

# HRR User's Guide

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June 1, 2016

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## Introduction

Crew health and performance is critical to successful human exploration beyond low Earth orbit. The Human Research Program (HRP) investigates and mitigates the highest risks to human health and performance, providing essential countermeasures and technologies for human space exploration. Risks include physiological and performance effects from hazards such as radiation, altered gravity, and hostile environments, as well as unique challenges in medical support, human factors, and behavioral health support. The HRP utilizes an Integrated Research Plan (IRP) to identify the approach and research activities planned to address these risks, which are assigned to specific Elements within the program. The Human Research Roadmap (HRR) is the web-based tool for communicating the IRP content, risk Evidence Reports, external reviews of HRP research, and general HRP organizational information. The HRR can be accessed at <https://humanresearchroadmap.nasa.gov>.

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*Note: In this document, when the words “Evidence”, “Risk”, “Gap”, “Task”, or “Deliverable” are used to refer to the content of the HRRCMS, the first letter will be capitalized. Also, the name of fields will be capitalized. This will help distinguish them from their normal English usage.*

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## System Requirements

As of the writing of this document, the following browsers are supported:

- Google Chrome (recommended)
- Internet Explorer 8+ (Internet Explorer 11 preferred)
- Mozilla Firefox ESR 38.7

In addition to a supported web browser, if you want to open exported Excel documents you will need a copy of Microsoft Office or another program capable of viewing XLS/XLSX files.

## Locating Items

There are several methods for locating a particular Risk, Gap, or Task in HRR:

### Item Listings

Click the navigation link for the item type you wish to locate: Risks, Gaps, or Tasks. A full list of the items in the database will be displayed:

The screenshot shows the NASA Human Research Roadmap (HRR) website. The top navigation bar includes the NASA logo, 'HUMAN RESEARCH ROADMAP', 'HRP', 'DATA', and 'EXPLORATION'. Below this is a search bar and a breadcrumb trail: 'Home | HRP Introduction | HRP Architecture | HRP Org Chart | Acronyms | Reviews | Help'. The main navigation bar has tabs for 'EVIDENCE', 'RISKS', 'GAPS', 'TASKS', and 'REPORTS', with 'RISKS' selected. To the right are 'EXPLORE' and 'SEARCH' buttons. The content area shows a 'Risks' section with a search box 'Search Risk Titles...' and a list of five risk titles:

- Concern of Clinically Relevant Unpredicted Effects of Medication
- Concern of Intervertebral Disc Damage upon and immediately after re-exposure to Gravity
- Risk of Acute (In-flight) and Late Central Nervous System Effects from Radiation Exposure
- Risk of Acute Radiation Syndromes Due to Solar Particle Events (SPEs)
- Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders

### Search By Title

At the top of the full item listings and the top of each item's page is a search box which will allow you to locate an item by title. Start typing a title and a list of results will be shown; clicking one of these results will bring up that item's page:

The screenshot shows the same NASA HRR website as above, but with the search box in the 'Risks' section containing the text 'Adverse'. A dropdown menu is open, showing search results for 'Adverse':

- Risk of **Adverse** Cognitive or Behavioral Conditions and Psychiatric Disorders
- Risk of **Adverse** Health & Performance Effects of Celestial Dust Exposure
- Risk of **Adverse** Health Effects Due to Host-Microorganism Interactions
- Risk of **Adverse** Health Event Due to Altered Immune Response
- Risk of **Adverse** Health Outcomes & Decrements in Performance due to Inflight Medical Conditions
- Risk of Performance Decrements and **Adverse** Health Outcomes Resulting from

At the bottom of the dropdown menu, it says 'Items 1-6 out of 6'.

## Full Search

You can locate an item by title and contents by typing a search query in the search box at the top-right corner of the page and clicking the Search button, or by clicking the Search navigation link:

The screenshot displays the NASA Human Research Roadmap (HRR) search interface. At the top, the NASA logo is on the left, and navigation tabs for 'HUMAN RESEARCH ROADMAP', 'HRP', 'DATA', and 'EXPLORATION' are on the right. A search bar contains the text 'Adverse' and a 'Search' button. Below the search bar is a navigation menu with 'EVIDENCE', 'RISKS', 'GAPS', 'TASKS', 'REPORTS', 'EXPLORE', and 'SEARCH'. The main content area shows search results for 'Adverse' in 'Titles and Contents' of 'Risks, Gaps, and Tasks'. A search filter box shows 'Keywords: Adverse', 'Type: All', and 'Search In: Titles and Contents'. The results list includes three items:

- Dose Tracker Application for Monitoring Crew Medication Usage, Symptoms and Adverse Effects During Missions** (100%)  
Aim 1: To develop an iOS application (app) for collection of medication usage data from crewmember participants during their missions. Aim 2: To employ the application to collect in-flight ...  
Last Published: Feb 4 2016 12:42PM (Central)
- Monitoring FDA Adverse Event Reports** (100%)  
Will examine FDA Adverse Event Reports for those that involve medications used in-flight, and those associated with known in-flight concerns. Integration/Unique Aspects: Informs all disciplines ...  
Last Published: Feb 4 2016 12:42PM (Central)
- CNS - 1: What are significant adverse changes in CNS performance in the context and time scale of space flight operations? How is significance defined, and which neuropsychological domains are affected? Is there a significant probability that space radiation exposure would result in adverse changes? What are the pathways and mechanisms of change?** (40%)  
Initial State of Gap: Possible acute (within mission) risks to the central nervous system (CNS) from galactic cosmic rays (GCR) and solar particle events (SPE) are a documented ...  
Last Published: Feb 4 2016 12:42PM (Central)

On the right side of the results list, there is a filter box with icons for 'Risk', 'Gap', and 'Task'.

By default, the search results will contain items of all types and search within titles and contents. You can restrict your results by changing the Type and Search In values or by using the Filters at the left side of the list of results.

## Reports

If you need to locate items based on precise conditions, you can use the Reports tool to run a custom query. Click the Reports navigation link to access the Reports tool. For more help on using the Reports tool, please see the “Reports User Guide” document on the Help page of HRR.

# Home Page

The main page of HRR gives a basic explanation of the Human Research Roadmap, with links to explore and search the data contained within:

The screenshot shows the NASA Human Research Roadmap (HRR) website. At the top left is the NASA logo. The main navigation bar includes 'HUMAN RESEARCH ROADMAP', 'HRP', 'DATA', and 'EXPLORATION'. Below this is a search bar with a 'Search' button. A secondary navigation bar contains 'Home', 'HRP Introduction', 'HRP Architecture', 'HRP Org Chart', 'Acronyms', 'Reviews', and 'Help'. A third navigation bar lists 'EVIDENCE', 'RISKS', 'GAPS', 'TASKS', 'REPORTS', 'EXPLORE', and 'SEARCH'. The main content area features a large banner image with the text 'Human Research Roadmap' and 'A Risk Reduction Strategy for Human Space Exploration'. Below the banner are three links: 'Explore the Roadmap', 'Search the Roadmap', and 'HRP Architecture'. A paragraph of text explains the HRP's role in crew health and performance. The footer contains the NASA logo, developer information (Joshua Foster, Dave Hanson), and a list of links to various NASA policies and reports.

**HUMAN RESEARCH ROADMAP**      **HRP**      **DATA**      **EXPLORATION**

Home | [HRP Introduction](#) | [HRP Architecture](#) | [HRP Org Chart](#) | [Acronyms](#) | [Reviews](#) | [Help](#)

[EVIDENCE](#) | [RISKS](#) | [GAPS](#) | [TASKS](#) | [REPORTS](#) | [EXPLORE](#) | [SEARCH](#)

## Human Research Roadmap

### A Risk Reduction Strategy for Human Space Exploration

[Explore the Roadmap](#)      [Search the Roadmap](#)  
[HRP Architecture](#)

Crew health and performance is critical to successful human exploration beyond low Earth orbit. The Human Research Program (HRP) investigates and mitigates the highest risks to human health and performance, providing essential countermeasures and technologies for human space exploration. Risks include physiological and performance effects from hazards such as radiation, altered gravity, and hostile environments, as well as unique challenges in medical support, human factors, and behavioral health support. The HRP utilizes an [Integrated Research Plan \(IRP\)](#) to identify the approach and research activities planned to address these risks, which are assigned to specific Elements within the program. The Human Research Roadmap is the web-based tool for communicating the IRP content.

