



# MANAGING HRP'S EXTERNAL DELIVERABLES: THE PROCESS AND THE CUSTOMERS



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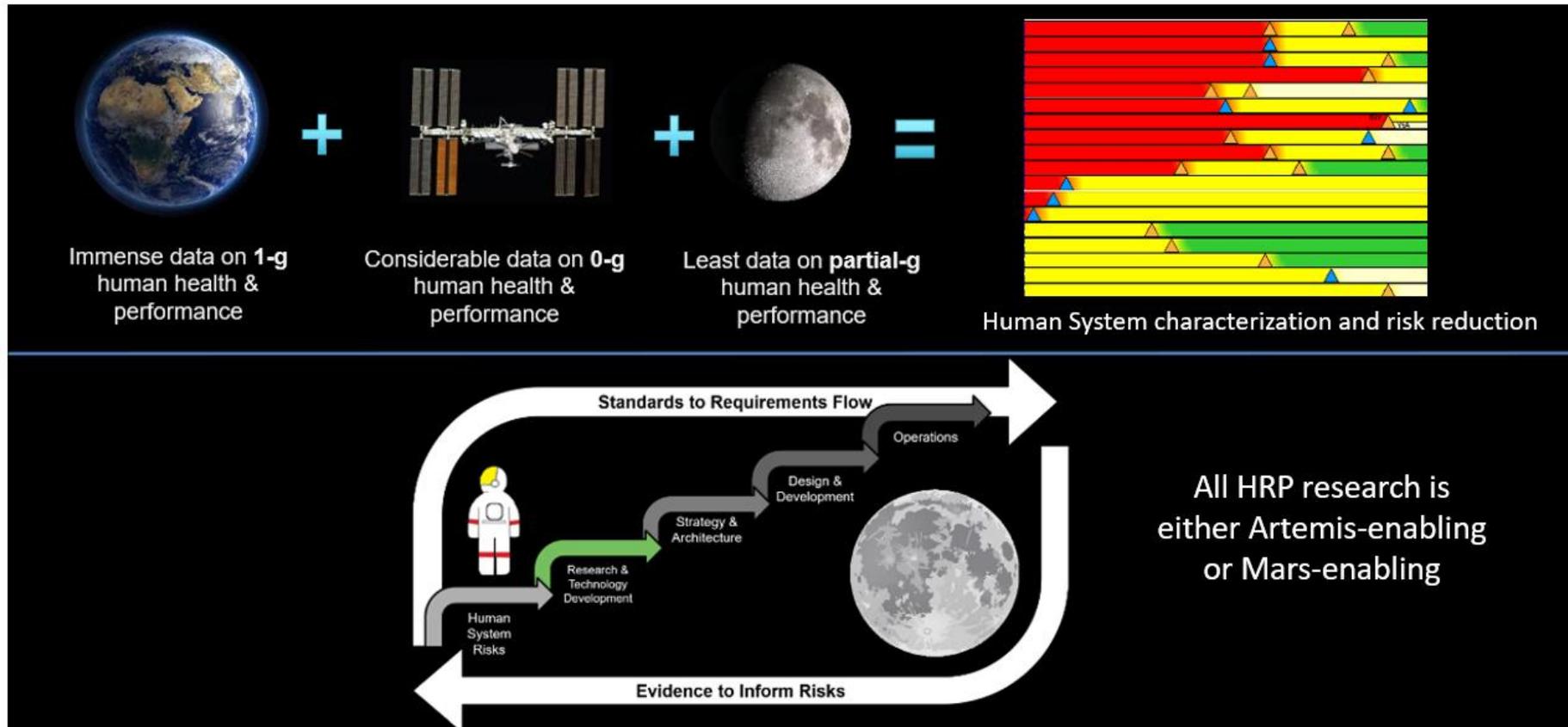
# Outline of the Presentation



- HRP Research Framework
- HRP External Deliverables (EDs)
- HRP External Deliverables: Customers
- HRP External Deliverables: Categories
- HRP General Strategy on External Deliverables
- Current Approach to External Deliverables
- Role of HRP's Maturation & Integration Office (MIO)
- HRP External Deliverables Process: Overview
- HRP External Deliverables Process: Collection of ED Metadata
- HRP External Deliverables Process: Engagement and Agreement



