NASA-STD-3001 Technical Brief

Medical Operations Spaceflight Considerations

OCHMO-TB-044

Executive Summary

Maintaining human health and performance during spaceflight missions is essential to achieving mission success. Having the appropriate medical operations plans and support in place pre, in-, and post-flight is key. The NASA Medical Operations Requirements Document (MORD) establishes requirements in accordance with NASA Policy Directives (NPDs), Code of Federal Regulations (CFR), program charters, IP Program Directives (PD) and Memoranda of Understanding (MOU). The requirements guide development of medical selection and certification standards, countermeasures, medical monitoring, response capability for medical events, support of crew behavioral health, environmental monitoring, emergency medical services, training and certification of crew flight surgeons and other medical personnel. This technical brief provides information regarding the many factors to consider when establishing the medical operations of a given program, lists the different personnel who support medical operations and human health and performance, and describes the types of documents used in historical and current programs.

Relevant Technical Requirements

NASA-STD-3001 Volume 1, Rev C
This technical brief is inclusive of NASA-STD-3001 Volume 1 as a whole. The full document can be found at the following link: https://www.nasa.gov/directorates/esdmd/hhp/human-spaceflight-and-aviation-standards/

[V1 6008] Crew Health Operations and Concept Document
[V1 6009] Medical and Crew Health Technical Requirements Document

NASA-STD-3001 Volume 2, Rev E
[V2 7043] Medical Capability

Houston We Have a Podcast:
Dr. Natacha Chough, Flight Surgeon, talks about what flight surgeons do and how they work with astronauts to monitor their health during spaceflight. Dr. Chough reveals health concerns that are unique to the space environment.
Ep22: Astronaut Health | NASA

Reference Data

Medical operations encompass everything related to crew health, from medical selection into the astronaut corps through post-flight rehabilitation and everything in between. Given the number of medical operations and crew health items to consider, it is important to document the requirements as well as designated roles and responsibilities. This becomes even more important when NASA is not the sole provider.

Each program develops a specific MORD document which contains much of the same information but may vary in specificity and detail. The components of the ISS MORD are listed below. The Moon 2 Mars MORD, which represents the Artemis program, is similar in content and will also be referenced in this technical brief.

Sample Components of the Medical Operations Requirements Document (MORD)

- **Pre-flight Crew Training** Crewmember medical training and support crew training
- **Medical Kits and Operations Hardware** Contents and Responsibility
- **Health Stabilization Program (HSP)** Roles, Responsibilities, and Protocol
- **In-flight Operational Support** Establish and define roles
- **Landing Operational Support** EMS and Contingency Plans
- **Post-mission Support** Post-flight medical evaluations and crew reconditioning

Medical training for crew in ISS mock-up at JSC NASA

NASA astronaut with medicine kit

ISS astronaut ultrasound scan NASA

*** More detailed example of Artemis and ISS MORD information located in Backup slides*

Reference Data

Medical Team Roles

While developing programs with providers, it is important to establish defined roles and responsibilities, authority chain, and agreed upon definitions and practices for every aspect of the mission. The following are some areas that must be well coordinated amongst all providers. Roles and descriptions may vary slightly between program MORDs but clinical coverage is similar.

Flight Surgeon (FS)	A physician with specialized training and certification in Aerospace Medicine. Knowledge includes clinical discipline encompassing physiological and psychological challenges of spaceflight environment and understanding the unique aspects of the environment's effect on the human as well as the operational demands required to survive in space. NASA currently requires flight surgeons to complete a certified Aerospace Medical surgeon programs.
Crew Surgeon (CS) & Deputy Crew Surgeon (DCS)	Crew Surgeon and Deputy Crew Surgeon are chosen for each increment from a cadre of certified Flight Surgeons. The CS and DCS manage anything medical from pre-flight through post-landing: • Provide/manage med intervention and care • Assist in flight crew Space flight Medical Certification • Supervise hazardous training events, assess medical hazards of payload activities • Supervise biomedical assessment data collection • Manage development and implementation of in-flight countermeasures • Monitor biomedical data, countermeasures, medical tests, experiments, and contingencies • Monitor in-flight timeline and scheduling constraints • Assist in development of increment specific aeromedical flight rules • Monitor crew health during launch and landing • Act on behalf of med management with support of specialist groups providing point of contact for coordinated health and safety issues • Ensure access to specialized medical, dental, and behavioral health consultants
Biomedical Engineer (BME)	Provide tech/operational expertise to CS/DCS, knowledge of aeromedical and other pertinent flight rules, timeline inputs, data management and equipment trouble shooting procedures. Generate/distribute daily status reports, coordinate private medical/psychological family conferences. Provide focal point for reaching persons with detailed tech expertise, coordinate with appropriate partner BMEs.
Chief Medical Officer (CMO)	Receives additional medical training to manage a variety of possible in mission health scenarios. Demonstrate proficiency in all medical procedures in JSC 48522 IMG Medical checklist, conduct in-flight physicals for increment crew, onboard management of increment crew medical data and records. Coordinate with CS in all medical intervention and care activities. Program designates/trains two CMOs for each increment.
Astronaut Strength, Conditioning, and Rehabilitation Specialist (ASCR)	Group comprised of certified strength and conditioning professionals, certified/licensed athletic trainers, and physical therapists who prescribe individual crew workouts to best protect crew health including behavioral health.
Delegation of Care	The conveyance of responsibility of medical care of crewmember(s) from the Artemis Crew Surgeon to designated medical personnel to act in lieu of the Artemis Crew Surgeon during any mission phase (preflight, in-flight, or postflight) with the Artemis Crew Surgeon still maintaining medical authority.
Medical Authority	The specific authority and responsibility required to make, provide, and direct medical decisions necessary to ensure and maintain the health and well-being of personnel.