Developer: Joshua Foster  
Responsible NASA Official: Dave Hanson

- > Budgets, Strategic Plans, and Accountability Reports
- > Equal Employment Opportunity Data Posted Pursuant to the No Fear Act
- > Information-Dissemination Policies and Inventories
- > Freedom of Information Act
- > President's Management Agenda
- > Privacy Policy & Important Notices
- > Inspector General Hotline
- > Contact HRP
- > Human Health and Performance DIR
- > Johnson Space Center
- > USA.gov
- > ExpectMore.gov

## HRP Introduction

The HRP Introduction page contains a more in-depth explanation of the background, goals, and requirements imposed on the Human Research Roadmap by the Human Research Program.

## HRP Architecture

The HRP Architecture page explains the basic architecture of the roadmap (Evidence, Risk, Gap, Task, Deliverable) and goes into detail about each item type.

## HRP Org Chart

The HRP Org Chart displays an organizational chart for the Human Research Program, including certain offices at NASA and each of the six Elements involved in performing HRP's research.

## Acronyms

The Acronyms page displays a list of acronyms used throughout the Human Research Roadmap:

Acronym	Definition
2D	Two Dimensional
3D	Three Dimensional
3xTg AD	Strain of Laboratory Mice
A	Acceptable
ABCAT	Automated Behavior and Cohesion Assessment Tools

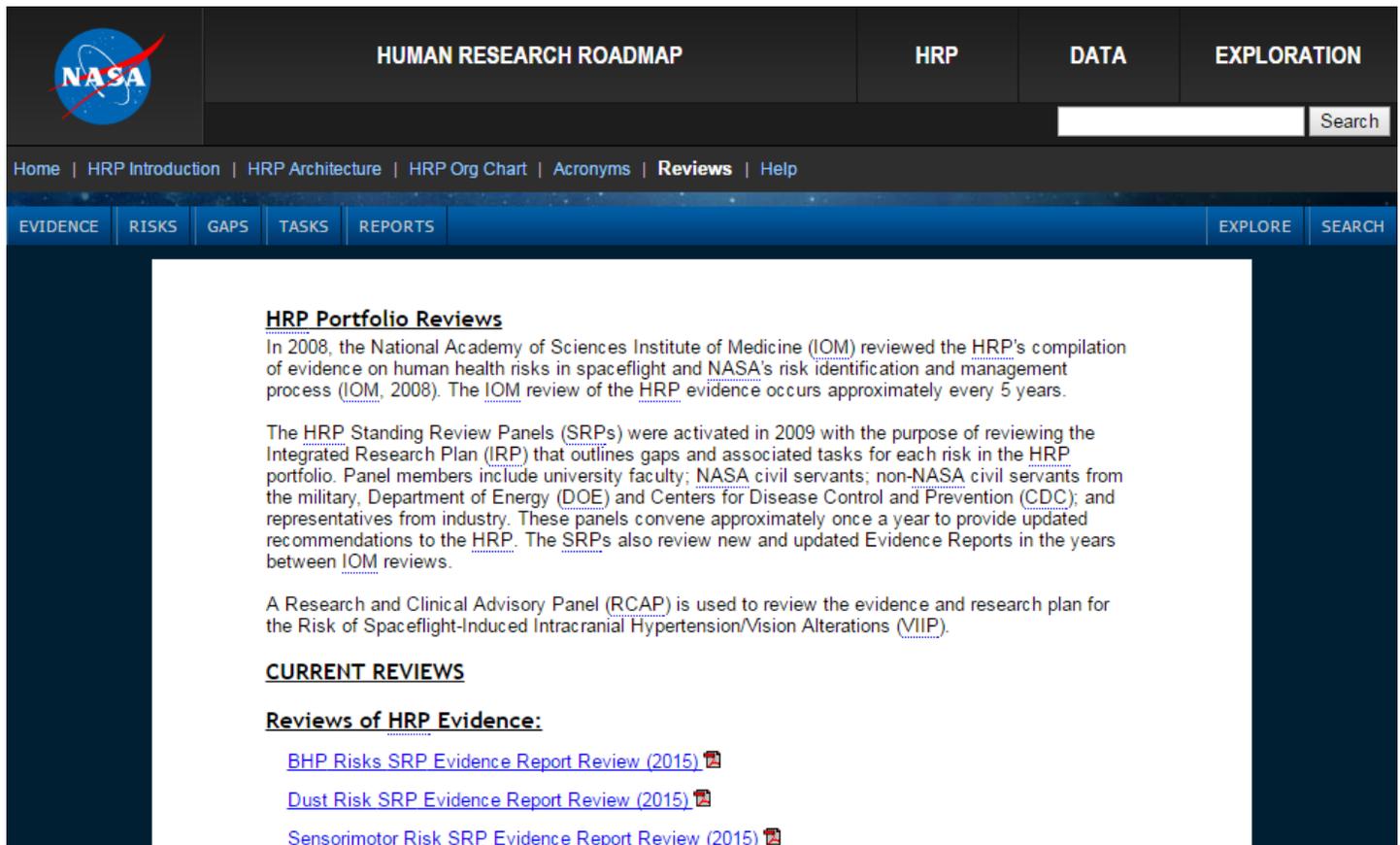
Enter text in the Search box to filter the list of acronyms and find all acronyms starting with a given set of characters:

Search:

Acronym	Definition
SR	Stochastic Resonance
SR	Space Radiation Element
SR MTECH	Space Radiation Measurement Technologies
SRP	Safety Review Panel
SRP	Standing Review Panel
SRR	Systems Requirements Review

## Reviews

The Reviews page contains a list of the current reviews performed on the HRP Evidence and Research Plans, as well as a page of archived reviews organized by year:



The screenshot shows the NASA Human Research Roadmap website. The top navigation bar includes the NASA logo, 'HUMAN RESEARCH ROADMAP', 'HRP', 'DATA', and 'EXPLORATION'. Below this is a search bar and a navigation menu with links for 'Home', 'HRP Introduction', 'HRP Architecture', 'HRP Org Chart', 'Acronyms', 'Reviews', and 'Help'. A secondary navigation bar contains 'EVIDENCE', 'RISKS', 'GAPS', 'TASKS', 'REPORTS', 'EXPLORE', and 'SEARCH'. The main content area is titled 'HRP Portfolio Reviews' and contains the following text:

**HRP Portfolio Reviews**  
In 2008, the National Academy of Sciences Institute of Medicine (IOM) reviewed the HRP's compilation of evidence on human health risks in spaceflight and NASA's risk identification and management process (IOM, 2008). The IOM review of the HRP evidence occurs approximately every 5 years.