# HRP Research Framework



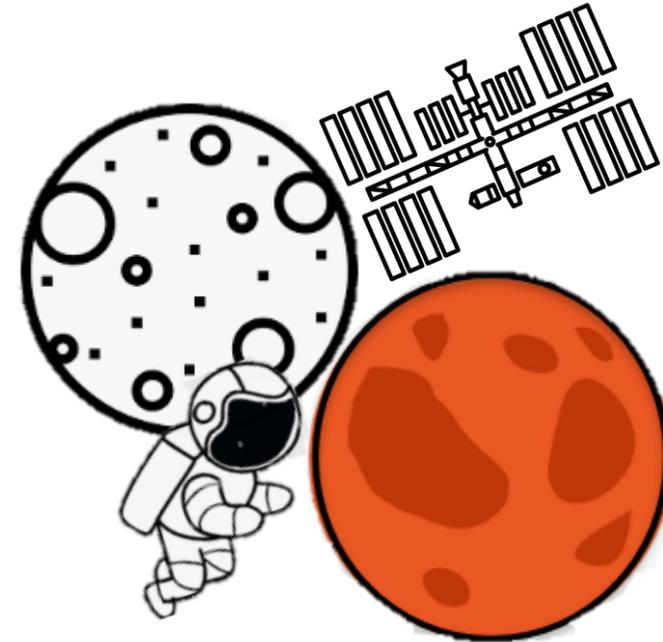


# HRP External Deliverables (EDs)



“External Deliverables” are HRP’s final synthesized research outcomes from solicited and directed research...

...that are delivered to non-HRP Customers to support exploration mission operations





# HRP External Deliverables (EDs)

HRP EDs by primary human system risk supported (as of June 2023\*) – these are the outcomes of maturation tasks listed in the Human Research Roadmap ([humanresearchroadmap.nasa.gov](http://humanresearchroadmap.nasa.gov))

- Behavioral**
- Thresholds and inputs for POLS and standards
  - Countermeasures for adverse outcomes
  - Standards and clinical guidelines
  - Key indicators and methods for monitoring
  - Validated thresholds and countermeasures for adverse outcomes



- Cardiovascular**
- Cardiovascular responses to HLS G-levels and countermeasures
  - Countermeasure combined effects
  - Standards



- Radiation Carcinogenesis**
- Baseline PEL
  - PEL update
  - Countermeasure identification
  - Integrated countermeasure tool kit
  - Fitness for Duty standards
  - Clinical Practice Guidelines



- Dynamic Loads**
- Standards for initial/interim injury assessment reference values (IARVs) and for protecting crew during dynamic phases of spaceflight
  - Standards for validated IARVs and protecting crew during seated and standing dynamic phases of spaceflight



- Team**
- Dynamic team composition algorithm and tool
  - Measures and thresholds of team functioning and performance
  - Countermeasures
  - Standards and guidelines
  - Validated integrated team countermeasures and tools
  - Validated key indicators



- SANS**
- Countermeasures (support and maintenance)
  - Standards for Long Term Health
  - Standards for Inflight Health



- EVA**
- EVA human performance testing and training
  - Contingency CO2 standards
  - Countermeasures
  - EVA dive computer
  - Fitness for Duty standards



- Sensorimotor**
- Countermeasures
  - Lunar countermeasures
  - Standards

- Immune**
- Countermeasures
  - Standards

- Human Systems Integration**
- Operational performance metrics and measures
  - Requirements for simulation-based verification of hardware and software
  - Standards and guidelines to enable critical Earth-independent functions

- Food and Nutrition**
- Food storage limit requirements
  - Food system requirement and resource trades

