Learning from space-based telemedicine systems to support spinoffs for Earth-based healthcare

Golda Nguyen

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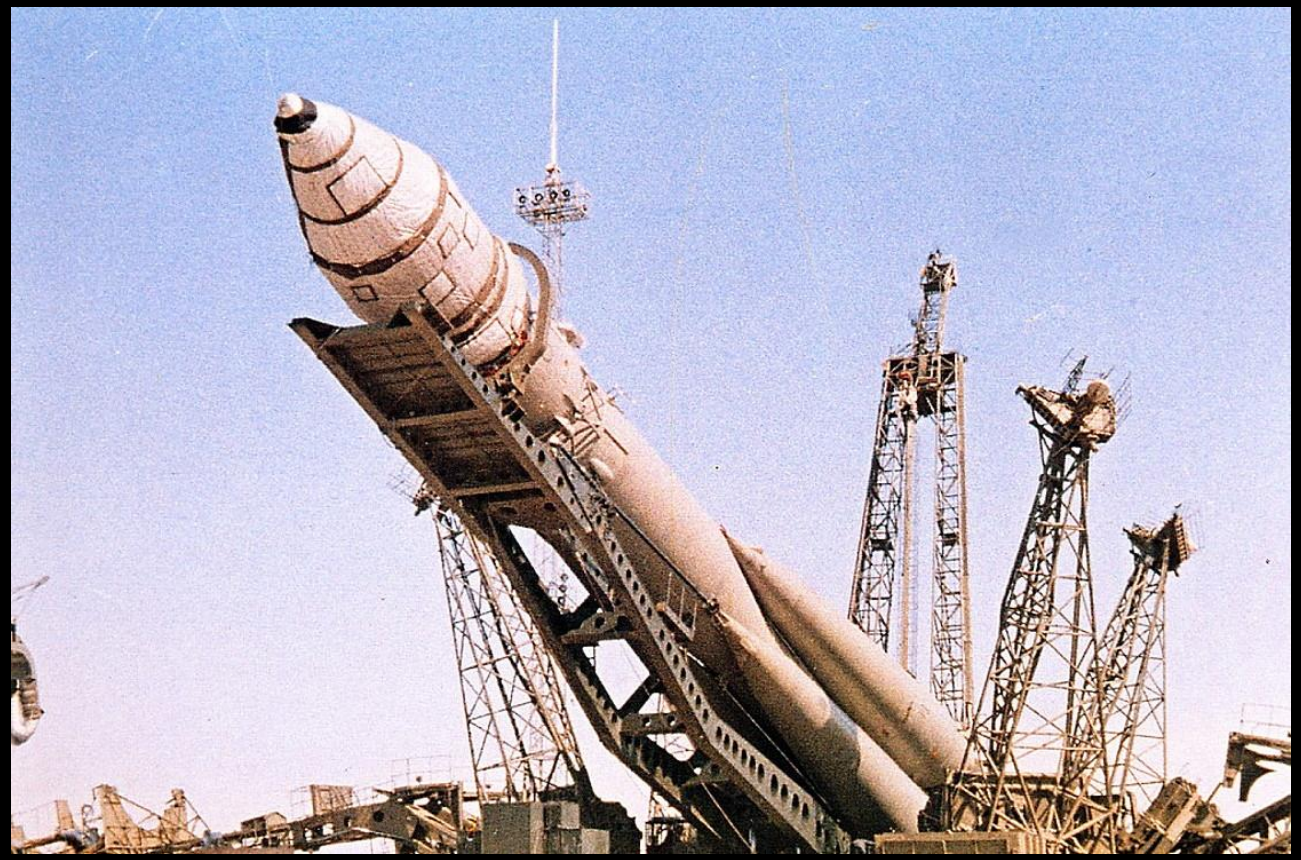
Session 2 – Is Space R&D Truly Fostering a Better World for Our Future?