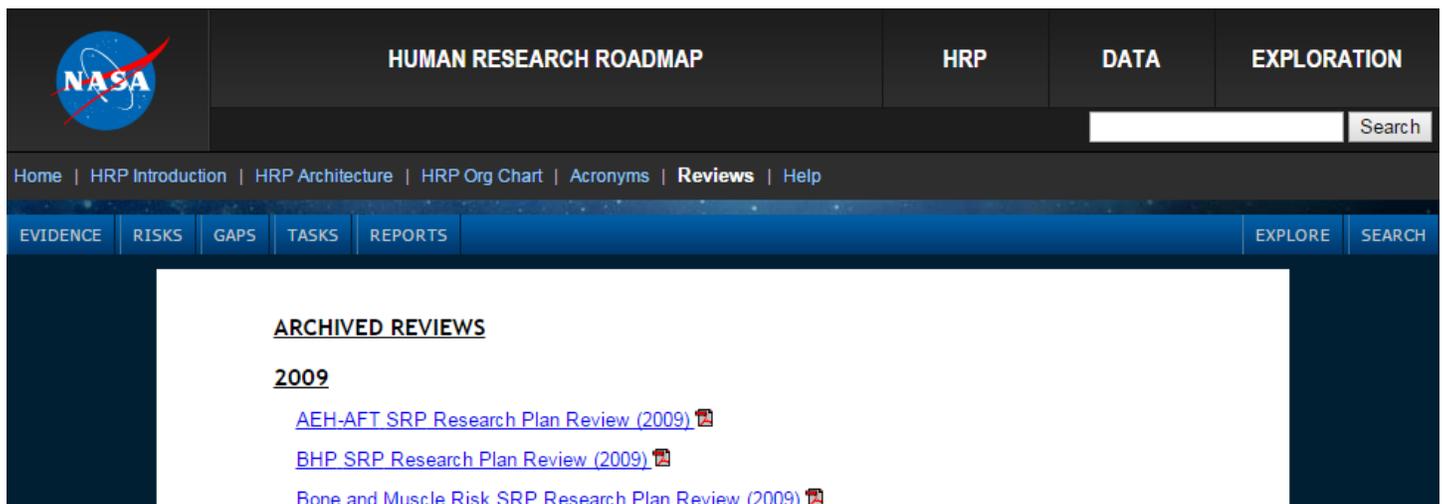
The HRP Standing Review Panels (SRPs) were activated in 2009 with the purpose of reviewing the Integrated Research Plan (IRP) that outlines gaps and associated tasks for each risk in the HRP portfolio. Panel members include university faculty; NASA civil servants; non-NASA civil servants from the military, Department of Energy (DOE) and Centers for Disease Control and Prevention (CDC); and representatives from industry. These panels convene approximately once a year to provide updated recommendations to the HRP. The SRPs also review new and updated Evidence Reports in the years between IOM reviews.

A Research and Clinical Advisory Panel (RCAP) is used to review the evidence and research plan for the Risk of Spaceflight-Induced Intracranial Hypertension/Vision Alterations (VIIP).

**CURRENT REVIEWS**

**Reviews of HRP Evidence:**

- [BHP Risks SRP Evidence Report Review \(2015\)](#)
- [Dust Risk SRP Evidence Report Review \(2015\)](#)
- [Sensorimotor Risk SRP Evidence Report Review \(2015\)](#)



The screenshot shows the NASA Human Research Roadmap website, specifically the 'Archived Reviews' section. The top navigation bar and secondary navigation bar are identical to the previous screenshot. The main content area is titled 'ARCHIVED REVIEWS' and contains the following text:

**ARCHIVED REVIEWS**

**2009**

- [AEH-AFT SRP Research Plan Review \(2009\)](#)
- [BHP SRP Research Plan Review \(2009\)](#)
- [Bone and Muscle Risk SRP Research Plan Review \(2009\)](#)

## Evidence

The Evidence page gives an introduction to the HRP Evidence Reports and an overview of the original Evidence Book. A list of Evidence Reports organized by Risk is given as well:

The screenshot shows the NASA Human Research Roadmap website. The top navigation bar includes the NASA logo, 'HUMAN RESEARCH ROADMAP', 'HRP', 'DATA', and 'EXPLORATION'. Below this is a search bar and a secondary navigation bar with links: Home | HRP Introduction | HRP Architecture | HRP Org Chart | Acronyms | Reviews | Help. The main navigation bar highlights 'EVIDENCE' and includes 'RISKS', 'GAPS', 'TASKS', 'REPORTS', 'EXPLORE', and 'SEARCH'. The content area is titled 'Evidence' and contains the following text:

**Human Research Program Evidence**

The NASA Human Research Program (HRP) Evidence is a collection of evidence-based risk reports or cited journal articles for each individual risk contained within the HRP Program Requirements Document (PRD). Thus, this set of reports provides the current record of the state of knowledge from research and operations for each of the defined human health and performance risks for future NASA exploration missions. The Evidence Reports provide a brief review article containing the evidence related to a specified risk, written at a level appropriate for the scientifically-educated, non-specialist reader. (For more information regarding the overview and evolution of the evidence, see [Evidence Book Overview](#).)

As an adjunct to these HRP-approved Evidence Reports, a [Wiki site](#) has been developed as an online collaborative environment that was developed to enable authors internal and external to NASA to update the evidence base for the HRP risks. This collaboration site provides the opportunity to generate more timely updates to the evidence base, and a peer review process is employed to ensure quality and validity of information.

**CROSS-CUTTING RISK EVIDENCE REPORTS**

[Artificial Gravity Evidence Report](#)  
Point Of Contact: [Gilles Clement](#)

**BEHAVIORAL HEALTH AND PERFORMANCE**

<a href="#">Evidence Report</a> <a href="#">HRP Wiki</a> <a href="#">Additional Evidence</a> Point Of Contact: <a href="#">Lauren Leveton</a>	<a href="#">Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders</a>
<a href="#">Evidence Report</a> <a href="#">HRP Wiki</a> <a href="#">Additional Evidence</a> Point Of Contact: <a href="#">Lauren Leveton</a>	<a href="#">Risk of Performance and Behavioral Health Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team</a>

## Risks

The Risks page lists every risk to human spaceflight assigned to the HRP for which research is needed:

The screenshot shows the NASA Human Research Roadmap website. The top navigation bar includes the NASA logo, 'HUMAN RESEARCH ROADMAP', 'HRP', 'DATA', and 'EXPLORATION'. Below this is a search bar and a secondary navigation bar with links: Home | HRP Introduction | HRP Architecture | HRP Org Chart | Acronyms | Reviews | Help. The main navigation bar highlights 'RISKS' and includes 'EVIDENCE', 'GAPS', 'TASKS', 'REPORTS', 'EXPLORE', and 'SEARCH'. The content area is titled 'Risks' and contains the following text:

**Risks**

Risks 1 - 33 ( of 33 )

- [Concern of Clinically Relevant Unpredicted Effects of Medication](#)
- [Concern of Intervertebral Disc Damage upon and immediately after re-exposure to Gravity](#)
- [Risk of Acute \(In-flight\) and Late Central Nervous System Effects from Radiation Exposure](#)
- [Risk of Acute Radiation Syndromes Due to Solar Particle Events \(SPEs\)](#)
- [Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders](#)

Clicking on an individual Risk in the list brings up details about that particular Risk:

The screenshot shows a web interface with a top navigation bar containing 'EVIDENCE', 'RISKS', 'GAPS', 'TASKS', 'REPORTS', 'EXPLORE', and 'SEARCH'. The main content area displays the following information:

- Title:** Concern of Clinically Relevant Unpredicted Effects of Medication
- Short Title:** PK/PD
- Element:** Human Health Countermeasures (HHC)
- Evidence:** Report
- Risk Master Logic Diagram:** Diagram
- Point of Contact:** Virginia Wotring
- Last Published:** 02/04/16 12:42:40 PM (Central)

Risk Rating	
ISS-12	Insufficient Data
Lunar	Insufficient Data
Deep Space Journey	Insufficient Data
Planetary	Insufficient Data

Below the table, there are expandable sections:

- Risk Statement:** Concern Statement: Given that terrestrial medical practices will be used as the basis for drug choice for use on spaceflight missions, there is a possibility that medications carried aboard and used on spaceflight missions will have unpredicted effects, resulting in ineffective treatment or unpredicted actions due to alteration in human physiology.
- Context:** Mitigation Strategy
- Gaps (3):**
  - Pharm03: We do not know the extent to which spaceflight alters pharmacokinetics.
  - Pharm04: We do not know the extent to which spaceflight alters pharmacodynamics.
  - Pharm05: We do not know the extent to which current antimicrobial therapies are effective against microbes that have been altered by spaceflight.
- Related Risks (5):**

## Title

The close-up shows a button with a roadmap icon to the left of the title text: **Risk of Acute (In-flight) and Late Central Nervous System Effects from Radiation Exposure**.

