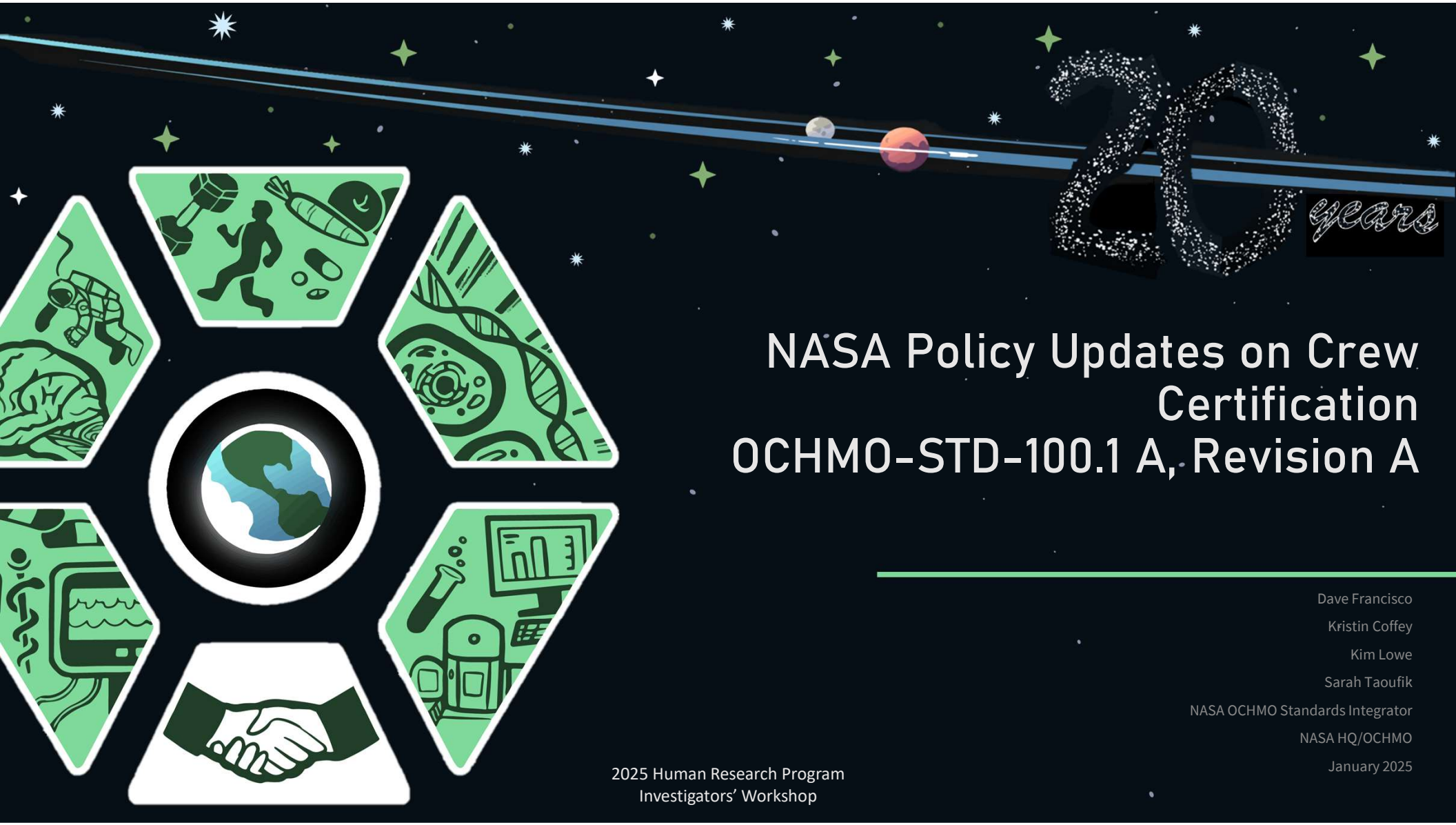

NASA Policy Updates on Crew Certification OCHMO-STD-100.1 A, Revision A

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January 2025

2025 Human Research Program
Investigators' Workshop

Objectives

- Provide information regarding the NASA Medical Selection, Recertification, and Mission Medical Evaluation Standards OCHMO-STD 100.1A
- Provide information regarding OCHMO NASA STD team body of work including NASA-STD-3001 Volumes 1 & 2, technical briefs, external reviews and their genesis

