



**NASA'S TRANSLATIONAL RESEARCH
INSTITUTE FOR SPACE HEALTH**



**TRANSLATIONAL
RESEARCH INSTITUTE FOR
SPACE HEALTH™**

STRATEGIC PLAN 2025–2028

July 2024



EXPLORING HEALTH'S NEW FRONTIERS

The Translational Research Institute for Space Health (TRISH) is a lean, virtual institute partnered with the NASA Human Research Program (HRP) to solve the challenges of human deep space exploration. We find and fund disruptive, breakthrough approaches that reduce risks to human health and performance.

The Institute's core components are the Translational Research Program, Scientist Program, and Supporting Program.

- The **Translational Research Program** makes up the Institute's research portfolio. TRISH supports both high-risk, early-stage research as well as more mature, late-stage health technologies that can be modified for use by astronauts headed back to the Moon and onward to Mars.
- A **Scientist Program** educates and excites the nation's brightest minds about space health research. This program attracts researchers of all backgrounds and career strata with a special emphasis on bringing auspicious trainees into our community.
- The **Supporting Program** connects the general public to the mission of humans exploring deep space. TRISH engages space health enthusiasts to learn about astronauts' health delivery needs and the translation of spacerelated technologies to everyone on Earth.

TRISH's programs all focus on providing exceptional research deliverables and human capital to NASA that will impact spaceflight for generations into the future. This work supports humanity's return to the Moon, through the Artemis missions, and future lunar operations. We also recognize that the next leap of space flight involves bringing people across the spectrum of health, backgrounds, sex/gender, etc. to venture into the unknown through both NASA and commercial spaceflight companies. The Institute advocates for and advances space health for the benefit of all future space travelers.

To develop the research and technologies that will help all of humanity, we must recruit new, diverse researchers and thinkers into our mission now. All people have a future in space if we make room for them today.

The Institute is a consortium led by Baylor College of Medicine and includes Caltech and Massachusetts Institute of Technology. These partners facilitate collaboration, amplify scientific learning and outreach, and provide a large network support.

This strategic planning document outlines the Institute's priorities through 2028.

VISION

TRISH aims to realize a future where all humans can thrive in deep space.

MISSION

To advance health solutions for spaceflight, empowering human exploration.

CORE VALUES

BOLDNESS

Risk is necessary to achieve disruptive progress in space health. We find comfort in uncomfortable ideas and fund research that others consider too risky.

CREDIBILITY

Self-discipline manifests in the highest-quality science and complete commitment to rigor.

IMPACT

We understand that space health has similar issues as terrestrial health. Our goal to create thriving astronauts in space must also enhance life of Earth.

COOPERATION

Seeking great ideas also means learning from new people, our investigators, and the space health community. Innovation does not happen in silos; we move forward together.

ENTREPRENEURSHIP

The programs and research opportunities in place today are not monolithic. New funding mechanisms and techniques will lead the path toward the countermeasures and technologies of tomorrow.

PLAYFULNESS

Celebrate discovery of our universe, our planet, our bodies, and our infinite ability to explore and learn. Remain gleefully curious always.





TRAJECTORY **TO 2028**

STRATEGIC GOALS

To execute the Institute mission and build towards our vision, TRISH will prioritize three strategic goals:

1. To seek operational insights and guiding principles that preserve human health and performance in space.
2. To enable scientific discovery in a global space health community;
3. To support the development of a skilled space health workforce.

1 | OPERATIONAL **INSIGHTS**

Goal: To seek operational insights and guiding principles that persevere human health and performance in space.

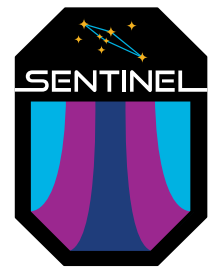
Since its inception in 2016, TRISH has invested in high-potential research and technologies to protect the bodies and minds of space explorers. On behalf of the nation's space program, TRISH investments in research and technology development have resulted in new approaches to safeguarding human health and performance in deep space.

The next step on the path to protecting explorers is to connect the dots between research and application while developing guiding principles that make operational impact. The Institute will maximize the impact of its previous investments by charting insights as it operationalizes new health tools, platforms and countermeasures that will safeguard sustainable deep space travel and habitation.

Key Institute priorities supporting Goal 1:

- **SENTINEL**

The Science ENterprise to INform Exploration Limits (SENTINEL) initiative will build microphysiological systems from specific astronauts. These organs-on-a-chip constructs will help characterize and test preventatives and an individual's health risks during space exploration. They will be flown alongside the astronaut being exposed to microgravity as radiation at the same time. Comparing the effects of spaceflight on the whole human to the effects on the cultures organ chips will help validate the platform and assays. TRISH will work toward automation and non-wet lab assays of the chips reducing valuable crew time for data collection and moving away from sample return to Earth for analysis. This platform will make it easier to understand the biological effects of the spaceflight environment beyond low Earth orbit, and yield operational advancements in personalized health.