- Bone Fracture**
- Countermeasures
  - Standards

- Microhost**
- Countermeasures
  - Standards

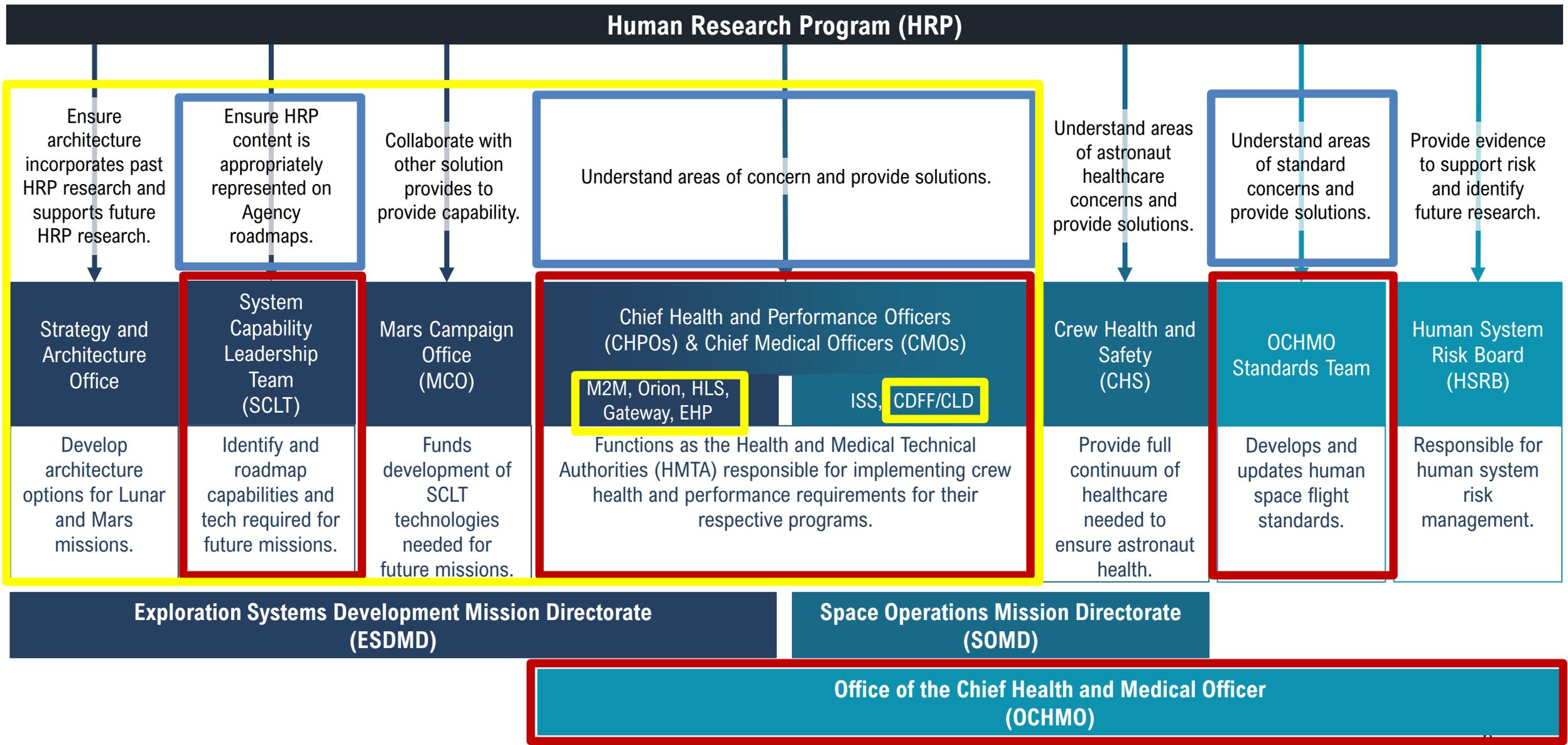
- Sleep**
- Countermeasure protocols for fatigue management for Mars (Lunar-applicable interim deliverables)
  - Fatigue monitoring for Mars (Lunar-applicable interim deliverables)
  - Lunar/Mars standards

- Medical Conditions**
- IMPACT tool (versions 1.0- 1.3)

\*Titles may vary from HRR



# HRP External Deliverables: Customers





# HRP External Deliverables: Categories

## Standards

- Agency technical requirements that enable human spaceflight missions by minimizing health risk(s), providing vehicle design parameter(s), and enabling the performance of flight and ground crew

## Requirements

- Recommendations for exploration program implementation to meet a standard or higher-level requirement.

## Countermeasures

- Specific protocols developed and validated to reduce risk likelihood and consequence.

## Tools/Technology

- Hardware, software, new processes, design tools, databases, models etc.