NASA OCHMO Standard Integration Team

- JD Polk — NASA Chief Health and Medical Officer
  - Dave Francisco — NASA Technical Fellow
    - Yamil Garcia — KBR HHPC Task Order Manager
      - Sarah Taoufik — Human System Standard Integrator & Team co- Lead
      - Kim Lowe — Human System Standard Integrator & Team co-Lead
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      - Laura Bostick — Human System Standard Integrator
      - Doug Ebert — Human System Standard Integrator
      - Joanne Kaouk — Human System Standard Integrator
      - Liz Warren — Human System Standard Integrator

Purpose of OCHMO Standards

Establish	Establish Agency-level standards (technical, medical requirements) that enable human spaceflight missions
Minimize	Minimize health risks, provide vehicle design parameters, and enable the performance of flight and ground crew
Enable	Via partnerships with programs and industry, enable the successful implementation of NASA programs and commercialization of human spaceflight
Update and disseminate	Routinely update and disseminate materials to the public OCHMO Standards website as a source of information. (required to be reviewed for updates every 5 years).

OCHMO Standards are used to generate Program Specific Requirements. The requirements may be tailored with NASA Chief Health and Medical Officer approval.

• NASA OCHMO Standards Development Process

- What risk(s) are being addressed/mitigated?
- Research data (Human Research Program (HRP), literature, collaboration studies, analogs, etc.)
- Terrestrial data/standards (OSHA, FDA, IEEE, ISO, ASTM, etc.)
- Industry research and insight: how can we improve our Standards and documentation to provide companies with the knowledge needed to build human-rated spaceflight vehicles and environments?
- Rationale may contain possible implementation guidance on how a medical professional, engineer, or designer would utilize the Standards
  - Guidance on when to use the standard, what calculations are required and any caveats
  - What considerations are required to successfully implement the Standards?

Sample 100.1 New VTE requirement

6.3.2 Screening for Deep Vein Thrombosis and Venous Flow Anomalies

[6041] Requirement: Every crewmember **shall** be screened for deep vein thrombosis (DVT) and flow anomalies of the internal jugular veins.

Rationale:

- *Primary DVT of the left internal jugular vein has been observed at elevated rates in microgravity. Flow anomalies are observed in a significant subset of crewmembers examined for both research and surveillance purposes, and likely represent a risk for DVT development.*
- *DVT is associated with significant mission impact and poses an acute risk to crewmember health.*
- *Early diagnosis of abnormality will help identify crewmembers at risk for DVT formation and may allow the provisioning of early treatment before DVT becomes symptomatic or results in a life- or mission- threatening complication such as pulmonary embolism.*

Description: Using an ultrasound device, duplex ultrasound of the bilateral extracranial internal jugular veins, with breathing and compression maneuvers, is performed with teleguidance and/or autonomously with just-in-time training. An onboard ultrasound device will be used for in-flight DVT and venous flow anomaly screening.
***Example Schedule based on 180-day ISS mission**: L-12/3 m, L+30 days; L+60 days; R-42 days, R+0/45d, ACI.*
Table 7, Table 8

NASA Medical Selection, Recertification, and Mission Medical Evaluation Standards OCHMO-STD-100.1A, Revision A - NASA Human Spaceflight Standards

- **NASA Astronaut Selection and Recertification**
- **Mission specific medical evaluation requirements for NASA Astronauts assigned to missions**
- **Medical Evaluations for Private Astronauts (Private astronauts are defined as a crew member who is not a NASA career (US government) astronaut or international partner astronaut).**
- **Medical Evaluations for NASA Suborbital Research Specialists (Suborbital Research Specialist is an individual employed by NASA or funded by NASA to conduct research, testing, training, or other activities on a sub-orbital vehicle excluding commercially employed crew.)**
- **Disqualifying Criteria Appendix**

National Aeronautics and Space Administration

[OCHMO-STD-100.1A]
Revision A
Release Date: 09/09/2024

OFFICE OF THE CHIEF HEALTH AND MEDICAL OFFICER

NASA SPACE FLIGHT MEDICAL SELECTION, RECERTIFICATION AND MISSION EVALUATION STANDARDS

NASA Human Spaceflight Standards Selection and Recertification Laboratory Tests (Sample)

- Laboratory Tests on Selection, NASA Astronaut Candidate (ASCAN) First Annual Exam, and Annual Recertification.