- **HERMES**

Future missions to the moon and beyond will require multiple vehicles, built and operated by various companies, with astronauts transitioning between them regularly. This inevitable increase in complexity compared to the current International Space Station (ISS) model will challenge our ability to leverage biomedical data and management requirements across all vehicles. Yet continuity of access to health and performance data is key for safeguarding the astronaut, assessing immediate health and performance risks, and making informed and timely decisions about fitness for duty. TRISH's HERMES initiative will develop a vehicle-agnostic data acquisition, ingestion, management, and usability framework necessary for the future. It will support the network infrastructure, biomedical peripherals, and end-users of the collected data. This will enable space and ground-based medical teams and systems to monitor and access crew health status and research study progress in real-time, even when the astronaut is far from Earth's surface and transitioning between vehicles and habitats.

- **Promoting Interoperability**

Acknowledging the fragmented Earth-based health care ecosystem, TRISH will be developing and pushing for adoption of data interface and vocabulary coding standards that enable an interoperable space health ecosystem. Biomedical, environmental, and operational data should be ingestible regardless of source and equally accessible to authorized data users unencumbered. This will enable an open marketplace for health care devices and analysis tools to best address the health, performance, and safety concerns of humans in spaceflight.

- **Technology Validation**

TRISH is poised to rigorously test and assess the efficacy, safety, and reliability of medical devices, treatments, and procedures intended for use in space. TRISH will leverage its commercial spaceflight research program, and access to unique ground-based spaceflight analogs such as the Australian Antarctic Program, to vet the technologies that will one day be deployed aboard spacecraft or space stations.

- **Transition to Operations**

TRISH has delivered many technology solutions and knowledge insights to NASA HRP. Through demonstrations and effective communication, TRISH will work to ensure that the potential impact of TRISH's previous and current investments is fully understood and considered by NASA, commercial spaceflight companies and other human exploration stakeholders.

- **Setting the Standard**

As an academic leader at the nexus with both governmental and commercial relationships, TRISH is well-positioned to lend its expertise and perspective to stakeholders developing the research, operational, and medical standards for the future of human spaceflight. TRISH support the advancement of standards, ethics, and regulations which sustain safe human exploration by engaging with decisional bodies, hosting forums for discussion of key topics, and authoring scientific papers and articles which elevate awareness of pertinent issues.

2 | **ENABLING** DISCOVERY

Goal: To enable scientific discovery in a global space health community.

Robust scientific research is essential for addressing key questions related to human adaptation and physiology in space. TRISH is committed to promoting the excellence of relevant science and creating new research opportunities that enable collaborative discovery. TRISH's efforts enhance the exchange of information and help define best practices among all stakeholders, including national space agencies, commercial spaceflight providers, researchers, and spaceflight analogs. This exchange of knowledge will lead to insights that could optimize operations, and ensure the safety, efficiency, and effectiveness of future missions beyond Earth's orbit.

Key Institute priorities supporting Goal 2:

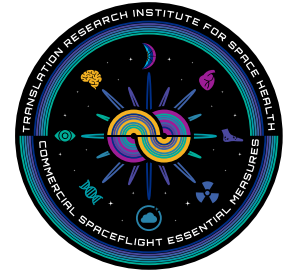
- **The EXPAND Database**

TRISH established EXPAND (Enhancing eXploration and ANalog Definitions) as the first-of-its-kind research platform to facilitate relevant human spaceflight research data collection on civilian spaceflight participants and analog crews. The EXPAND database provides a state-of-the-art integrated medical, research, and environmental knowledge bank as well as a repository for biological samples from participants.



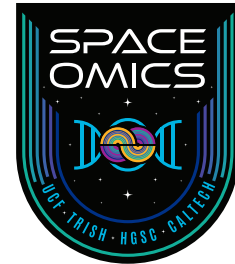
- **TRISH Essential Measures**

TRISH's complement of research for commercial missions provides a standard data collection method harmonized with NASA's standard measures complement and ensures that essential research data is collected on every willing participant. It is also designed to maximize the collection of valuable information while minimizing the crew time and up-mass requirements. TRISH Essential Measures collect data, samples, and medical data pre- and post-flight including environmental data from the vehicle or space station.