The primary title of the Risk. To the left of the Title field is a button with a roadmap icon. If you hover your mouse over this button, the associated Gaps and Tasks are shown in a tree structure allowing you to navigate to each item by clicking on it:

The screenshot shows the dropdown menu for the risk title. The menu items are:

- CNS - 1
- CNS - 2
- CNS - 3
- CNS - 4
- CNS - 5
- CNS - 6
- CNS - 7
- CNS - 8

When hovering over CNS - 5, a sub-menu is displayed with the following items:

- NeuroB
- SR Risk Assessment-Cucinotta
- HZE Behavior and Neural Circuitry
- CNS Mechanisms

## Short Title

**Short Title:** PK/PD

The abbreviated title for the Risk.

## Element

**Element:** Human Health Countermeasures (HHC)

The HRP Element responsible for investigating the Risk.

## Evidence

**Evidence:** [Report](#)

A clickable hyperlink to the HRP Evidence Report connected to the Risk, if available.

## Risk Master Logic Diagram

**Risk Master Logic Diagram:** [Diagram](#)

A clickable hyperlink to the Master Logic Diagram connected to the Risk, if available.

## Point of Contact

**Point of Contact:** [Janice Huff](#)

The person responsible for handling inquiries about the Risk content. Clicking the hyperlink will take you to a contact form allowing you to send a message to the point of contact person.

## Risk Ratings and Dispositions

**Risk Ratings and Dispositions per Design Reference Mission (DRM) Category**

DRM Categories	Mission Duration	Operations		Long-Term Health	
		LxC	Risk Disposition *	LxC	Risk Disposition *
Low Earth Orbit	6 months	3x4	Accepted/Optimize	2x3	Not Applicable
	1 year	1x2	Insufficient Data	2x3	To Be Determined
Deep Space Sortie	1 month	1x2	Partially Controlled	2x3	Requires Mitigation
Lunar Visit/ Habitation	1 year	3x2	Accepted	Not Applicable	Requires Mitigation
Deep Space Journey/Habitation	1 year	1x1	Uncontrolled	1x3	Accepted
Planetary	3 years	2x3	Uncontrolled	3x2	Controlled

A table of various Design Reference Mission (DRM) categories, with likelihood and consequence ratings and risk dispositions associated with operations and long-term health for each category.

## Risk Statement

### Risk Statement

Given that the crew is exposed to radiation from the space environment, there is the possibility that they will develop CNS damage leading to acute (in-flight) and/or late changes in cognition, motor function, behavior and mood, or neurological disorders.

A statement describing the Risk and how it affects human spaceflight. Click the /  buttons to show or hide this field's contents.

## Context

### Context

Possible acute (in-flight) and late risks to the central nervous system (CNS) from galactic cosmic rays (GCR) and solar particle events (SPE) are documented concerns for human exploration of space. Acute CNS risks include: altered cognitive function, impaired motor function, and behavioral changes, all of which may affect performance and human health. Late CNS risks include neurological disorders such as Alzheimer's disease, dementia or accelerated aging.

The context information for the Risk. Click the /  buttons to show or hide this field's content.

## Mitigation Strategy

### Mitigation Strategy

The NASA Permissible Exposure Limits for CNS risk were developed based on existing animal data from heavy ion exposures. Although evidence from animal experimental data and from humans receiving cranial radiotherapy for brain cancer suggests that adverse CNS structural and functional impacts from radiation exposure are possible, additional research is required to fully understand and quantify this risk, especially for

The mitigation strategy to be used for the Risk. Click the /  buttons to show or hide this field's content.

## Gaps

### Gaps (3)

- Pharm03: We do not know the extent to which spaceflight alters pharmacokinetics.
- Pharm04: We do not know the extent to which spaceflight alters pharmacodynamics.
- Pharm05: We do not know the extent to which current antimicrobial therapies are effective against microbes that have been altered by spaceflight.

A list of Gaps associated with the Risk. Click the top /  buttons to show or hide the list of Gaps. Click each Gap Title to view its page in HRR, or click the /  buttons next to the Gap Title to show or hide the Gap's information.

## Related Risks

### ☐ **Related Risks (5)**

⚡ [Risk of Adverse Health Effects Due to Host-Microorganism Interactions](#)

[Common Item\(s\)](#)

⚙️ [Efficacy of Antimicrobials on Bacteria Cultured in a Spaceflight Analog](#)

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⚡ [Risk of Ineffective or Toxic Medications Due to Long Term Storage](#)

[Common Item\(s\)](#)

⚙️ [Clinical Trial and FDA Approved Technology Watch](#)

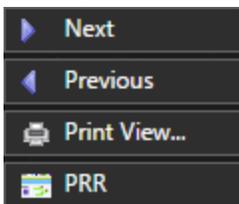
A list of Risks related to the current Risk, either by a shared Gap or a shared Task. Each common Risk is displayed with a list of items common between that Risk and the current Risk. Click the ☒/☑ buttons to show or hide the list of Risks.

## Last Published

Last Published: 02/04/16 12:42:40 PM (Central)

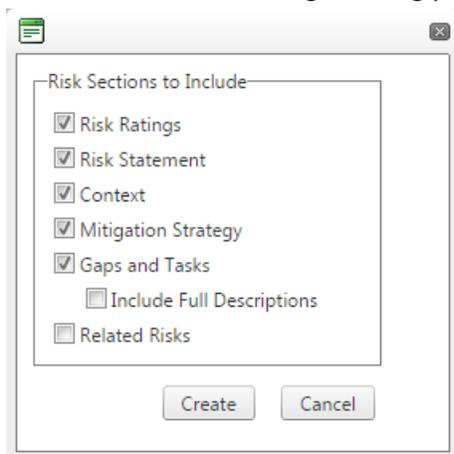
The date and time the Risk's content was last updated. This timestamp is shown next to the Short Title field at the top-right corner of the page.

## Navigation Buttons



The navigation buttons hover at the top-right corner of the page, below the Explore and Search navigation links.

- Next: View the next Risk (sorted alphabetically by title)
- Previous: View the previous Risk (sorted alphabetically by title)
- Print View: Shows a dialog allowing you to customize a printer-friendly view of the Risk:



Click the Create button to open the printer-friendly view in a new tab.

- PRR: Opens the Path to Risk Reduction document for the current Risk

# Gaps

The Gaps page lists every gap in knowledge associated with the risks to human spaceflight, as identified by the HRP:

**HUMAN RESEARCH ROADMAP** | HRP | DATA | EXPLORATION

Home | HRP Introduction | HRP Architecture | HRP Org Chart | Acronyms | Reviews | Help

EVIDENCE | RISKS | **GAPS** | TASKS | REPORTS | EXPLORE | SEARCH

Gaps 1 - 25 (of 317)  25 Items Per Page

- A4: Establish VO2 standards for successful completion of mission tasks.
- A6: Develop pre-flight, in-flight, and post-flight evaluations to determine if VO2 standards are met.
- A7: Develop the most efficient and effective exercise program for the maintenance of VO2 standards.
- A9: Identify and validate exploration countermeasure hardware for the maintenance of VO2 standards.

Acute - 1: Determine the dose response for acute effects induced by SPE-like radiation, including synergistic effects arising from other spaceflight factors (e.g. altered gravity ( $\mu$ -gravity), stress, altered immune function, or other) that modify and/or enhance the biological response.

Clicking on an individual Gap in the list brings up details about that particular Gap:

EVIDENCE | RISKS | **GAPS** | TASKS | REPORTS | EXPLORE | SEARCH

**B16: Can inhibitors of stone formation be sufficiently provided through dietary sources?**

Last Published: 02/04/16 12:42:40 PM (Central)

**Responsible Element:** Exploration Medical Capability (ExMC)

**Status:** Open

**Description**  
Lorem ipsum dolor sit amet, consectetur adipiscing elit. Quisque non erat vehicula, feugiat tellus id, fringilla sem. Nam aliquet vitae neque non molestie. Vivamus accumsan neque non nisl tristique mollis. Pellentesque vel ullamcorper lorem, vitae placerat nunc. Etiam sed consequat diam. Nunc non ipsum vel tellus maximus convallis a id ipsum. Donec aliquam lorem et lorem commodo mollis. Nulla facilisi. Integer suscipit scelerisque dui non eleifend. Nunc sed lorem ut risus aliquet molestie eget vitae risus. Quisque eu risus quis augue vestibulum vulputate.

