

# Behavioral Health and Performance Risk to Mitigation Strategy

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## Introduction

### NASA Behavioral Health and Performance

Two components of the NASA Behavioral Health and Performance group is the Operations Group, which supports current space flight, and the Research Element, which manages an integrated program of research for future space flight.

### Behavioral Health and Performance Operations Group

The NASA Behavioral Health and Performance Operations Group (BHP Ops) supports astronauts and their families before, during, and after a long-duration mission on the ISS. BHP Ops provides ISS crews with services such as the following:

- Training
  - Expeditionary Training (classroom and field)
  - Psychological factors of long-duration mission (LDM)
  - In-flight resources planning (services available)
  - Practical planning for LDM
  - Behavioral Medicine training (for Crew Medical Officer)
- Behavioral health services for astronauts and dependents
- Behavioral health monitoring
  - Behavioral health evaluations (preflight, postflight)
  - Private psychological conferences (in-flight)
  - Cognitive assessment (pre-, in- and postflight)
- In-flight psychological support services
  - Family communication, care packages, provisions for off-hours entertainment, special family and mission events, onboard web site content

ISS astronauts continuously recognize the relevant and helpful support provided to them by BHP Ops.

In May 2009, the crew of ISS will increase from a crew of three to a crew of six. Not only will the jump in crew size modify the situational requirements of life on the ISS, it will also potentially introduce increased diversity in the cultural composition of the crew.

### Behavioral Health and Performance Research Element

Future exploration missions beyond ISS will pose even stronger challenges. Lunar and Mars missions will require long-duration stays in remote, isolated, and unique environments, with extended periods of heavy workload. Day and night cycles will differ from standard Earth time; teams composed of only a few individuals will experience prolonged confinement as well as times of monotony. Crews will also have to deal with issues concerning limited communication, sleep, and autonomy.

In preparation for these exploration missions to the Moon and Mars, the Behavioral Health and Performance Research Element (BHP) conducts and supports research to address three human health risks:

“Sleep Risk”: *Risk of Performance Errors due to Sleep Loss, Fatigue, Circadian Desynchronization, and Work Overload;*

“Team Risk”: *Risk of Performance Errors Due to Poor Team Cohesion and Performance, Inadequate Selection/Team Composition, Inadequate Training, and Poor Psychosocial Adaptation;*

“B-Med Risk”: *Risk of Behavioral and Psychiatric Conditions*

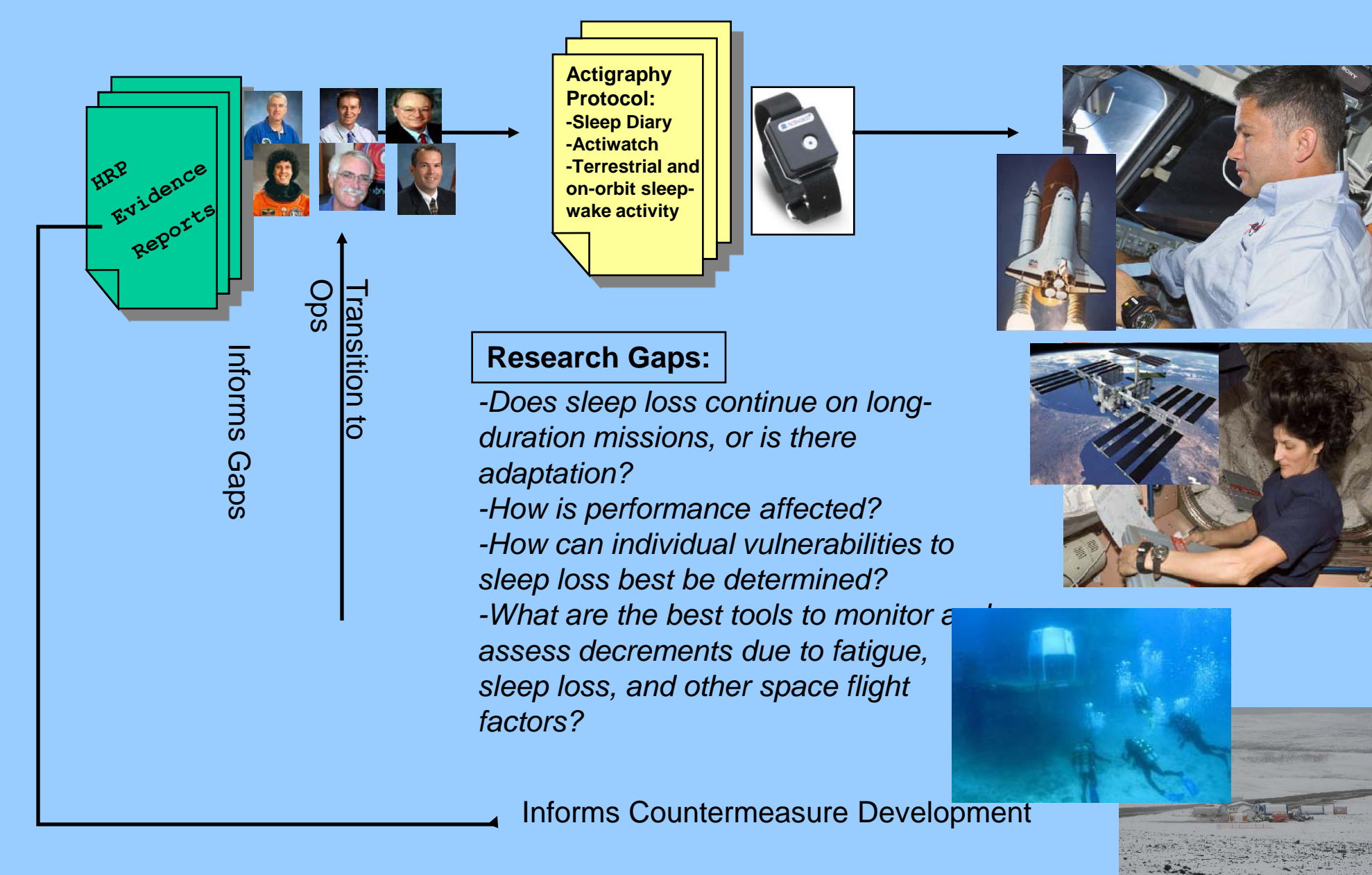
The Goal of the NASA Behavioral Health and Performance Research Program Element (BHP) is to identify, characterize, and prevent or reduce behavioral health and performance risks associated with space travel, exploration, and return to terrestrial life.