Laboratory Tests on Selection of NASA Astronauts

Biochemistry

- Liver function - Aspartate aminotransferase (AST), alanine aminotransferase (ALT), gamma-glutamyl transferase (GGT), bilirubin, alkaline phosphatase (ALP), lactate dehydrogenase (LDH)
- Total serum protein,
- Renal function - Ure Cl [chloride], K [pot
- Endocrine - Thyroid T4 (thyroxine), anti-
- Fasting blood gluco:
- Cardiovascular prof

NASA Astronaut Candidate (ASCAN) First Annual Exam

ABO Group & Rh Type
Cytomegalovirus IgG Antibody
Epstein-Barr Virus IgG Antibody to Nuclear Antigen

Venous Thromboembolism Panel:

- Cardiolipin IgG Antibody
- B2 glycoprotein 1 IgM/IgG Antibody
- Activated Protein C (APC) Resistance
- Prothrombin Nucleotide 20210 G/A Gene Mutation (Factor II)
- Protein C
- Protein S
- Anti-Thrombin
- Anti-phospholipid antibodies
- Factor V Leiden

Laboratory Tests on Annual Recertification of NASA Astronauts

Hematology

- Complete Blood Count – To include hemoglobin, hematocrit, red blood cell count, red blood cell indices, white blood cell count, differential count, platelet count
- Reticulocyte count

NASA Human Spaceflight Standards Selection and Recertification Special Assessments (Sample)

– Specialist Assessments for Selection and Annual Recertification of NASA

Ophthalmology Specialist Assessment (Optometrist)	Selection	Annual
Visual acuity (Snellen or Landolt-C)		
• Near vision	✓	✓
• Distance vision		
Color vision (computer-ba or equivalent pseudo-isocl [PIPs] to include red-gree		

Cardiopulmonary	Selection	Annual
Resting 12-lead electrocardiogram (ECG)	✓	✓
Direct or indirect measurement of cardiorespiratory fitness (CRF) in ml/kg/min or METS) on maximum exercise stress test	✓	✓
Echocardiogram, Doppler, and color flow study	✓	
• Within the last 5 years		✓
24-Hour ECG monitoring	✓	
Pulmonary function testing	✓	
Cardiovascular Risk Prediction (AstroCHARM)	✓	✓
Coronary calcium scoring (>50 yrs old)	✓	
Within the last 5 years		✓

Specialist Assessments include:

Ophthalmology	Behavioral Health
Otolaryngology	Gynecological
Dental	Radiological
Cardiopulmonary	Radiation
Gastroenterology	
Musculoskeletal	
Neurology	

Mission Medical Evaluations for Short Duration (<30d) Missions

Schedule/need provided for informational purposes only. Based on 30-day ISS mission.

Clinical Assessment and Monitoring	Med Eval Requirement	Annual ***	PRE-FLIGHT (L-)	IN-FLIGHT	POST-FLIGHT (R+)
Neurological Assessment	[6004]		AME L-12/6 m		R+0 d and R+3/7 d ACI
Neurovestibular Platform Test	[6005]	Table 2	AME L-9/6 m, L-90/30 d		R+7/10 d
Resting ECG	[6006]	Table 6	AME L-12/6 m		ACI
24-hour Ambulatory ECG			On Record		
Hearing Assessment	[6007]	Table 6	AME L-12/6 m	ACI	R+3 d, If abnormal, R+10/14 d, R+60 d
Hearing Protection	[6008]		L-18/12 m		
Dental Examination	[6009]	Table 6	AME L-12/6 m		
Dental Orthopantomogram or Full Mouth X-Ray Series	[6010]	Table 6	AME L-12/6 m		

m= months d= days y= year L= launch R= return AME – Annual Medical Evaluation ***Annual Tests - Table 3 Overv
Evaluation Procedures for NASA, Table 4 Overview of Medical Evaluation Procedures for NASA Astronauts to be applied annually,
Laboratory Tests on Annual Recertification, and Table 7 Special Assessments for Recertification

6.1.5 Neurovestibular Platform Test

[6005] Requirement: Crewmembers **shall** undergo an objective assessment of neuro-vestibular function before and after flight.