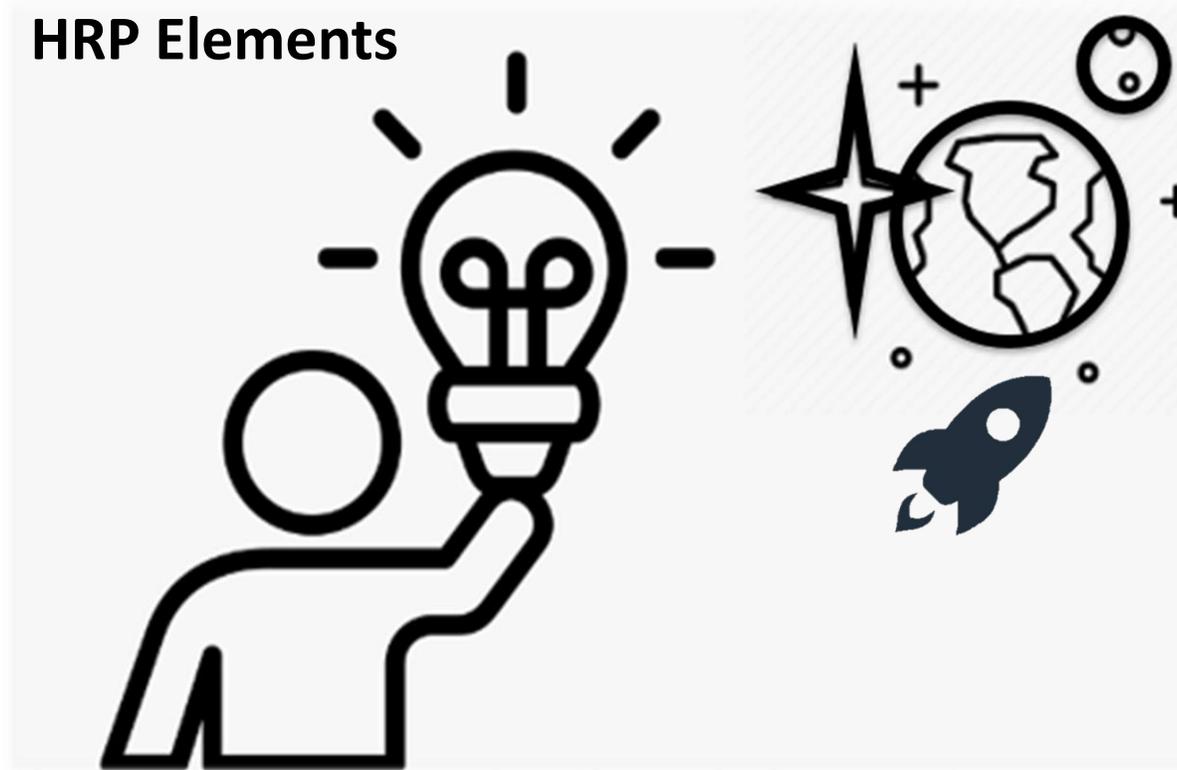
These groups describe the current set of EDs. As programs evolve, these are also expected to evolve as HRP aligns with those customer needs.



# General Strategy on External Deliverables



## HRP Elements



HRP Elements take a proactive stance in identifying knowledge and requirement gaps, and develop products in anticipation of exploration mission needs.



# Current Approach to External Deliverables

- Increase engagement with Customers



- Implement an agile approach in responding at the speed of Programs and aligning with Customer needs





# Role of HRP's Maturation and Integration Office (MIO)



- HRP's **Maturation and Integration Office (MIO)** was set up to mature and integrate HRP research results and products to vehicles and habitats (i.e. other Programs and organizations) to enable mission planning.
- One of its goals is to support and facilitate the process of delivering HRP EDs to targeted Customers in alignment according to their expectations and needs.