- **Space Omics Project Assays**

The Space Omics project, part of EXPAND Essential Measures and enabled by Baylor College of Medicine's Human Genome Sequencing Center, includes state-of-the-art assays and clinical grade CLIA (Clinical Laboratory Improvement Amendments) pharmacogenomics and pathogenic variants analyses.



- **Actionable Biomarkers**

Whether a commercial spaceflight participant is accessing low earth orbit, or a governmental astronaut is exploring the Lunar or Mars surface, it is essential to prevent health events from progressing to situations that threaten the immediate or long-term well-being of the crew or the success of the mission objectives. TRISH will develop a list of candidate actionable health and performance

biomarkers that are easily evaluated in the spaceflight environment without sample return to the ground. This effort will leverage on existing knowledge developed by space and non-space researchers, and the Institute's own unique datasets from spaceflight participants. Leveraging TRISH programs like EXPAND to access spaceflight and analog environments, the Institute hopes to begin testing and validation of new ways to measure biomarkers.

- **Insights**

Keeping diverse humans healthy in a hostile environment such as spaceflight requires early knowledge of when an adaptation is proven to be a prelude to a pathology that will impact the short- or long-term health and performance of each crewmember. Identifying clinically meaningful biomarkers of maladaptive responses and distinguishing these from "space-normal" adaptive responses is the "holy grail". The EXPAND Data has the potential to lead to candidate biomarkers. TRISH will begin to explore this hypothesis through both hypothesis and non-hypothesis-based research queries.

- **Data Privacy and Release Board**

Spaceflight samples are limited and precious and should be used sparingly to advance scientific and medical knowledge, all while protecting subject privacy. TRISH established a Data Privacy and Release Board (DPRB), comprised of external experts, to ensure that EXPAND's data and samples are used in the most appropriate way possible, while maintaining privacy for the spaceflight participants.

- **Analogs**

Space health research analogs on Earth mimic aspects of spaceflight conditions, enabling scientists to study the effects of space travel on human physiology and psychology. TRISH works to build relationships that create new research analogs for the space health community. This effort includes partnering with the Australian Antarctic Division to deploy medical device and mental health research in austere Antarctic stations and partnering with Zero-G and other sub orbital flight providers for access short-term weightlessness analogs.

- **National Leadership**

Building on TRISH's successful partnership with NASA HRP, TRISH will act as the space health nexus between private space companies, and local, state, and federal government such as NASA. This work will include elevating visibility of space health research, technology development, and workforce and career training needs.

- **International Collaboration**

Where appropriate, TRISH engages with international collaborators to advance space health goals. Through workshops and direct partnerships, this widespread community of engaged individuals will include scientists, healthcare professionals, engineers, astronauts, government agencies, and private companies involved in space exploration and research.

3 | EDUCATION

Goal: To support the development of a skilled space health workforce.

The future of human exploration will require a skilled, diverse, and multidisciplinary workforce equipped to address the complex challenges of human space exploration. This workforce includes scientists, engineers, physicians, psychologists, educators, and other professionals functioning as part of the new space economy. By investing in the development of a highly capable workforce, TRISH ensures that the space industry has the human capital necessary to sustainably advance human space exploration, mitigate health risks, and optimize the well-being and performance of astronauts during missions. By demystifying space health, TRISH engages the public and non-traditional space researchers today and inspires future generations.

Key Institute priorities supporting Goal 3:

- **Space Health Ingress Program (SHIP)**

TRISH makes space for new investigators from communities that haven't traditionally worked with NASA. This program ensures that the space biomedical community continues to attract, engage, and train innovative problem-solvers to tackle the challenges to human health and performance in space.

- **Academy of Bioastronautics**

TRISH's research postdoctoral fellowships enable early career scientists to design, develop and conduct their own space-related research projects under the guidance of experienced academic mentors.

- **Training Next Generation Science Leaders**

In addition to space-aware researchers, TRISH will invest in the development of future scientific leaders and program officers. Trainees will learn to lead a diverse research program and guide scientific studies designed to advance space biomedical research.

- **Space Health Internship**

Skillful science communication will build support for space health research and human exploration missions. TRISH's Space Health Internship engages communications and STEM professionals in the critical work of promulgating research advances for education and outreach.

- **Share Results and Elevate Conversations**

TRISH employs a comprehensive communication strategy that encompasses scholarly journals, opinion pieces, and media outreach to effectively share its expertise and research findings. TRISH's insights and perspectives on relevant issues drive conversations and support reasoned, inclusive decision-making processes. By disseminating knowledge and engaging with diverse audiences, TRISH advances the frontier of space health and accelerates progress toward ensuring the well-being of future space travelers.