Rationale: *To perform functional assessments regarding neuro-vestibular re-adaptation to Earth gravity following prolonged weightlessness. Results will be used to establish a more precise return-to-normal daily activities (stairs, driving a car, showering, etc.) criteria and return-to-duty criteria.*

Post-flight Med evaluation

In-flight Medical evaluation

Mission Medical Evaluations for Long Duration (>30d) Missions

Schedule/need provided for informational purposes only. Based on 180-day ISS mission.

Clinical Assessment and Monitoring	Med Eval Requirement	Annual ***	PRE-FLIGHT (Including Annual)	IN-FLIGHT	POST-FLIGHT
Neurological Assessment	[6004]	Table 2	AME L-9/6 m		R+0 d, R+3 d, R+7/14 d
Neurovestibular Platform Test	[6005]		AME L-9/6 m, L-90/30 d		R+7/10 d
Resting ECG	[6006]	Table 6	AME L-9/6 m to L-10 d		R+0/3 d
24-hour Ambulatory ECG			L-365/330 d		R+0, R+10/14 d
Hearing Assessment	[6007]	Table 6	L-90/30 d	On or before FD21, then every 3 months regardless of mission length	R+3 d, If abnormal, R+10/14 d, R+60 d

m= months d= days y= year L= launch R= return AME – Annual Medical Evaluation ***Annual Tests - Table 3 Overview of Medical Evaluation Procedures for NASA, Table 4 Overview of Medical Evaluation Procedures for NASA Astronauts to be applied annually, Table 5 Laboratory Tests on Annual Recertification, and Table 7 Special Assessments for Recertification

Laboratory Tests and Specialist Assessment for Private astronauts with No Critical Duties on Missions <30 days

Hematology/Thrombophilia Screen	First Flight	Subsequent Flights
Complete Blood Count – To include hemoglobin, hematocrit, red blood cell count, red blood cell indices, white blood cell count, differential count, platelet count	1 year	1 year
Screening tests for thrombophilia: Prothrombin time (PT), Activa (aPPT)		
Biochemistry		

Ophthalmology Specialist Assessment (Optometrist)	First Flight	Subsequent Flights
Uncorrected and corrected near and distance visual acuity (Snellen or Landolt-C)	1 year	1 year
Color vision (computer-based test, Ishihara, or equivalent pseudo-isochromatic plates [PIP's] to include red-green and blue-yellow)	1 year	1 year
fraction	1 year	1 year
	1 year	1 year
	1 year	1 year
exam	1 year	1 year

Axiom private astronaut crew

Medical Evaluation Procedures for NASA Suborbital Research Specialists

NSRS Shall have the medical screening including procedures listed below completed and forwarded to the AMB prior to flight

- FAA Class III Exam or equivalent
- Plus: EKG, Standard Blood (CBC,BMP) & Urine Analysis
- Valid for 1 year