**Target for Closure**  
Lorem ipsum dolor sit amet, consectetur adipiscing elit. Quisque non erat vehicula, feugiat tellus id, fringilla sem. Nam aliquet vitae neque non molestie. Vivamus accumsan neque non nisl tristique mollis. Pellentesque vel ullamcorper lorem, vitae placerat nunc. Etiam sed consequat diam. Nunc non ipsum vel tellus maximus convallis a id ipsum. Donec aliquam lorem et lorem commodo mollis. Nulla facilisi. Integer suscipit scelerisque dui non eleifend. Nunc sed lorem ut risus aliquet molestie eget vitae risus. Quisque eu risus quis augue vestibulum vulputate.

**Mappings**  
⚡ Risk of Renal Stone Formation

You are here! **B16: Can inhibitors of stone formation be sufficiently provided through dietary sources?**  
Completed

- ☑ Data Mining for Incidence of Renal Stone Formation Following Spaceflight
- ☑ Renal Stone Risk during Spaceflight: Assessment and Countermeasure Validation (Renal Stone - DSO 633)

**Documentation:**  
No Documentation Available

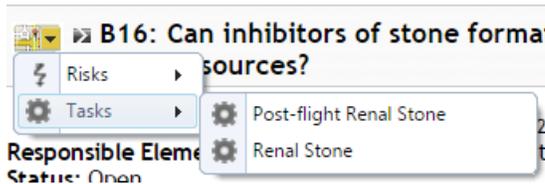
☑ **Related Gaps (7)**

Next  
Previous  
Print View...  
PRRs (1)

## Title

 **B16: Can inhibitors of stone formation be sufficiently provided through dietary sources?**

The full title of the Gap in the format Short Title: Full Title. To the left of the Title field is a button with a roadmap icon. If you hover your mouse over this button, the associated Risks and Tasks are shown allowing you to navigate to each item by clicking on it:



## Responsible Element

**Responsible Element:** Exploration Medical Capability (ExMC)

The HRP Element responsible for closing the Gap.

## Status

**Status:** Open

The current status of the Gap. There are five possible values for the Status field:

- Open: The Gap is currently open and requires further research to be closed
- Closed: The Gap has been closed
- Merged: The Gap has been merged into another Gap and is no longer part of the research plan. Merged Gaps will only show the Gap Title and a link to the target Gap:

 **PH01: Inadequate tracking of medication use, indication, efficacy, and side effects. (this gap has become Pharm01)**

**This Gap was merged into the following Gap:**

[Pharm01: We do not know how medications are used during spaceflight.](#)

- Split: The Gap has been split into one or more other Gaps and is no longer part of the research plan. Split Gaps will only show the Gap Title and links to the target Gaps:

 **B16: Can inhibitors of stone formation be sufficiently provided through dietary sources?**

**This Gap was split into the following Gaps:**

[B11: What are the effects of radiation on bone? \(Merged with Osteo 4\)](#)

[B2: What new technologies are available for in-flight fracture diagnosis? \(Transferred to ExMC gap 4.02\)](#)

- Archived: The Gap has been removed from the research plan. Archived Gaps will only show the Gap Title and a statement that the Gap has been Archived:

 **B16: Can inhibitors of stone formation be sufficiently provided through dietary sources?**

**This Gap has been Archived and removed from the Current Research Plan.**

## Content Split Into

Content from this Gap was split into 2 other Gaps

Content from this Gap was split into:

[B11: What are the effects of radiation on bone? \(Merged with Osteo 4\)](#)

[B2: What new technologies are available for in-flight fracture diagnosis? \(Transferred to ExMC gap 4.02\)](#)

Gaps that are split can still be part of the current research plan if the original gap is still relevant. For this case, the original gap will show some content split into other Gaps with a statement “Content from this Gap was split into # other Gaps” message. Click the “# other Gaps” link or the  button to show a list of links to the target Gaps; click the  button to hide this list again.

## Closure Rationale

### Closure Rationale

This gap existed to explore the optimal means of preparing crew medical officers (CMOs) for the potential medical conditions on the Exploration Medical Condition List (EMCL) that a crew might face during an exploration mission. For this gap, the term “medical” encompasses dental and behavioral health conditions. Evidence from published reports on medical education, training, and validation, in addition to results from a survey on topics related to ISS crew medical officer (CMO)

The rationale behind the closure of the Gap. This field is only visible if the Status is Closed.

## Closure Documentation

### Closure Documentation:

- [test.pdf](#)

A set of files containing documentation related to the closure of the Gap. Click each link to view each document. This field is only visible if the Status is Closed.

## Description

### Description

#### 1) Initial State

Due to the stringent astronaut screening process and pre-flight medical care, the human space flight program has fortunately not yet seen traumas or severe illness requiring on-orbit medical emergency care. Therefore, it has been difficult to determine the effectiveness of the full breadth of CMO skills training given to the crew regardless of their medical background (i.e., physician astronaut vs. non-physician-astronaut). This gap focuses on the identification of the

A description of the Gap being investigated. Click the /  buttons to show or hide this field’s content.

## Target for Closure

### Target for Closure

Delivery of white paper to identify the best training methods and validation techniques for the skills needed to address the Exploration Medical Condition List (EMCL) for CMO and ground personnel.

The target to be met in order to consider the Gap closed. Click the /  buttons to show or hide this field’s content.

## Mappings

### ☐ Mappings

⚡ Risk of Renal Stone Formation

You are here!

▶▶ **B16: Can inhibitors of stone formation be sufficiently provided through dietary sources?**

*Completed*

- ☑  [Data Mining for Incidence of Renal Stone Formation Following Spaceflight](#)
- ☑  [Renal Stone Risk during Spaceflight: Assessment and Countermeasure Validation \(Renal Stone - DSO 633\)](#)

A list of Risks and Tasks associated with the Gap. Risks are listed first, then the current Gap, then an expandable list of Tasks (grouped by Funding Status). Click the top ☑/☐ buttons to show or hide the entire field. Click each Risk Title or Task Title to view its page in HRR, or click the ☑/☐ buttons next to the Task Title to show or hide the Task's information.

## Documentation

### Documentation:

- [test.pdf](#)

A set of files containing documentation related to the Gap. Click each link to view each document.

## Related Gaps

### ☐ Related Gaps (7)

▶▶ [B5: What is the current state of knowledge regarding renal stone formation due to spaceflight?](#)

Common Item(s)

- ⚡ [Risk of Renal Stone Formation](#)
  - ⚙ [Data Mining for Incidence of Renal Stone Formation Following Spaceflight](#)
  - ⚙ [Renal Stone Risk during Spaceflight: Assessment and Countermeasure Validation \(Renal Stone - DSO 633\)](#)
- 

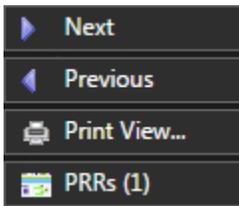
A list of Gaps related to the current Gap, either by a shared Risk or a shared Task. Each common Gap is displayed with a list of items common between that Gap and the current Gap. Click the ☑/☐ buttons to show or hide the list of Gaps.

## Last Published

Last Published: 02/04/16 12:42:40 PM (Central)

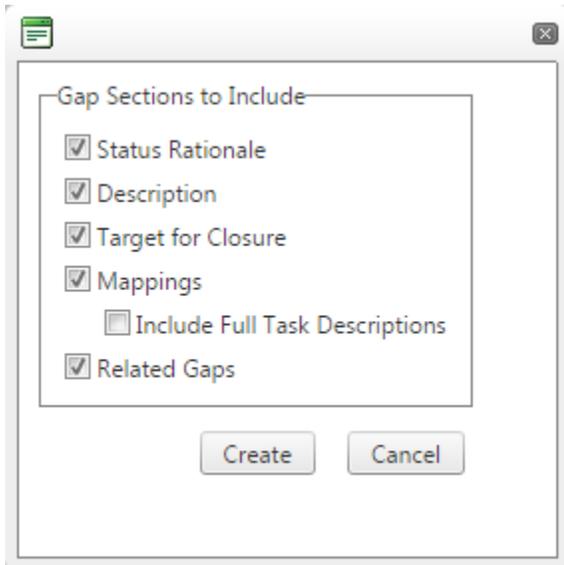
The date and time the Gap's content was last updated. This timestamp is shown below the Title field at the top of the page.

