASA Medical Risk Study 1996 und FUTRON Studie 2001
Risk Mitigation through Ground Control

- private conferences
- (limited) telemedicine capabilities
- „Store-and-Forward“ und Real-Time data analysis
- monitoring of technical systems
- Timeline & Scheduling
- experiments and hazards
Medical Risk-Mitigation Strategies

- Strict Selection Criteria
- Intensive Annual Medical Check
- Preventive Measures
- Medical Check 10 days prior to mission
- Quarantine 8 days prior launch
- Training of 2 Crew Medical Officers to operate as Paramedics
- On-Board Medical Infrastructure
- Routine Private Medical and Psychological Conferences with the crew surgeon and crew psychologist
- Routine Private Family Voice/Video Conferences
Direct Return

- Direct Return from Scotland to Cologne
- Crew Quarters
- Medical examinations
- Science BDC
- PR and Briefings
- Integrated Schedule
6 phases of the ESA astronaut selection

1. Preparation Phase (expected >10000)
   - Upload of private pilot medical certificate

2. Online Application (8400)
   - computer based evaluation
   - manual evaluation

3. Cognitive Functions Testing (920)

4. Psychological Testing/Assessment Center (190)

5. Medical Evaluations (45)

6. Professional Interview (22)
★ Rescue capability for up to 7 astronauts
★ provision of emergency medical care
★ „Stabilize and Transport“ or
★ „Stand and Fight“
On-Board Medical Capabilities

★ Crew Medical Officer
  ★ basic medical knowledge, nomenclature
  ★ Basic Life Support
  ★ routine and emergency medical procedures
  ★ 3-day Medical Field Course
★ Medical Checklists
  ★ bi-lingual catalogue of medical procedures and algorithms
  ★ medications-list
★ Medical Hardware
  ★ basic medical supplies (non-prescription)
  ★ emergency medical kit
  ★ Defibrillator, Intubation, Infusion
  ★ Clean-Up Kit
Training and Testing
The Evolution of the Ship Doctor

Doctor a hologram - that can be turned off!
★ fundamental research
★ applied/operational research
★ Collaboration
★ Therapy / Prevention
   ★ Medications (pharmacology, resupply & production)
   ★ Food, Water (resupply & production)
   ★ Robotics, minimally invasive surgery
★ Diagnostics
   ★ Imaging, clinical lab, microbiology
★ Crew Physician
   ★ novel academic pathways
      ★ Space Physiology & Health (Kings)
      ★ European Space Medicine Academy
★ Selection, Training, Skill Maintenance
★ Avoid “Dead Weight”
★ Human Patient Simulators
★ “Genomics”
Thank you for your attention!

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