60 years of human spaceflight

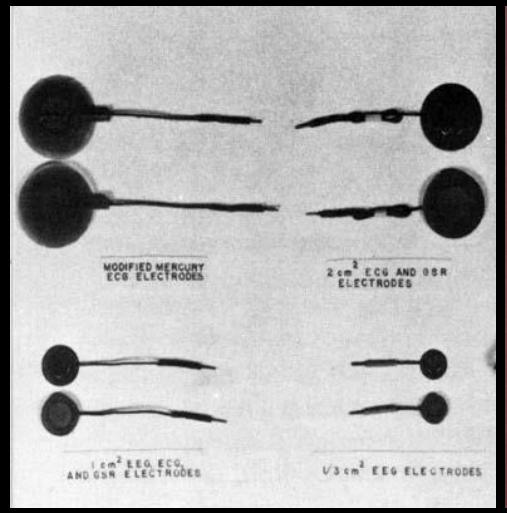


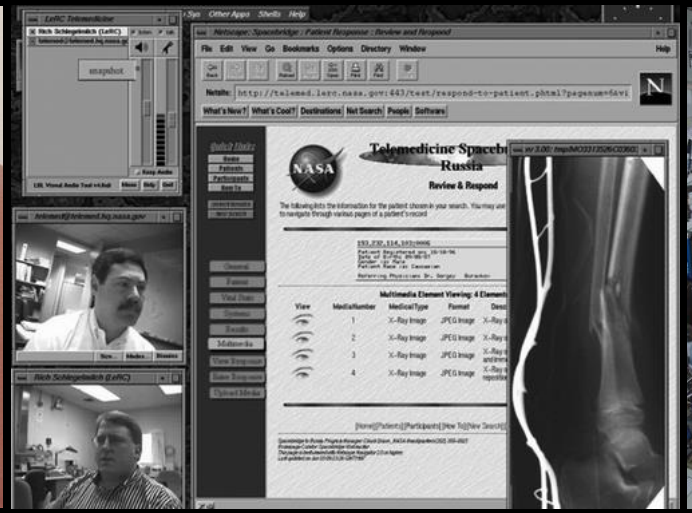
60+ years of telemedicine in space and on Earth

Image credits: RSC Energia, Fenway Health

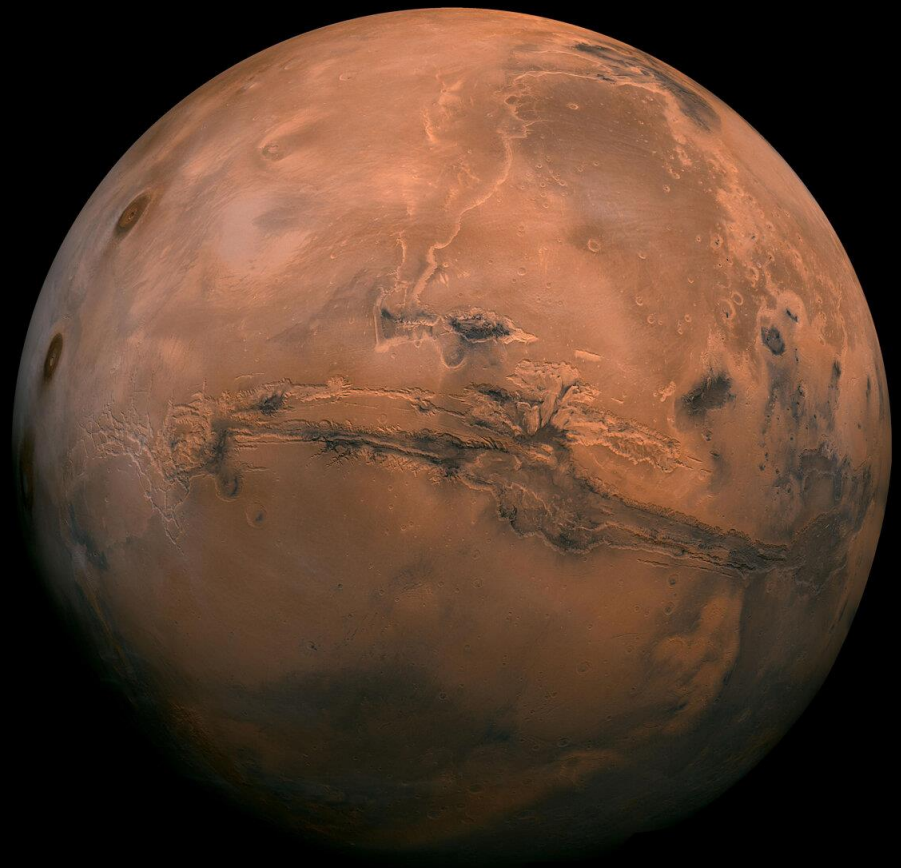
Decades of innovations and spinoffs from space telemedicine R&D