Background

Training, Certification, and Medical Evaluation

All programs follow program official training and certification; the MORD describes training and certification flow for crew and medical support personnel. This information may include:

- Assign who defines/approves standardized medical and behavioral training and certification criteria, develops and documents medical evaluation and certification requirements.
- Determines medical certification of all program crewmembers.
- Define how IP's (international partners) conduct medical screening/testing/and certification per program requirements, medical evaluations, training guidelines and certification criteria for BME/medical support.

Flight Surgeon Training and Certification

- Ensures CSs, DCSs, FSs complete training guidelines/criteria/language.

BME/Medical Support Specialist

- Define BME/medical support training guidelines and certification. BME working at host agency trained/certified to host criteria.

Flight Crew Medical Training and Certification

- Provides crew with basic operations and maintenance medical training including countermeasures, environmental, health maintenance, behavioral health, securing medical resources prior to evacuation.

Advanced CMO – Define advanced medical training required of CMO:

- Advanced Life Support (ALS)
- Ambulatory Medical Care (AMC)
- Pre-hospital and emergency
- In-flight medical hardware
- In-flight medical exams
- Medical operations checklist procedures
- In-flight medical records management
- Behavioral health and performance
- Telemedicine and remote communication

NASA astronaut medical evaluation

Hazardous Training Ensure host agencies assign training in hazardous pre- and post-flight training or testing to all personnel including IP partners**.** Host agency ensures and provides documentation that non-increment assigned astronauts, cosmonauts, and support personnel are medically fit for hazardous program testing/training.

Medical Evaluation Define how crew are medically evaluated and certified based on program medical evaluation documents (i.e., NASA OCHMO 100.1A). Medical Evaluation results are presented by designated FS. Appointed board determines med certification of crew and reports status. In-mission crew are monitored via in-flight medical exam/evaluations/conferences. Medical information is coordinated, and documents of health risk info collected to inform medical evaluation and decision making. CS informs of all pertinent medical info; IP FS informs specific agencies.

Background

Medical Evaluation

Crewmembers are medically evaluated and certified for flight based on program and internationally approved requirements for all mission phases. The MORD defines roles and responsibilities to ensure all medical evaluations are performed to best protect crewmembers, including how results are presented, who approves medical certifications, and who coordinates and performs evaluations per program schedule. Evaluation requirements may include:

Pre-flight Identify who coordinates/performs all pre-flight medical evaluations.

Ensure pre-flight research baseline data collections including informed consent.

In-flight Identify who coordinates evaluations performed per program schedule or as clinically indicated, including:

- Private Medical Conferences (PMC)
- Private Psychological Conferences (PPC)
- Periodic health status (PHS)
- Periodic fitness exam
- Pre and post EVA examinations
- Hearing assessments
- Pre-landing med evaluations
- Ensure CS informs Commander/FD if any crew condition could impact mission ops.

Post-flight

- Immediate post-flight medical evaluation per CS/DCS/FS
- Post flight medical evaluations, per CS and appropriate IP partners, including daily health status exam
- Ensure planning/implementation of post flight research collections.

Examination and conference results Establish who evaluates crew including appropriate experts. Define evaluations including assessing health/fitness/behavioral health, workload/rest changes, predict tolerance for physical challenges including EVA and reentry landing, provide basis for in-flight medical certification.

Private Medical/Psychological Conference (PMC/PPC)

- Ensure PMC scheduled per program requirements.
- Ensure private (visual and auditory) location for FS to conduct PMCs with access to voice loops.
- Establish PMC loop directives privatized without negative mission impact ability to be recorded.
- Establish more than one voice loop available to communicate with other crew during PMC or a way to break into PMC in case of emergency.