## Navigation Buttons



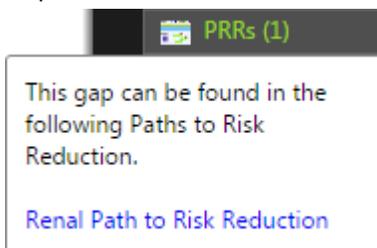
The navigation buttons hover at the top-right corner of the page, below the Explore and Search navigation links.

- Next: View the next Gap (sorted alphabetically by title)
- Previous: View the previous Gap (sorted alphabetically by title)
- Print View: Shows a dialog allowing you to customize a printer-friendly view of the Gap:



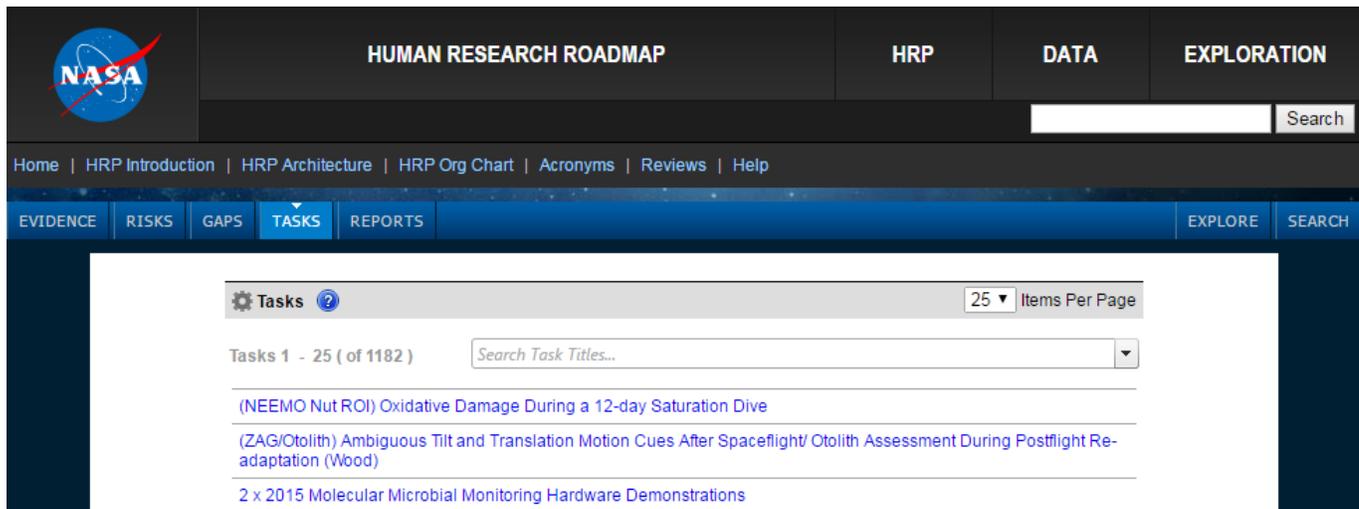
Click the Create button to open the printer-friendly view in a new tab.

- PRR: Hover over this button to show the Path to Risk Reduction documents for the Risks associated with the Gap:

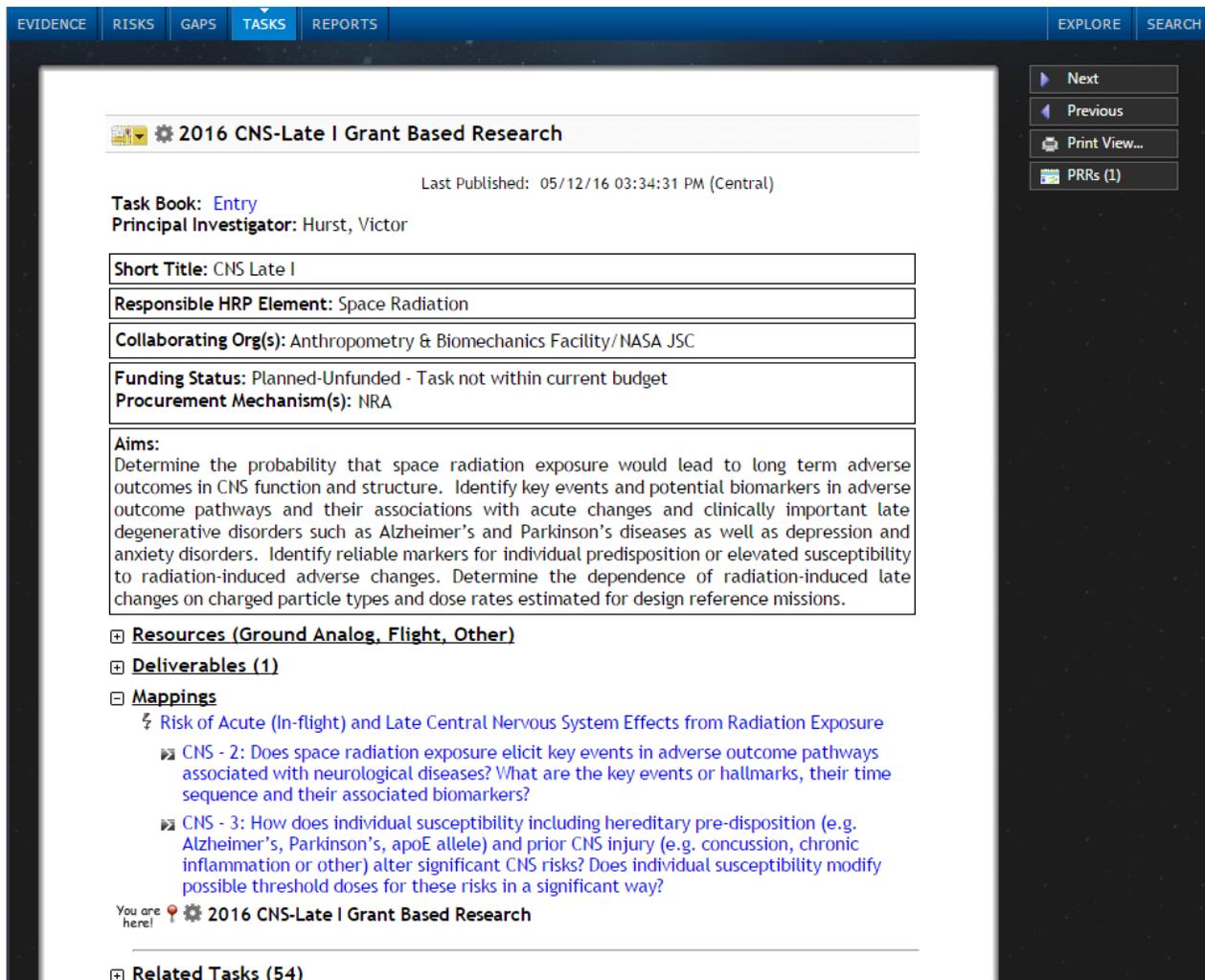


# Tasks

The Tasks page lists every task being undertaken by the HRP to close identified gaps in knowledge associated with the risks to human spaceflight:



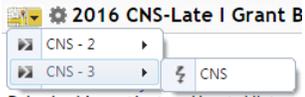
Clicking on an individual Task in the list brings up details about that particular Task:



## Title

  **2016 CNS-Late I Grant Based Research**

The primary title of the Task. To the left of the Title field is a button with a roadmap icon. If you hover your mouse over this button, the associated Risks and Gaps are shown in a tree structure allowing you to navigate to each item by clicking on it:



## Task Book

**Task Book:** [Entry](#)

A clickable hyperlink to the Task Book entry connected to the Task, if available.