- Biomedical sensing miniaturization and remote monitoring
- Telecommunications infrastructure development
- Remote diagnostics and treatment development
- Remote medical operations and autonomy advancement





Deep space missions will face unique challenges



Challenges & Constraints

- Communication delays with Earth
- Inability to return to Earth quickly
- On-board technology limitations
- Limited infrastructure and supplies
- Limited medical expertise

Needs

- Increased autonomy
- Effective tools and systems on-board for real-time support
- Asynchronous operations with Earth

Shared challenges and needs for many communities on Earth…

Challenges & Constraints

- Communication delays with providers
- Inability to seek immediate care
- Technology limitations
- Limited infrastructure and supplies
- Limited medical expertise

Needs

- Increased autonomy
- Effective tools and systems at-home for real-time support
- Asynchronous operations with remote provider

Telemedicine lessons to be shared…

Sharing knowledge on:

- Medical procedures and operations
- Tools, technologies, and mediums for care (diagnosis, treatment, prevention)
- Telecommunications tools and infrastructure
- Capacity building and technology transfer mechanisms

Telemedicine can support healthcare access for:

- Remote or rural patients
- Communities with health care provider shortages
- Communities with limited, intermittent, or unreliable telecommunications
- Patients who may not speak the same language as their providers

Various entities fostering space and Earth health collaborations

- United Nations Office of Outer Space Affairs – Working Group on Space and Global Health
- Space Generation Advisory Council – Space Medicine and Life Sciences Project Group
- International Academy of Astronautics – Space Life Sciences Study Group
- International Space Life Sciences Working Group
- Research collaborations across space agencies, academia, industry, government

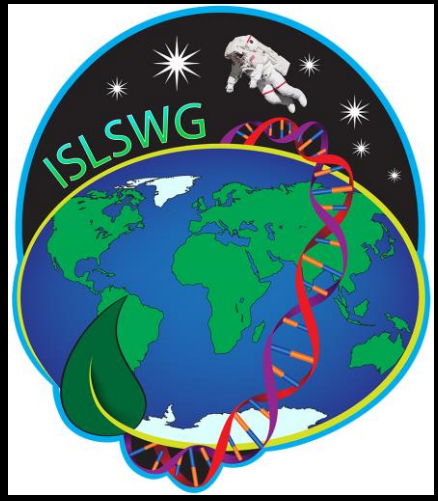


Image credits: UNOOSA, NASA, SGAC, IAA, ISLSWG

UNOOSA-NASA Memorandum of Understanding (2020)

“To provide a framework for cooperation… in expanding opportunities to enjoy the benefits of space-based activities and exploration to a wider group of Nations.”

Collaboration currently focused on Earth/climate sciences and outreach:

- Capacity building
- Environmental and ecological management
- Natural resource and agricultural monitoring
- Disaster risk reduction and management
- Promoting youth engagement in STEM

But there are additional opportunities for collaboration on health:

- Health and life sciences
- Medical capacity building

Analyzing how we share knowledge and technology using system architecture

NASA and UNOOSA can be viewed as systems for knowledge and tech transfer

- Stakeholders: transfer agents, beneficiaries
- Objectives: space, health capacity building
- Forms of transfer: policy, outreach, licensing
- Functions: exchange knowledge, disseminate resources, invest in R&D
- Constraints: policy, infrastructure limitations
- Outputs: increased STEM, space capacity