Voice Loops

- Develop com plan to ensure adequate voice loops for ground support, personnel interaction. Consider backroom support in addition to front room, flight control and support team, integration between multiple agencies with variable need to know and access levels.

Console Integration

- Identify operations run through provider mission control center, define training and certification of FS and personnel integrated into provider flight control/MCC or ensure adequate certification.
- Establish what key personnel have loop access at what schedule, describe sufficient telemetry for vehicle situation awareness and medical response.
- Access to crew procedures and all flight rules.
- Delineate authority/responsibility for aeromedical (and other relevant) flight rule violations.
- Establish NASA flight surgeon has access to electronic medical records and NASA internal websites and support applications.

Background

Medical Intervention and Care

MORD establishes information the program must provide to ensure successful medical intervention and care plan. Information may include:

- Host agencies provide capabilities, infrastructure including evacuation to DMCF during preflight training and testing.
- Program delegates primary responsibility for in-flight medical event response to missions lead MCC.
- Provide and identify medical support specialists to assist crew in providing medical intervention and care.
- Assign Access to Crewmember medical information; EMR, real-time data and performance tracking.
- Defines IP role in providing full access to crew medical information.
- Program gives top priority to communication between CS/DCS and crew in event of emergency.
- Program ensures medical equipment can be deployed for use within specified time period.
- Program ensures crew/team has access to human research and life science experiment hardware items with clinical usefulness.

Define levels of intervention and care including:

Advanced Life Support	Stabilization and Transport	Evacuation for Medical Reasons
Basic Life Support	Ambulatory Care	Death of a Crewmember
Decompression Sickness	Dental Care	
Use of program resources	In-flight Biomedical Monitoring/diagnostics	

NASA crewmember Nicole Mann in ARED training

Crewmember receiving medical training

Astronaut Jeff Williams in front of the ISS Crew Health Care System (CHeCS) rack

Medical Kits and Operations Hardware:

Historically, NASA has provided all medical kits except the provider medical supplies to be used for a higher level of medical care post-landing and the medical survival kit located onboard the vehicle (the kit for crew in the event of a contingency landing). MORD describes medical kit operation requirements including:

- Establish potential conditions: requires special knowledge of the vehicle to ensure all contingency scenarios (for example, toxin exposures) are known/recognized with appropriate provision of medical capability to respond. If NASA remains responsible, NASA personnel must train on provider vehicles (example: Hawthorne Surgeon recognition of onboard concerns for Dragon, requires deep-dive training to Dragon systems for awareness).
- Establish responsibility of medical recovery kits used by the flight surgeons at a landing site.
- Establish responsibility for the procedures, resupply, and tracking of inventory.

Background

Operational Support:

- Establish number of support personnel and type (NASA/provider physicians, nurses, EMTs, BME, others) for each phase (pre-launch, launch, in-mission, return, landing, post-landing) and location (crew quarters, launch site, Mission Control Center(s) (MCC), landing site(s), post-landing).
- Define roles of NASA and provider personnel at each phase/location. Who has responsibility over the crew and when/how does handover occur.
- Describe communication methods and hierarchy within and between groups.
- Include contingency situations including notification pathways, call trees, and how to activate contingency teams.

Definitive Medical Care Facility (DMCFs):

- Have agreements in place with DMCFs for launches and landings.
- Describe integration plans between the mission support personnel (NASA, commercial provider) and the DMCF team.
- Provide briefings on what to expect with deconditioned crewmembers as well as information about each crewmember.
- Agreed upon practices regarding what information is shared, when (i.e., nominal vs. contingency sharing of information), to whom, how it is stored, etc. This includes having clear rules in place about times where mission cabin video feeds are not shareable even within a provider's own team.

Mission Control Center Houston
Photo: NASA

NASA Flight Surgeon providing landing support in Kazakhstan
Photo: NASA

Post-flight Medical Intervention

Provide rehabilitation plan and schedule for post-flight crew rehabilitation for each increment as directed by program requirements.

Operational Support Team Training/Skillset

Define knowledge base and certifications needed for all medical roles pre-, in-, and post-flight, including console support positions in MCC as well as associated partner requirements.

