

Medical Challenges and Projects in support of Space Exploration

A circular graphic with a blue and yellow border. Inside, there is a white stethoscope and a white cross. Below the cross, the text 'DOWNSTREAM GATEWAY' and 'Space for Earth' is written.

DOWNSTREAM GATEWAY
Space for Earth

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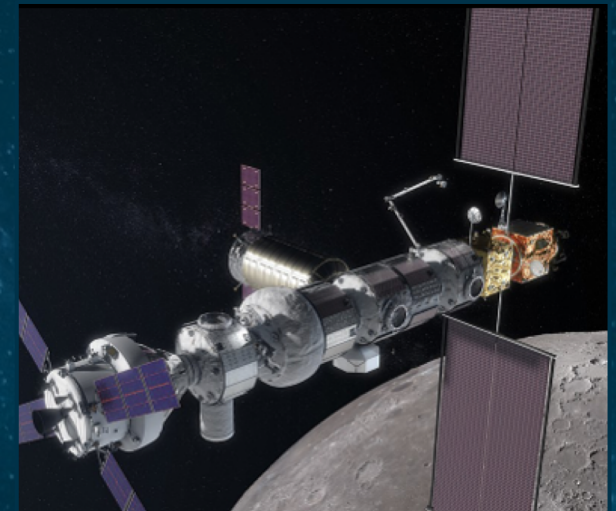
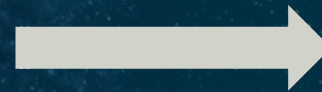
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→ THE EUROPEAN SPACE AGENCY

Human Spaceflight: from today to tomorrow



Credit: NASA



→ THE EUROPEAN SPACE AGENCY

Medical Challenges of Space Exploration



Low Earth Orbit (ISS)

- 'Immediate' evacuation
- Paradigm: "scoop & run"
- Traditional "Patient – Doctor"
- Minimal in-flight technology
- 'Basic' medical training
- 'Unlimited' medical resources:
 - Time;
 - communications;
 - equipment (inc. exercise).

Beyond Low Earth Orbit

- Delayed (or no) evacuation
- Paradigm: "stand & fight"
- Increased crew autonomy
- New technologies
- Increased medical training
- Constrained resources:
 - Communication delays;
 - data transfer volume;
 - equipment.



Medical Challenges of Space Exploration (2)



Low Earth Orbit (ISS)

- Moderate radiation exposure
- Real-time communication
- Comfortable resources:
 - high data bandwidth
 - big internal volume
 - regular (re)supply

Beyond Low Earth Orbit

- Increased radiation exposure (time, intensity, spectrum)
- Communication latency
- Limited resources:
 - limited bandwidth
 - limited volume
 - limited (and costly) (re)supply for food, water and spares



A new paradigm

From:



Credit: Huntington Hospital
<https://huntington.northwell.edu/emergency-department>

A new paradigm



To:

ISOLATION

IRRADIATION

COMMUNICATION
DELAYS

DECONDITIONNING

NO POSSIBLE
EVACUATION

ACCIDENTS/
INJURIES

LIMITED
RESOURCES

UNKNOWN
DANGERS



Medical Capabilities for Space Exploration



- Available medical capabilities still under definition/arbitration
- Treatment capabilities defined according to destination (levels of medical care)
- Diagnostic capabilities likely to include:
 - Vital signs
 - Vital functions support and resuscitation
 - Radiation exposure monitoring
 - Biology (POCD)
 - Medical data recording and processing
 - Medical decision support system
 - ...



Development of Medical Capabilities



Medical Projects concept:

*“Continuous Improvement of Astronaut Support
in Preparation of Exploration”*

- Filling ‘gaps’ in the Space Medicine Team “toolbox”:
 - What do we need (technology) and need to know (knowledge)?
 - What do we have/know and what are we missing?
 - Technology and Knowledge ‘gaps’

Needs → Requirements → Potential Solutions (evaluation).



Development of Medical Capabilities (2)



Needs → Requirements → Potential Solutions (evaluation).

- **Identifying the need:**
 - more things, more accurate or latest technology are not always good reasons to adopt something
 - Needs come from the medical risks, which are difficult to quantify (lack of data)
- **Defining the requirements:**
 - Necessitates a quantification and prioritization of the risks



Development of Medical Capabilities (3)



Needs → Requirements → Potential Solutions (evaluation).

- Identifying the solution:
 - Answering the risks by technology : matching capabilities and maturity (TRL)

Solutions are new technologies & processes, and come from terrestrial sources and from past/current spaceflight;

- Demonstrating function and effectiveness:
 - *Will it work in space ?*
 - *Is it effective in space to answer the risk ?*

Space needs can not be a driver for Healthcare R&D,

Space Exploration is certainly a demanding application area due to operational constraints,

Due to these constraints every new device shall demonstrate:

- *effectiveness in space*
- *added benefits*

Space can be a very solid and eye-catching validation field for healthcare technology