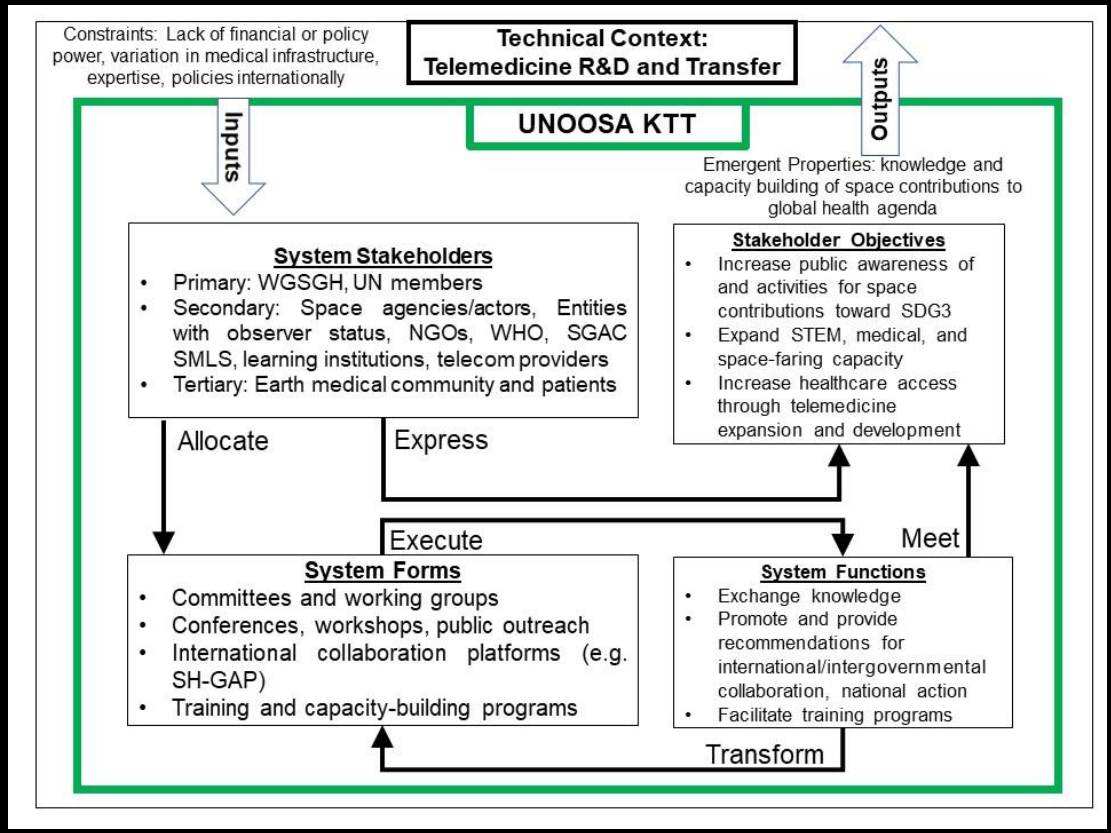


Image credits: UNOOSA, NASA

Current challenges

Knowledge access and transfer challenges

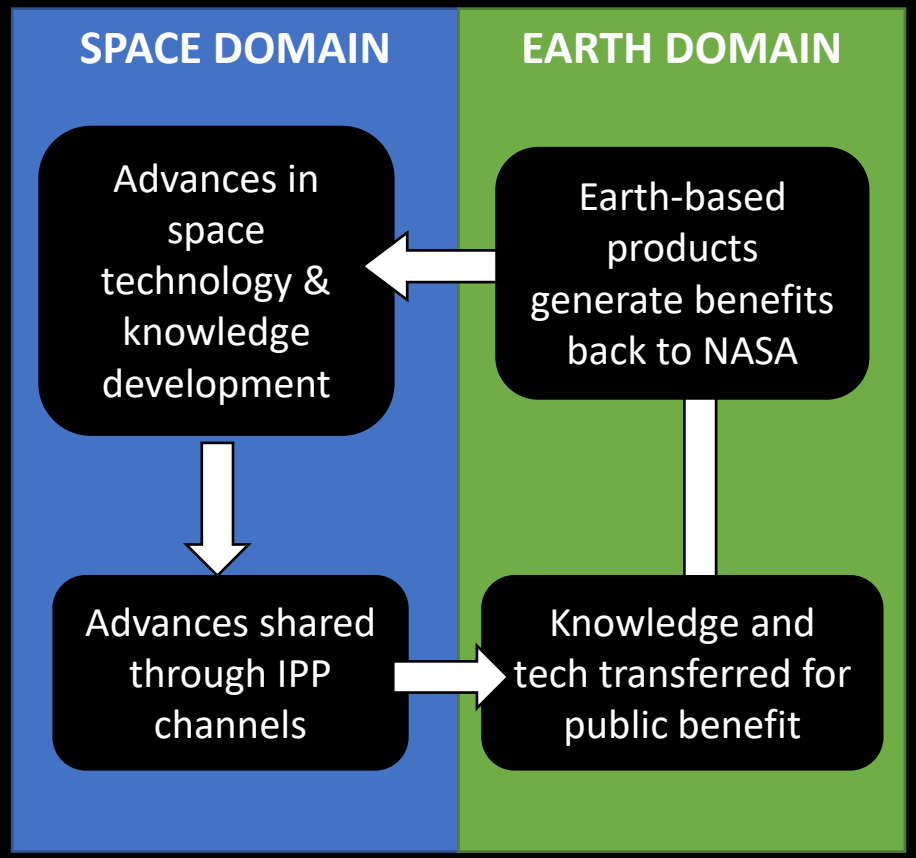
- Communication and awareness of mutual Earth and space benefits from space health R&D
- Balancing medical privacy and access to research data
- Research/knowledge siloes – lack of access and difficulty in translating knowledge across contexts
- Difficulty in coordination across interdisciplinary, international entities