## Principal Investigator

**Principal Investigator:** Krihak, Michael

The name of the principal investigator performing research on the Task.

## Short Title

**Short Title:** CNS Late I

The abbreviated title for the Task.

## Responsible HRP Element

**Responsible HRP Element:** Space Radiation

The HRP Element responsible for managing/conducting the Task.

## Collaborating Org(s)

**Collaborating Org(s):** Anthropometry & Biomechanics Facility/NASA JSC

A list of organizations collaborating with the HRP on the Task.

## Funding Status

**Funding Status:** Planned-Unfunded - Task not within current budget

The current status of funding for research on the Task. Note that Completed Tasks are shown in gray text and have a "(Completed)" message next to the Task Title:

  **A Novel Biodosimetry Method** (Completed)

## Procurement Mechanism(s)

**Procurement Mechanism(s):** Directed

A list of procurement mechanisms used to perform research on the Task.

## Aims

### Aims:

Determine the probability that space radiation exposure would lead to long term adverse outcomes in CNS function and structure. Identify key events and potential biomarkers in adverse outcome pathways and their associations with acute changes and clinically important late degenerative disorders such as Alzheimer's and Parkinson's diseases as well as depression and anxiety disorders. Identify reliable markers for individual predisposition or elevated susceptibility to radiation-induced adverse changes. Determine the dependence of radiation-induced late changes on charged particle types and dose rates estimated for design reference missions.

A description of the aims of the research being performed on the Task.

## Resources

### Resources (Ground Analog, Flight, Other)

#### Ground Analog Resources

##### Ground-Based Flight Analogs

- Reduced Gravity Flight

Number of Subjects	1
--------------------	---

#### Flight Resources

Number of Subjects	2
--------------------	---

#### Other Resources

Other Resources Needed?	Yes
-------------------------	-----

The resources needed to perform research on the Task. Click the /  buttons to show or hide the contents of the field.

- Ground Analog Resources
  - Ground-Based Flight Analogs: A list of flight analogs to be used in place of flight resources
  - Number of Subjects: The number of human subjects needed for the flight analogs
- Flight Resources
  - Number of Subjects: The number of human subjects needed for flight research
- Other Resources
  - Other Resources Needed?: A Yes/No value indicating if other resources are needed

## Deliverables

A Task can produce multiple Deliverables in the course of research. Each Deliverable has its own section on the page, and you can click the / buttons to show or hide the list of Deliverables.

### Deliverables (1)



**Category:** Technology or Tool  
**Subcategory:** Database

**Description:**

Annual and final reports providing evidence for radiation-induced late adverse outcomes in the CNS and organizing findings in adverse outcome pathways. Identify potential biomarkers of radiation-induced adverse outcomes that are shared by known neurodegenerative diseases to aid in assessing significance of risks and identify molecular targets for mitigation. Reports and peer-reviewed publications will provide the necessary knowledge for identifying and validating mitigation strategies. This task will contribute to gap closure by providing the necessary knowledge for developing risk estimates. Results will inform and prioritize concerns to be used in an integrated research approach using the NSCOR funding approach. This task supports the path to risk reduction milestone for risk characterization on Late CNS Effects.

**Internal Customers:**

Behavioral Health and Performance

**External Customers:**

AES - Advanced Exploration Systems

**Is a Customer-Supplier Agreement (CSA) Required?** Yes

### *Category and Subcategory*

**Category:** Technology or Tool  
**Subcategory:** Database

The category and subcategory that the Deliverable falls under.

### *Description*

**Description:**

Annual and final reports providing evidence for radiation-induced late adverse outcomes in the CNS and organizing findings in adverse outcome pathways. Identify potential biomarkers of radiation-induced adverse outcomes that are shared by known neurodegenerative diseases to aid in assessing significance of risks and identify molecular targets for mitigation. Reports and peer-reviewed publications will provide the necessary knowledge for identifying and validating mitigation strategies. This task will contribute to gap closure by providing the necessary knowledge for developing risk estimates. Results will inform and prioritize concerns to be used in an integrated research approach using the NSCOR funding approach. This task supports the path to risk reduction milestone for risk characterization on Late CNS Effects.

A description of the Deliverable to be produced.

### Internal Customers

#### Internal Customers:

Behavioral Health and Performance

A list of HRP Elements that will receive the Deliverable once produced.

### External Customers

#### External Customers:

AES - Advanced Exploration Systems

A list of external customers that will receive the Deliverable once produced.

### Is a Customer-Supplier Agreement (CSA) Required?

#### Is a Customer-Supplier Agreement (CSA) Required? Yes

A Yes/No value indicating that a Customer-Supplier Agreement (CSA) is required for the Deliverable. This field is only visible if the list of External Customers is not empty.

## Mappings

### Mappings

#### Risk of Acute (In-flight) and Late Central Nervous System Effects from Radiation Exposure

-  CNS - 2: Does space radiation exposure elicit key events in adverse outcome pathways associated with neurological diseases? What are the key events or hallmarks, their time sequence and their associated biomarkers?
-  CNS - 3: How does individual susceptibility including hereditary pre-disposition (e.g. Alzheimer's, Parkinson's, apoE allele) and prior CNS injury (e.g. concussion, chronic inflammation or other) alter significant CNS risks? Does individual susceptibility modify possible threshold doses for these risks in a significant way?

You are here!  **2016 CNS-Late I Grant Based Research**

A list of Risks and Gaps associated with the Task. Click the /  buttons to show or hide the contents of the field.

## Related Tasks

### Related Tasks (54)

#### Space Radiation Risk Assessment Project-Cucinotta

##### Common Item(s)

-  Risk of Acute (In-flight) and Late Central Nervous System Effects from Radiation Exposure

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#### Neurodegeneration and Adaptation in Response to Low-Dose Photon Irradiation

##### Common Item(s)

-  Risk of Acute (In-flight) and Late Central Nervous System Effects from Radiation Exposure
-  CNS - 2: Does space radiation exposure elicit key events in adverse outcome pathways associated with neurological diseases? What are the key events or hallmarks, their time sequence and their associated biomarkers?

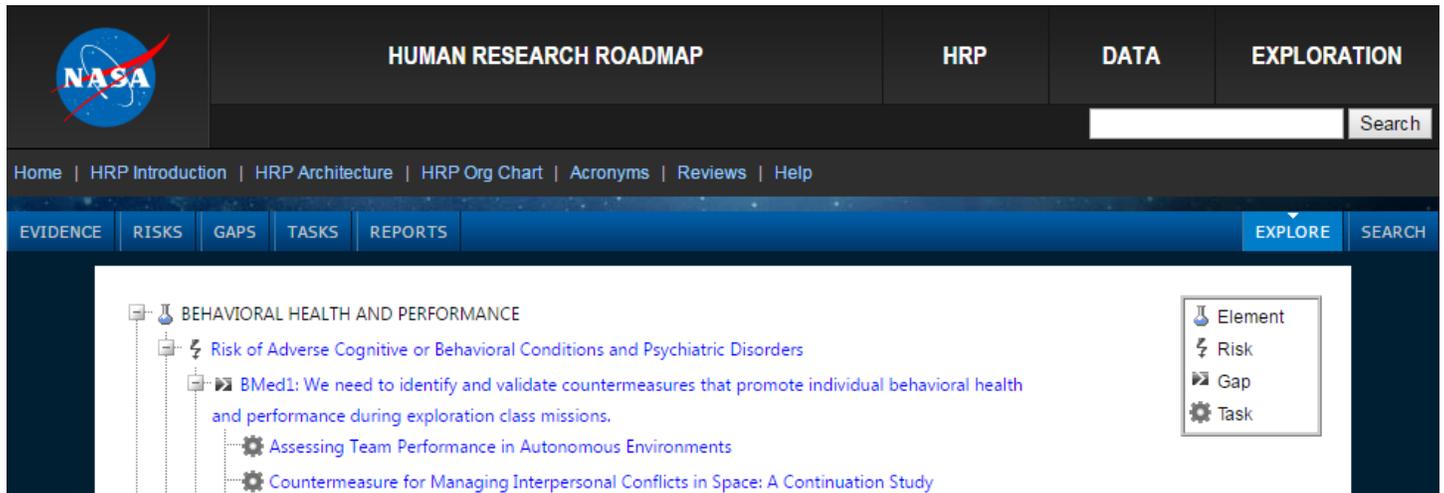
A list of Tasks related to the current Task, either by a shared Risk or a shared Gap. Each common Task is displayed with a list of items common between that Task and the current Task. Click the /  buttons to show or hide the list of Tasks.