Background

Medical Data Management

- Coordinate collection, documentation, distribution and management of medical data
- Integrate medical data and information from all mission phases into crew EMR and related data repositories

Extravehicular Activity (EVA)

- Development/approval of an EVA process with NASA medical operations
- EVA suit parameters
- Depress/prebreathe protocols
- Decompression sickness prevention and treatment

Crew Injury/Fatality During Spaceflight

Delineate authority for:

- Provision of medical care
- Final decision-making regarding evacuation
- Termination of medical effort
- Development of Crew mortality plan
- Establish Crew Fatality coordination between NASA directorates
- Death pronunciation
- Collection/disposition of post-mortem samples
- Remains disposition and incorporation of needed resources into vehicle design architecture (e.g., containment units, refrigeration capability)
- Onboard resources/mass/volume/power limitations

Contingency Operations

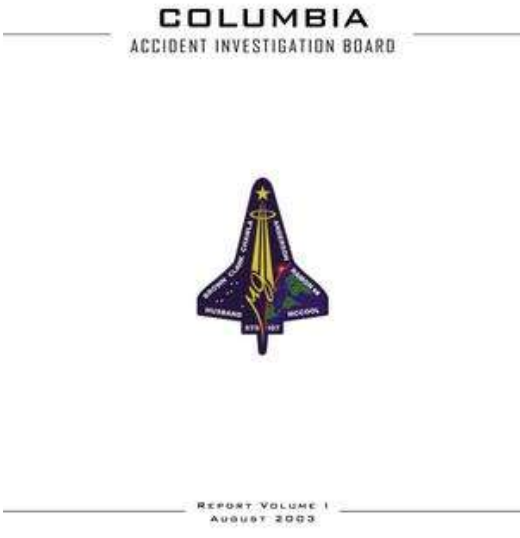
Delineate authority over:

- Mishap/contingency response
- Investigation
- Safety review
- Integration between NASA and Provider teams for resulting investigation
- Personnel support/physical and mental health services
- Access to data
- Press release
- Integration of lessons learned
- Implications for future flight/coordinated programs (i.e., investigation time, approval for return to flight, processes for a return-to-flight, etc.)

Reference OCHMO-TB-037 Decompression Sickness (DCS)

Reference OCHMO-TB-012 Mortality Related to Human Spaceflight

Reference OCHMO Mishaps Technical Briefs



Background

Crew Timeline:

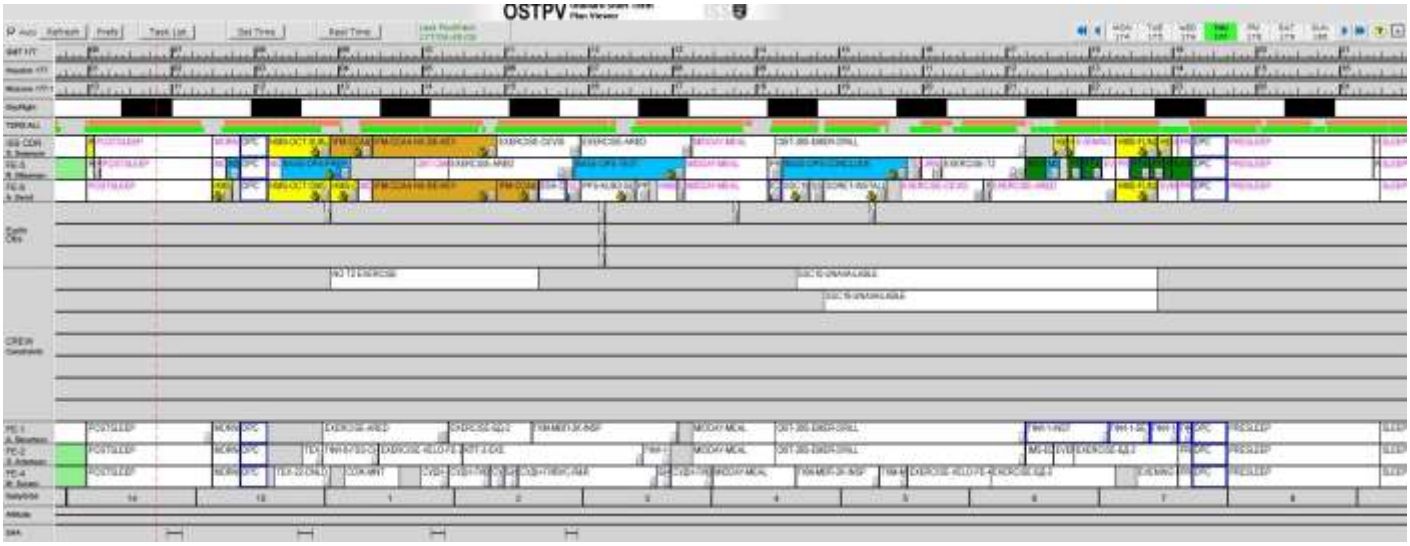
- Medical operations support personnel must have the capability to access the crew timeline and provide inputs pre-flight and in-flight. For early Commercial Crew missions, the providers did not have a formal way to provide inputs to the crew schedule while in their vehicle and this created issues.
- Crew duty day and crew time off must be established.
- Space adaptation sickness can be persistent for a number of days, and motion sickness associated with adaptation can last, on average, for 3 days.
- Multiple crew health and medical operation activities need to be accounted for in the timeline, for example:
  - PMCs/PPCs/PFCs
  - Environmental sampling (including return air sample)
  - Exercise countermeasures
  - Extravehicular Activity (EVA): Crew pre-breathe prior to an EVA; pre- and post-EVA health assessments