# HRP External Deliverables Process: Overview





# HRP External Deliverables Process: Collect ED Metadata



## Sample EDs and excerpt of metadata:

HRP Element	Deliverable Category	Deliverable	Primary Customer	Impacted Customer Product	Customer Target Platform/DRM/ Document	Lifecycle Milestone	Customer Schedule Driver	Customer Need Date
Human Health & Countermeasures (HHC)	Countermeasures	<b>Immune CMs</b> - Requirements for immune countermeasures that have been validated in ground analogs and inflight will be delivered to HMTA. Countermeasures will respond to in-flight assessments of immunity, viral reactivation, and physiological stress.	SCLT/Health & Medical Technical Authority	Medical operation/ activity/ procedure executing CMs delivered, e.g. - Medical Operations Requirements Document				
Human Factors & Behavioral Performance (HFBP)	Standards	<b>Inputs to standards for behavioral health and performance</b> - Recommended update(s) to standards to help inform crew behavioral health and performance (Volume 1), and to help design and implement human factors, habitability, and environmental design into spaceflight vehicles/missions (Volume 2)  Best available evidence will be used as an interim step for lunar DRMs, and standards and clinical guidelines will be refined for Mars DRMs.	OCHMO Standards Team  SCLT/Health & Medical Technical Authority	NASA-STD 3001 V1 and V2				
Exploration Medical Capability (ExMC)	Technology/Tool	<b>IMPACT Tool Version 1.0</b> - Trade space analysis tool suite for a medical system baselined to lunar missions (i.e., sustaining lunar/lunar Services capability and beyond)	Space and Clinical Operations Division	Exploration Medical System Tradespace ground tool				
Space Radiation (SR)	Standards	<b>Cancer recommendations for Clinical Practice Guidelines</b> - Recommendations for medical surveillance and early detection of cancer to improve quality of life and reduce consequences	OCHMO Standards Team	NASA-STD 3001 V1 4.8.2 <i>Career Space Permissible Exposure Limit for Space Flight Radiation</i>  Occupational Surveillance				



# HRP External Deliverables Process: Engage & Establish Agreement



Iterative discussions between HRP Elements and Customers finalize the terms of expectations regarding dates and format of ED delivery (including interim products) within the tracker sheet.



No additional formal documentation needs to be developed.



# HRP External Deliverables Process: Track



- MIO-EP tracks updates to HRP Element ED development based on schedule data and status reports at management reviews
- MIO-EP facilitates needed discussions between HRP Elements and Customers, and records updates to accepted terms.



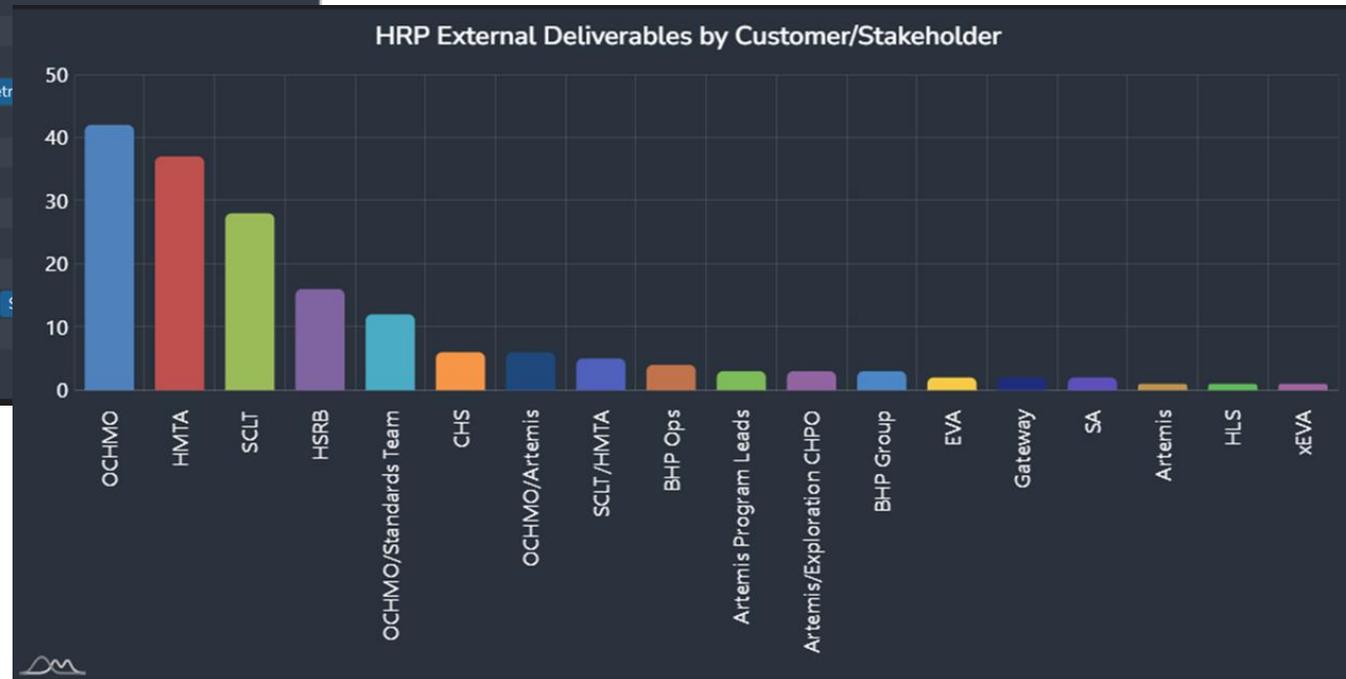
# Additional Impact of HRP External Deliverables Process