NASA Astronaut Disqualifying Standards

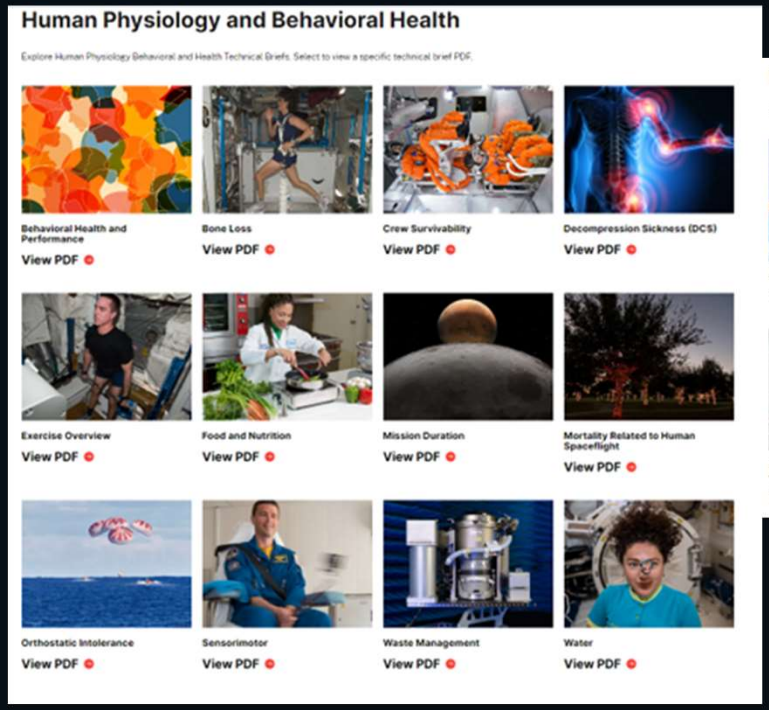
APPENDIX A. DISQUALIFYING MEDICAL STANDARDS

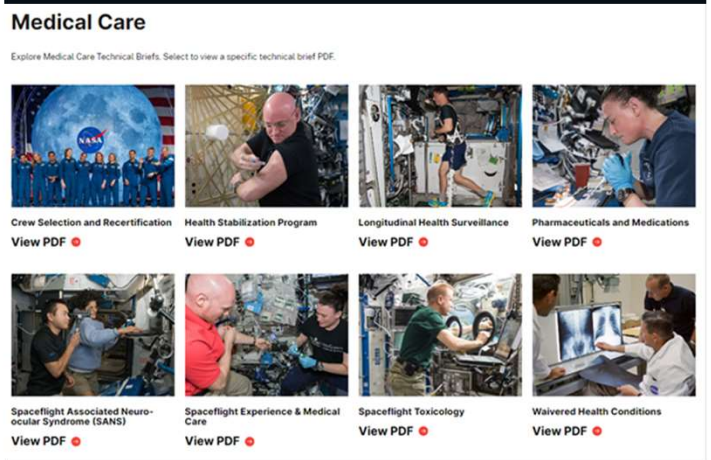
A. GENERAL
1. Any medical condition that, in the judgment of the AMB, may compromise mission operations, performance of duties, or crew health or safety.
2. All injuries, contusions, fractures, or surgery unless healed and not associated with functional deficit that could interfere with the performance of duties.
3. History of heat stroke, temperature intolerance, or environmental injuries associated with significant sequelae that could interfere with performance of duties.
4. History of sensitivity or demonstrated allergy of sufficient severity so as to interfere with the perform
5. Habitual
6. Chronic

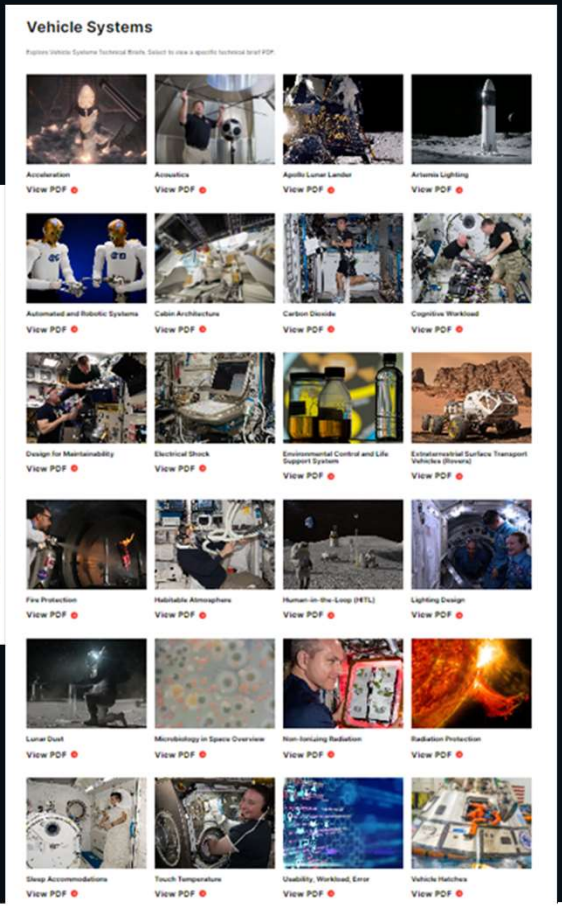
G. CARDIOVASCULAR
1. Any condition of the cardiovascular system that interferes with the performance of duties.
2. Cardiomyopathy such as hypertrophic or right ventricular cardiomyopathy (other than physiologic heart changes). History of acquired cardiomyopathy if recovered and left ventricular ejection fraction is <50% requires specialist evaluation.
3. Hypertension, as defined by sustained systolic blood pressure of 140 mmHg or greater or diastolic of 90 mmHg or greater.
4. Recurrent syncope or symptomatic orthostatic intolerance (e.g., medication-induced, autonomic dysfunction, or other causes not otherwise specified), excepting post-spaceflight orthostasis. Recurrent neurally mediated syncope with clear precipitating factors requires specialist evaluation.