Sample PMC schedule

Event	Duration	Crew
Within 48hrs prior to lunar landing operations	15 minutes	All crew together[1]
After landing on Lunar surface before first pre-sleep period	15 minutes	Per crewmember
Prior to and following each EVA[2]	15 minutes	Per crewmember
Post-lunar ascent, prior to NRHO docking operations	15 minutes	All crew together[1]

Notes:
1. "All crew together" is acceptable, but not required (could be multiple subsets of the crew if preferable for scheduling reasons)
2. Pre and Post EVA PMC can be combined following the first EVA

Example of an ISS Crew Timeline



Fatigue Management:

Delineated authority/responsibility for:

- Fatigue management
- Shift scheduling
- Nominal duty day limits (launch day, landing day, free-flight day)
- Approval of duty hours and flight rule violations

See OCHMO-TB-041 Sleep Accommodations and OCHMO-TB-032 Cognitive Workload for additional information.

Reference Data

Environmental Health

The MORD provides requirements needed to ensure maintenance of an environment conducive to crew's health and well-being, and to maximize productivity in carrying out mission objectives. Environmental areas in this section include water, air, microbiology, ionizing and non-ionizing radiation, and acoustics. Content aboard the vehicle must be assessed with pre-flight testing and pre/in-flight decontamination and contingency plans provided. A MORD document environmental health information may include:

- **Water** All water aboard vehicle must be assessed and decontamination contingency plans provided.
- **Air Quality** Must be assessed and monitored using program standards of trace contaminants to be controlled. Air quality trend analyses for toxicology and life support engineers tracks contaminants within ranges to acceptable risk limits.
- Air Sampling- ensure program collects air samples pre and inflight.
- **Toxic Substances** All potentially hazardous substances must be assessed and identify potentially hazardous substances. Ensure final toxicological assessments, quantity, and location accessible to crew, MCC medical personnel, engineers.
- **Biological Materials-** ensure that all biological materials used in habitable volume undergo biosafety review prior to launch.
- **Visiting Vehicle** Ensure program monitors, prior to launch, the atmosphere of modules and cargo vehicles to be permanently or semi-permanently affixed to ISS to aggregate off-gassing.
- **Target Contaminants** Ensure monitoring for select target compounds corresponding to plausible off-nominal events (combustion, system chemical leaks, etc.).
- **Microbiology** Ensure environmental parameters in compliance with established standards including air, surfaces, payloads, and hardware. Perform micro analysis of foods, water, cabin air, and internal surfaces as required by program. Establish contingency plan in event of off-nominal findings identified as a threat to crew payloads or spacecraft systems.
- **Radiation** Establish medical support requirements for radiation exposure including dose limits, monitoring, record keeping, and management of radiation exposure ensuring ALARA objectives are met for all mission phases. Ensure exposure protection of tissues/organs. Provide guidelines for radiation monitoring through all mission phases including personal biodosimetry and exposure limit references. Ensure plan to notify crew and contingency plans for off-nominal situations.
- **Contingency** Ensure monitoring during off-nominal situations for water, air quality, toxic substances, visiting vehicle cross-contamination, target contaminants.
- **Acoustics** Ensure pre-acoustic assessment of environment and flight hardware and in-flight continuous noise level monitoring. Provide crew acoustic dosimetry and monitoring schedule including high noise level reporting and provide countermeasures/hearing protection.
- **Preflight Environmental sampling** access and assessments
- **Sharing Data** Programs must make all environmental data collected available to CS, IP , FS. Ensure assessment of biohazardous materials, including sample analysis and anomaly resolution.