HRP is planning to use ED tracker data to generate a Gantt chart of the timeline of HRP work to expected delivery, and the distribution of EDs by Customer → will support integrated roadmaps

HSRB Risk ↓ <sup>1</sup>	Location ↑↓	Start ↑↓	Deliver ↑↓	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032
Carcinogenesis	Mars	6/1/15	10/29/24	Baseline PEL									
Carcinogenesis	Artemis	9/1/18	9/30/30	Clinical Practice Guidelines									
Cardiovascular	Artemis	4/1/22	2/13/25	Cardiovascular Responses to HLS G-levels and Countermeasures									
EVA	Artemis	10/1/28	10/1/28							EVA Human Performance Testing			
EVA	Artemis	7/26/21	9/29/28	Contingency CO2 Standards									
EVA	Artemis	10/1/24	10/1/29		EVA Dive Computer								
Food and Nutrition	Mars	10/1/26	3/26/31				Food System Requirements and Resource Trades						
Food and Nutrition	Mars	10/1/19	10/3/28	Food Storage Limit Requirements									
HSIA	Artemis	9/30/32	9/30/31										
HSIA	Artemis	12/1/33	9/30/27										
HSIA	Artemis	10/1/26	9/30/30					Operational Performance Metr					
Immune	Mars	11/13/14	10/30/26	Standards									
Medical Conditions	Artemis	4/1/23	11/15/23		IMPACT v1.1								
Medical Conditions	Artemis	5/16/24	11/15/24			IMPACT v1.3							
Medical Conditions	Artemis	10/1/19	3/31/23	IMPACT v1.0									
Medical Conditions	Artemis	11/16/23	5/15/24		IMPACT v1.2								
Microhost	Mars	10/1/19	9/30/27	Standards									
SANS	Mars	4/2/29	9/28/29										
Sensorimotor	Artemis	3/31/26	4/1/27					Countermeasure (Ground Studies)					
Team	Artemis	10/3/22	9/30/25	Validated Key Indicators									

Notional charts





# Additional Impact of HRP External Deliverables Process



The Human Research Roadmap (HRR), the public interface of HRP's Integrated Research Plan, will also capture pertinent ED tracker data

humanresearchroadmap.nasa.gov/Tasks/task.aspx?i=2597

EVIDENCE MDRP RISKS GAPS TASKS REPORTS

**EVA Fitness for Duty Standards to OCHMO** Last Published: 07/29/22 01:33:24 PM (Central)

Task Book: Entry Unavailable  
Principal Investigator: TBD

Short Title: EVA Fitness for Duty Standards to OCHMO

Responsible HRP Element: Human Health Countermeasures

Collaborating Org(s):

Funding Status: Planned-Funded - Task expected to be within budget  
Procurement Mechanism(s): Maturation

Aims:  
The maturation task will:

- (1) assess readiness to perform critical EVA tasks within 24 hours after planetary landing and egress of the capsule;
- (2) standards will be focused on preventing injury.; and
- (3) present the findings at boards to transition to appropriate operations stakeholders, as required

Resources (None Listed)

Deliverables (1)

- Category: Standard  
Subcategory:
- Deliverable Title: EVA Fitness for Duty Standards to OCHMO
- Description:  
EVA fitness for duty standards that assess readiness to perform critical EVA tasks within 24 hours after planetary landing and egress of the capsule for e (planetary landing). Permissible outcome standards will be f
- Internal Customers:  
Human Health Countermeasures
- External Customers:  
Office of Chief Health and Medical Officer (OCHMO)

Including other selected fields from the ED tracker



# Conclusions



- HRP is working towards improving its articulation and documentation of:
  - where and why it is doing its research
  - the Customer-managed products and NASA Agency gaps to which its EDs map
  - the capabilities on Artemis or Mars programs/platforms its EDs enable and provide
- Successful transfer of HRP EDs to Customers will help mitigate the health and performance risks that crewmembers will face during NASA's future exploration missions.