Disqualifying condition categories	
General	Genitourinary
Head, Face	Musculoskeletal
Nose, Sinuses	Skin Disorders
Ears	Neurological
Eyes	Psychiatric disorders
Lungs and Chest Wall	Obstetrics/Gynecology
Cardiovascular	Dental
Hematology	Infectious Disease
Abdomen	Radiation
Endocrine	Anthropometry Criteria

OCHMO-STD-100.1 Revision A, related Technical Briefs







Waivered Health Conditions Technical Brief

Executive Summary

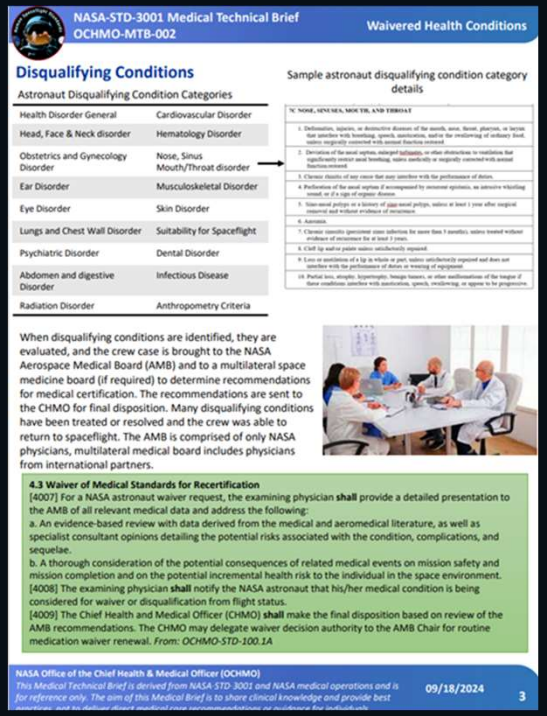
NASA astronaut applicants undergo a thorough medical examination and screening process prior to being selected as astronauts. During the initial selection process, applicants are screened for a list of disqualifying health conditions per OCHMO-STD-100.1A and are eliminated from the selection process with no possible waivers considered. Astronauts, once selected, complete a yearly recertification exam ensuring maintenance of health and fitness required for spaceflight. At this point, if they develop health conditions before/during/or after flight that were non-waivable during selection, they are assessed and may be waivable if the condition(s) is treated/resolved, and the medical team determines that the crewmember is fit for duty and can safely return to flight eligibility status. This medical technical brief discusses the selection/recertification process and outlines the procedure along with examples for waiving a medical condition on recertification.