Reference Data

Countermeasures

Prolonged exposure to weightlessness and conditions of prolonged confinement and isolation are associated with a range of physiological and behavioral health responses and adjustments that impact crew health, safety, and performance**.** Countermeasures are needed to address issues such as physical fitness and general crew health and well-being. Countermeasures include considerations for hygiene, privacy, nutrition, crew schedule, workload, Earth observation, and entertainment. The MORD details requirements needed to ensure countermeasure plans are established to protect crew health, information may include:

Pre-flight behavioral health, exercise, medical assessment, HSP, circadian entrainment
In-flight schedule planning, physical/physiological CM, establish available in-flight countermeasures (exercise, LBNP, loading suits, thigh cuffs, pharm, hearing protection, nutrition, behavioral health)
In-flight data collection capability to communicate and downlink results
Mission duration limits considering biomedical and behavioral health and performance factors associated with specific mission duration
Post-flight readaptation countermeasures, rehabilitation, medical assessment, behavioral health

SpaceX triage training

Emergency Medical Service

The MORD establishes specific program requirements for launch and/or landing site emergency medical intervention and care including:

- Host agency EMS
- Other partner EMS plans
- EMS communication capability
- Transportation of medical providers to landing and emergency site
- Establish guidelines for crewmember fatality
- Contingency report on overall effectiveness and issues
- Medical record keeping

Reference Data

Health Stabilization Program

A MORD identifies that programs shall implement an infectious disease prevention program for the pre-launch period of human spaceflight missions. The JSC 22538 HSP (Health Stabilization Program) document delineates the medical operations requirements for the NASA HSP. The HSP goals are accomplished through an awareness campaign and procedures such as limiting access to crewmembers, medical screening, vaccinations, and restriction of crewmember activities. The medical operations requirements baselined in this document are applicable to crewed spaceflight vehicles launched from the U.S. for NASA missions, or that involve NASA assets such as NASA astronauts, the International Space Station (ISS), or other orbital resources such as the Orion Vehicle, and Advanced Exploration Systems (AES) Programs' vehicles, including but not limited to, Gateway and Human Landing System (HLS) vehicles.

Health Stabilization Program (HSP)

PPE	Education
Identification	Medical Screening
Duration of Contact	Immunizations
Responsibility	Quarantine Period
Emerging Threats of concerns	Quarantine Measures

Expedition 65 prime and backup crew are seen in quarantine, behind glass, during a press conference.
Photo: NASA

Reference OCHMO-TB-006 Health Stabilization Program for additional information.

Individuals who must have close contact with the crew or will enter quarantine facilities during the quarantine period are identified as HSP participants. Individuals without HSP participant status are not permitted close contact with crew or access into quarantine facilities during the quarantine period unless authorized by the HSP Lead Surgeon. The type and duration of interaction dictates the specific requirements for HSP participants.

HSP Participant Status

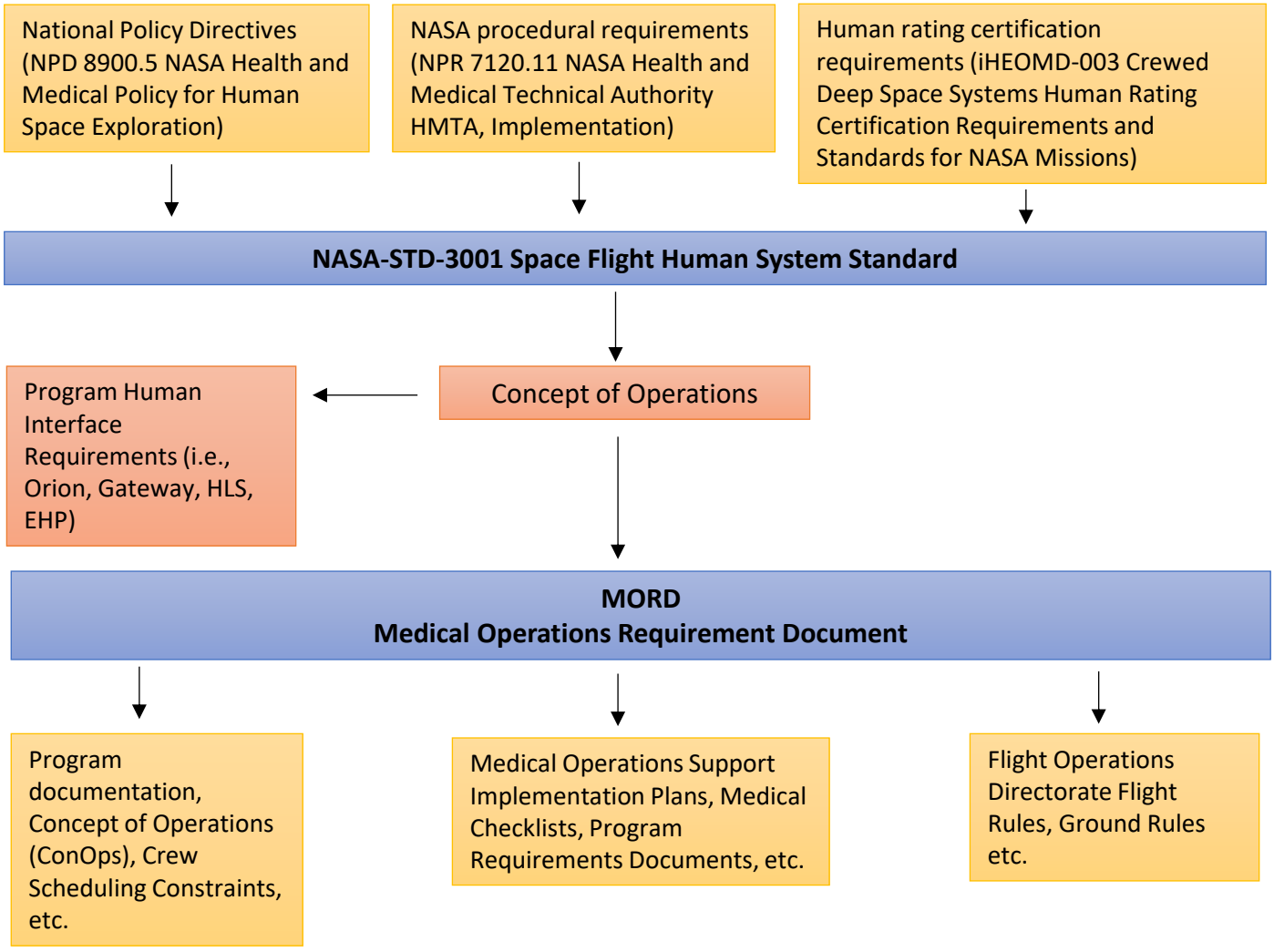
Group A - close contact
Group B - close contact with PPE
Group C - Social distance and PPE
Group D - Behind glass/social distance and PPE