## Reports

The Reports tool allows you to build and run custom reports against the data in the HRR database. This tool is quite flexible and powerful, so a separate User Guide has been written for it. Please see the “Reports User Guide” document on the Help page of HRR for more information.

## Explore

The Explore page displays all of the Risks, Gaps, and Tasks in the system organized in the research plan hierarchy starting with Element:



The screenshot displays the NASA Human Research Roadmap (HRR) interface. At the top, there is a navigation bar with the NASA logo and tabs for 'HUMAN RESEARCH ROADMAP', 'HRP', 'DATA', and 'EXPLORATION'. Below this is a search bar and a breadcrumb trail: 'Home | HRP Introduction | HRP Architecture | HRP Org Chart | Acronyms | Reviews | Help'. A secondary navigation bar contains tabs for 'EVIDENCE', 'RISKS', 'GAPS', 'TASKS', 'REPORTS', 'EXPLORE', and 'SEARCH'. The main content area shows a tree view under the 'BEHAVIORAL HEALTH AND PERFORMANCE' element. The tree includes a risk node: 'Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders', which is expanded to show a gap: 'BMed1: We need to identify and validate countermeasures that promote individual behavioral health and performance during exploration class missions.' This gap is further expanded to show two tasks: 'Assessing Team Performance in Autonomous Environments' and 'Countermeasure for Managing Interpersonal Conflicts in Space: A Continuation Study'. A legend on the right identifies the icons for Element (blue circle with 'I'), Risk (lightning bolt), Gap (document with 'X'), and Task (gear).

The tree nodes can be expanded by clicking the plus icon (⊕) and collapsed by clicking the minus icon (⊖).

# Search

You can locate an item by title and contents by typing a search query in the search box at the top-right corner of the page and clicking the Search button, or by clicking the Search navigation link:

**HUMAN RESEARCH ROADMAP**      HRP      DATA      EXPLORATION

Adverse      Search

Home | HRP Introduction | HRP Architecture | HRP Org Chart | Acronyms | Reviews | Help

EVIDENCE   RISKS   GAPS   TASKS   REPORTS      EXPLORE   SEARCH

Keywords: Adverse      Search      Help

Type: All

Search In: Titles and Contents

83 results found for "Adverse" in Titles and Contents of Risks, Gaps, and Tasks

**Filters**

- Item Type
- Responsible Element
- Gap Status
- Task Collaborating Orgs
- Task Funding Status
- Task Procurement Mechanisms
- Task Flight Resources Required?
- Task Ground Resources Required?
- Task Ground-Based Flight Analogs
- Task Other Resources Required?
- Task Has Deliverables?

**Legend:** Risk, Gap, Task

- Dose Tracker Application for Monitoring Crew Medication Usage, Symptoms and Adverse Effects During Missions** (100%)  
Aim 1: To develop an iOS application (app) for collection of medication usage data from crewmember participants during their missions. Aim 2: To employ the application to collect in-flight ...  
Last Published: Feb 4 2016 12:42PM (Central)
- Monitoring FDA Adverse Event Reports** (100%)  
Will examine FDA Adverse Event Reports for those that involve medications used in-flight, and those associated with known in-flight concerns. Integration/Unique Aspects: Informs all disciplines ...  
Last Published: Feb 4 2016 12:42PM (Central)
- CNS - 1: What are significant adverse changes in CNS performance in the context and time scale of space flight operations? How is significance defined, and which neuropsychological domains are affected? Is there a significant probability that space radiation exposure would result in adverse changes? What are the pathways and mechanisms of change?** (40%)  
Initial State of Gap: Possible acute (within mission) risks to the central nervous system (CNS) from galactic cosmic rays (GCR) and solar particle events (SPE) are a documented ...  
Last Published: Feb 4 2016 12:42PM (Central)

By default, the search results will contain items of all types and search within titles and contents. You can restrict your results by changing the Type and Search In values or by using the Filters at the left side of the list of results. For example, to restrict the results to only those items whose Responsible HRP Element is Human Health Countermeasures, click the  button next to “Responsible Element” and mark the checkbox next to “Human Health Countermeasures (HHC)”. The list of results is automatically updated to reflect the new filter:

Keywords:   [Help](#)

Type:

Search In:



17 results found for \*Adverse\* in Titles and Contents of Risks, Gaps, and Tasks with a filter on Responsible Element 

**Filters**

- Item Type 
- Responsible Element 
  - Behavioral Health and Performance (BHP)
  - Exploration Medical Capability (ExMC)
  - Human Health Countermeasures (HHC)
  - Space Human Factors and Habitability (SHFH)
  - Space Radiation (SR)
- Gap Status 
- Task Collaborating Orgs 
- Task Funding Status 
- Task Procurement

-  [Dose Tracker Application for Monitoring Crew Medication Usage, Symptoms and Adverse Effects During Missions](#) (100%)  
 Aim 1: To develop an iOS application (app) for collection of medication usage data from crewmember participants during their missions. Aim 2: To employ the application to collect in-flight ...  
**Last Published: Feb 4 2016 12:42PM (Central)**
-  [Monitoring FDA Adverse Event Reports](#) (100%)  
 Will examine FDA Adverse Event Reports for those that involve medications used in-flight, and those associated with known in-flight concerns. Integration/Unique Aspects: Informs all disciplines ...  
**Last Published: Feb 4 2016 12:42PM (Central)**
-  [Risk of Adverse Health Event Due to Altered Immune Response](#) (30%)  
 Given that exposure to orbital spaceflight results in persistent dysregulation of the immune system, which leads to reactivation of latent herpes-viruses and likely to an increased clinical ...  
**Last Published: Feb 4 2016 12:42PM (Central)**

-  Risk
-  Gap
-  Task

Multiple filters can be applied at the same time; for example, to only display Planned-Funded Tasks in the previous set of results, click the  button next to “Task Funding Status” and mark the checkbox next to “Planned-Funded”:

Keywords:   [Help](#)

Type:

Search In:



2 results found for \*Adverse\* in Titles and Contents of Risks, Gaps, and Tasks with filters on Responsible Element  and Task Funding Status 

**Filters**

- Item Type
- Responsible Element 
  - Behavioral Health and Performance (BHP)
  - Exploration Medical Capability (ExMC)
  - Human Health Countermeasures (HHC)
  - Space Human Factors and Habitability (SHFH)
  - Space Radiation (SR)
- Gap Status
- Task Collaborating Orgs
- Task Funding Status 
  - None
  - Active
  - Planned-Funded
  - Planned-Unfunded
  - Completed
  - Terminated

-  [Effects of emotional stress on the cardiovascular system \(Stress and CV Health-TBD, Planned\)](#) (8%)  
It is becoming clearer that stress can adversely affect the function of many organ systems, including the cardiovascular system. A number of mechanisms have been proposed to account for this ...  
**Last Published: Feb 4 2016 12:42PM (Central)**
-  [Immune Countermeasures Validation \(Analog\)](#) (5%)  
The purpose of this study will be to develop countermeasures (i.e., exercise, pharmaceutical or nutritional supplements) to mitigate the adverse effects of spaceflight on the immune system as ...  
**Last Published: Feb 4 2016 12:42PM (Central)**

  1   Items 1 to 2 of 2

-  Risk
-  Gap
-  Task

To remove a filter, either clear its checkboxes in the Filters section or click the  button in the results header next to the filter you wish to remove.