BHP conducts research that will yield technologies and methods to aid the behavioral health and performance of astronaut crews during and after these exploration missions.

Specifically, BHP research aims to:

- Quantify BHP risks for Moon and Mars missions
- Develop countermeasures and technologies to prevent or mitigate adverse outcomes of BHP risks
- Develop countermeasures and technologies to monitor and treat adverse outcomes of BHP risks
- Enable the development and validation of the Fitness for Duty Behavioral Health and Cognition standard, and the Circadian Entrainment and Workload sections of the Spaceflight Human Systems Standard, Vol. 2.

## Risk to Mitigation Strategy



### BHP Research Element: Risk-to-Mitigation Strategy

To provide technologies and methods to aid the behavioral health and performance of space flight crews, BHP utilizes a risk-to-mitigation strategy that comprises the following:

#### Collaborate with Operations

The focus of the BHP Element is to support future Exploration Missions; however current crews on both shuttle missions and missions to the ISS can, when appropriate, benefit from BHP research tasks. As an example, flight surgeons, mission controllers, and astronauts have reported that sleep and circadian issues currently take place on ISS. A current BHP research task utilizes Actiwatch technology and sleep diaries to monitor sleep-wake activity and light exposure in flight. While these data are being collected, flight surgeons have found the information useful for supporting their crew, and are therefore making use of the feedback gathered. Crews have expressed appreciation for the evidence-based feedback they receive from their flight surgeon to help ensure their sleep.

BHP therefore partners representatives in Operations to determine what is needed to support space flight, both current and future. The feedback from the operational community further ensures that research tasks will yield studies and deliverables that are operationally relevant and acceptable.

#### Determine Operational Endpoints / Stakeholders

Once a need has been identified, BHP clearly identifies the customer or end user of a needed deliverable. Understanding to whom the deliverable will be provided and for what purpose ensures that there will be an endpoint to the tasks - a specific point where research and ops work together to transition the deliverable into operational practice.

#### Determine Mission Requirements

When defining deliverables and what is needed operationally, BHP considers the known mission requirements: short-term missions to the Moon (less than 30 days), long-term missions to the Moon (more than 30 days and up to six months), and missions to Mars (three years). It is anticipated that short-duration missions to the Moon will be high tempo, involve some shift work, and close to real-time communication with the ground. Mars missions, on the other hand, will include times of monotony, and will require crews to be increasingly autonomous in their daily operations. Considering the requirements of each mission helps to identify the research needs. Working with flight surgeons, mission planners, astronauts, and researchers, BHP assesses the content of the current support in light of the requirements of future missions to adapt services to the unique demands of exploration missions.



### Review the Evidence

It is possible that a research question can be answered by the existing evidence or that, perhaps, evidence can further refine the research question and take it in a different or more focused direction. Before conducting research tasks, therefore, BHP conducts a thorough review of the existing evidence, both space flight and ground. As an example, BHP currently carries a gap related to changes in cognitive functioning on long-duration missions to the Moon and Mars. While space flight evidence is lacking in this area, there has been research conducted related to cognition in individuals wintering over in Antarctica, an environment analogous to space flight. As a result, BHP is starting with a review of this evidence to ensure that future research tasks in this area 'learn' from previous efforts.

### Systematically Identify Appropriate Research Platform

It may seem logical that the ISS or shuttle serve as the ideal platform for conducting research that relates to space flight missions, however this may not always be the case. In some instances, the question driving the research is related to a Mars or lunar long scenario, in which case the ISS may not serve as the best analog; in fact, Antarctica, or another ground analog may serve as a more appropriate fit for the question. Or, perhaps the purpose of the endeavor is to mature a technology, in which case the ISS again may not serve as the appropriate platform. BHP therefore incorporates a systematic assessment for determining which analogs are a best fit for the research question. This process considers a) which mission is the research/deliverable addressing; 2) when considering certain BHP-relevant characteristics, how similar is the analog environment to the mission; 3) how important are the BHP-relevant characteristics to the research question.



### Implement Tasks and Monitor Progress

BHP serves as a conduit for the research investigator, helping him/her navigate the NASA channels to implement their task. BHP also continues to bridge the realm between research and operations, coordinating communication between the researchers and the operations world. Research investigators provide monthly or quarterly reports outlining the progress of their deliverable and informing BHP of any concerns they may have towards reaching their end goal.

### Transition to Operations

The BHP Research Strategy is to conduct operationally relevant research that will yield operationally relevant deliverables. Progress, task results, and deliverable maturation are tracked by countermeasure readiness levels/technology readiness levels. BHP works with customers - Medical Operations and Mission Operations - to keep them informed about progress and to provide deliverables on time to customers.