* The HSP Lead Surgeon, Coordinator, CS, other medical providers, and FOD have the authority to revoke HSP participant status at any time to protect the health of crewmembers or HSP participants.

Back-Up

ISS Medical Operations Requirement Document: Example of flow

The Medical Operations Requirements Document (MORD) defines operational requirements of the flight support system and crew in accordance with NASA-STD-3001, National Aeronautics and Space Administration (NASA) Space Flight Human System Standard documents and in accordance with the responsibilities assigned by applicable NASA Policy Directives, Standards, Code of Federal Regulations, Program charters, Programs commercial partner agreements, and other related agreements between International Partners. Requirements are intended to be tailored and flowed to individual Programs, per systems engineering processes, Program operational products such as flight rules, crew scheduling constraints, mission timelines, console handbooks, and training plans. *Moon to Mars Program ACD Revision A*.



ISS Medical Operations Requirement Document

The multilateral medical management groups are established by agreements between international partners (IPs) and charters. Participation of medical representatives is reflective of the crew on an increment, but all IPs have input into activities affecting medical operation policies and procedures.

Multilateral Medical Policy Board (MMPB) Top level medical policy and oversight, coordinates the technical content of the document.

Multilateral Space Medicine Board (MSMB) Crew medical certification, approves mission assigned Flight Surgeon (FS).

Multilateral Medical Operations Panel (MMOP) Control of all technical requirements.

- Establishes processes for medical selection, training, and certification of crewmembers
- Defines and implements medical monitoring and countermeasures
- Develops and implements response capability for in-flight medical events
- Develops requirement for hardware, ground support, human behavior, performance support, monitoring environment, EMS requirements
- Develops certification guidelines for IP FS and endorse mission assigned IP FSs to MSMB for approval
- Coordinates specialty working groups on biomedical issues
- Presents findings and recommendations to MMPB and MSMB as required

Space Station Control Board (SSCB) Official delivery of the document

SMMT Safety, Reliability, Maintainability, and Quality Assurance and Risk Management.