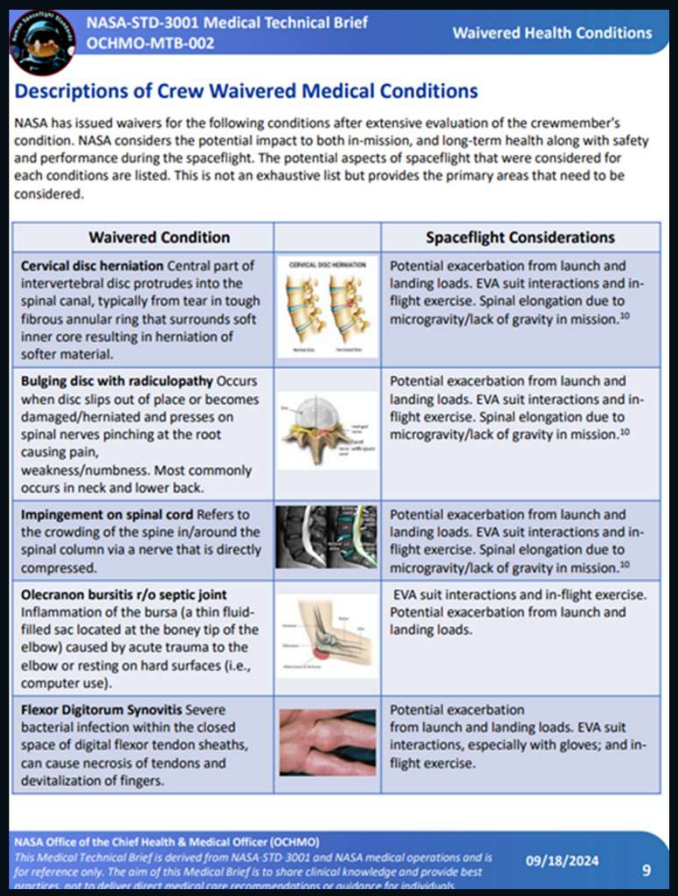
Relevant Technical Requirements

NASA-STD-3001 Volume 1, Rev C
[V1 3001] Selection and Recertification
[V1 3018] Post-Mission Long-Term Monitoring

OCHMO-STD-100.1A, *NASA Spaceflight Medical Selection, Recertification and Mission Evaluation Standards*

Hip fracture is an example of a condition that has been waivered in active astronauts. Once the crewmember recovered from the injury; the medical team determined they could safely return to flight.





OCHMO-STD-100.1 A, Revision A Future Direction

Today
Mission medical evaluation exams for short duration (<30 days) and long-duration (>30 days) missions
The current astronaut medical evaluation criteria is based on decades of research and experience with Apollo, low-earth orbit mission operations with a robust medical system and real-time ground support.

Standard allows for future updates to address missions beyond the Lunar Surface

Future:
Mission medical evaluation for long duration Lunar and Mars
Future missions to the Moon, Mars, and beyond will require discussions on risk-trade analysis of medically selecting and evaluating astronauts for these more complex missions

- Genetic Screening
  - Tailored Countermeasures
- Additional Screening tests
- Prophylactic surgeries – appendix, gall blader

Note : These medical evaluation are the basis for short duration ARTEMIS missions.