Development timelines for space telemedicine

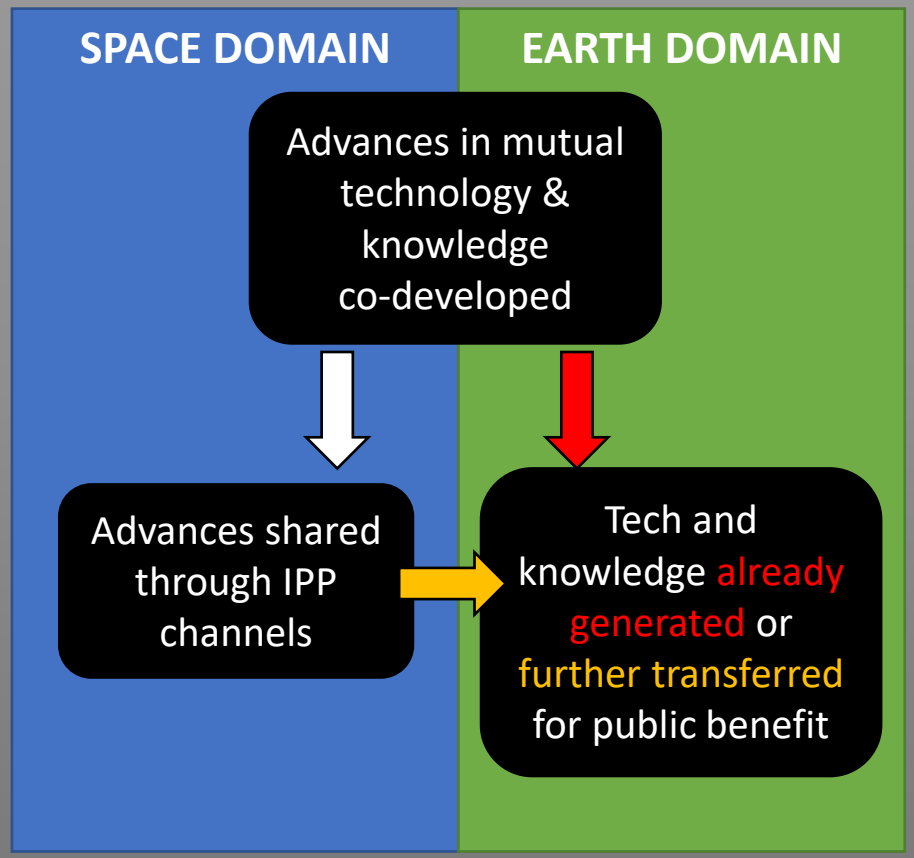
- Balancing development of Moon telehealth architectures vs. Mars telehealth architectures
- Inability to “test like you fly, fly like you test” - asynchronous telemedicine has not been tested in actual spaceflight

Traditional vs. Proposed Transfer Methods

Traditional Technology Transfer



Proposed Technology Transfer for More Immediate Generation of Earth Benefits



Opportunities to continue and expand space-Earth collaboration

- Expansion of telecommunications access through new modalities – satellite constellations may help expand infrastructure
- Increasing commercial/civilian access to space – increasing knowledge of different types of people in space, expanding design envelopes for telemedicine tools, and accelerating development
- Telemedicine expansion during COVID-19 – immediate opportunities for co-development of public health and deep space health solutions

Space telemedicine R&D can actively support advancing telemedicine efficacy and access for Earth-based communities.

Thank you

Golda Nguyen

gnguyen@mit.edu

https://www.media.mit.edu/people/gnguyen/overview/