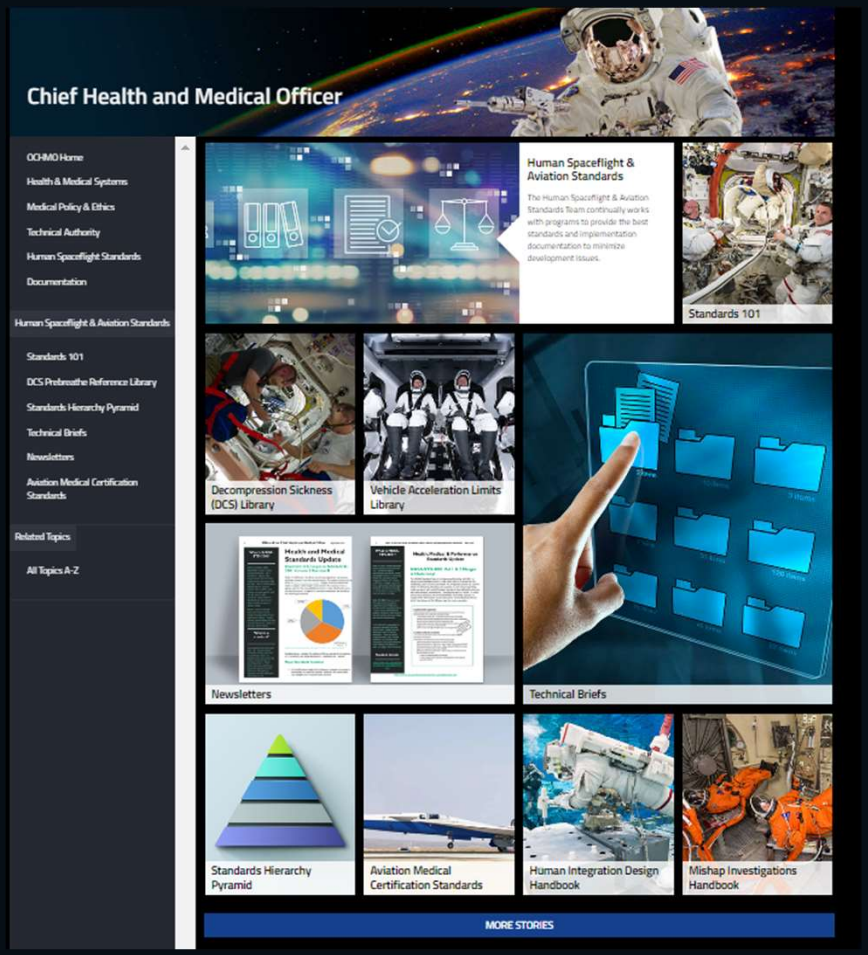
Public Website – Accessible by vendors

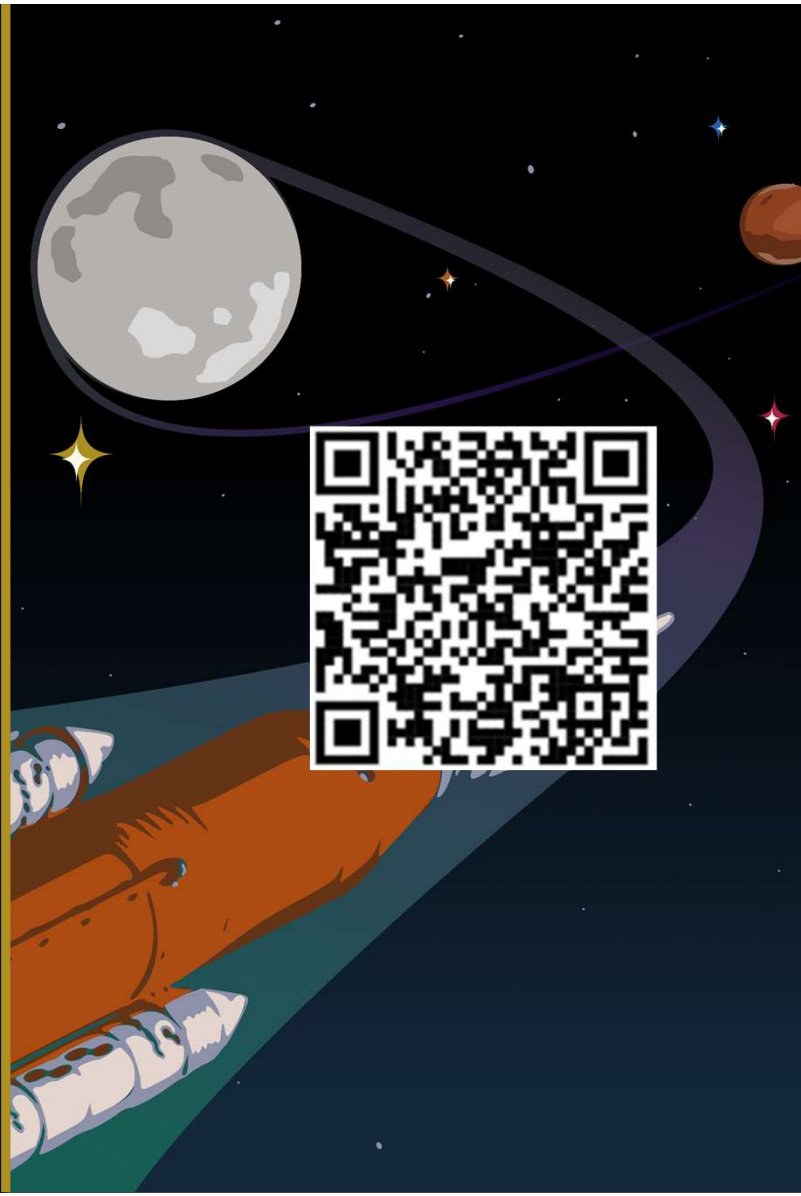
Resources Include:

- Access to standards & handbooks
- Reference Libraries
- Standards Hierarchy
- Technical Briefs
- Newsletters

Resources to understand and implement Human Spaceflight Standards are provided on a public facing website
Search NASA & OCHMO
Link Below

https://www.nasa.gov/offices/ochmo/human_spaceflight/index.html





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Questions??