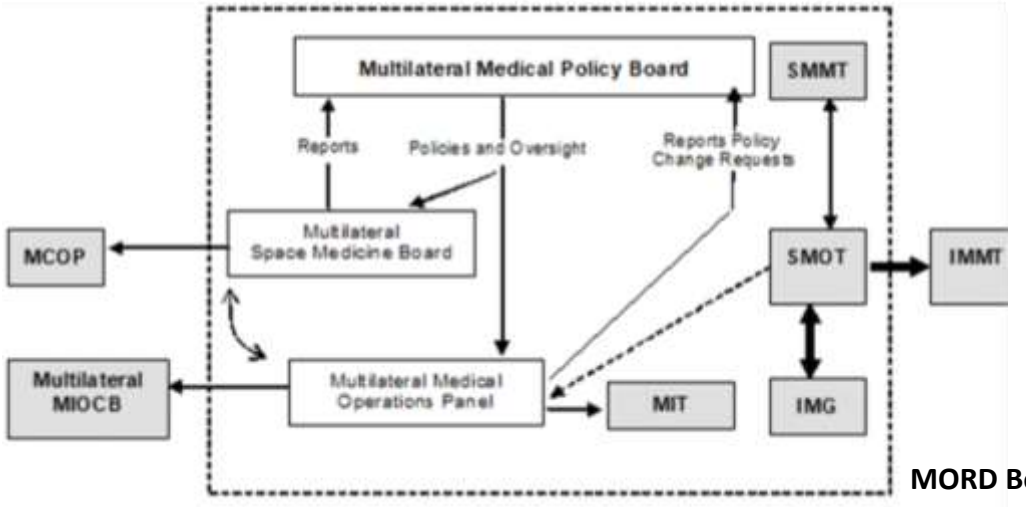
Space Medicine Operations Team (SMOT) International discussion/resolution of ops issues, concerns involving crew health, safety, wellbeing, performance, working conditions, work/rest sleep/wake cycles, external/internal environment and habitability, integrated med system hardware and ops.

International Medical Group (IMG) Cadre of international FS trained to MMOP standards and certified by MSMB, led by CS. Primary interface for med ops with flight control team.

Mission Management Team (IMMT) Representatives from IPS in management, operations, engineering. Responsible for day-to-day management, development, integration, and operation of vehicle, and ultimate op decisions including evacuation along with flight director.

Multilateral Crew Operations Panel (MCOP) Responsible for determining readiness of crew for flight based on medical condition, performance during training, and other factors.

Medical Integration Team (MIT) integrates and implements MMOP approved requirements, medical relevant protocols/procedures, training and logistics timeline inputs, and mission planning and support.



MORD Board Hierarchy

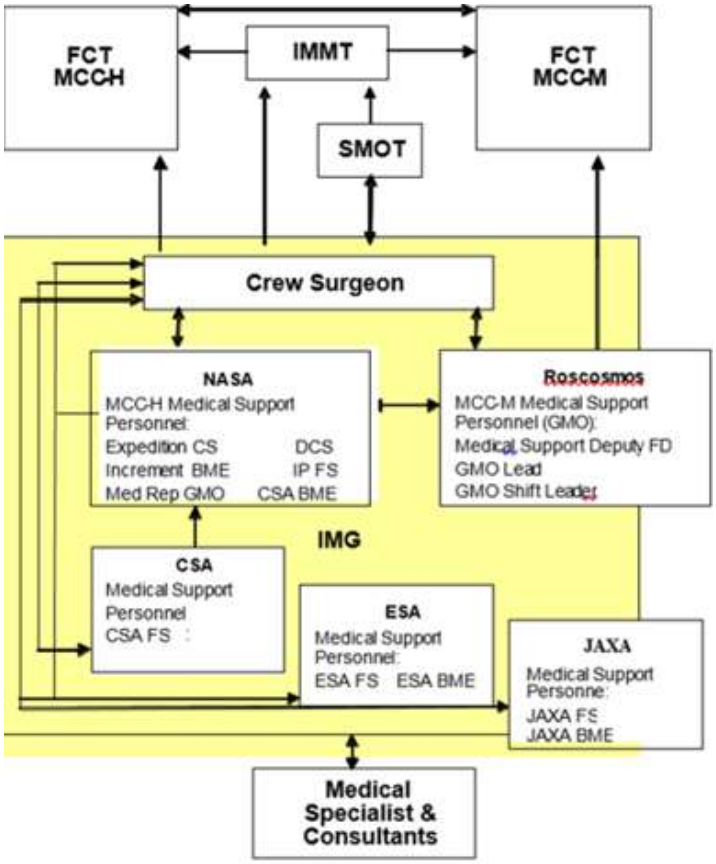
ISS Medical Operations Requirement Document

The International Medical Group (IMG) is the primary interface of program medical operations with the Flight Control Team. The Expedition Crew Surgeon (CS) leads and coordinates the activities of the IMG. IMG is formed from a cadre of International FSs trained to MMOP standards and are certified by MSMB as well as Medical Support Specialists at Mission Control Centers. Consultants, specialists in medicine, and psychology are also included as needed.

Mission Medical Authority International Medical Group

Medical authority: medical decision-making lies with the CS, acute medical contingency situations requiring real-time decisions will include IMG.

Docked operations: International vehicles' IP FS is responsible for medical authority until vehicle docks to ISS, once hatches open med authority for all crew lies with CS and IMG, IP FS becomes member of IMG and will help coordinate crew health issues with CS and DCS.



CSA - Canadian Space Agency
Roscomos - Russian Space Agency
ESA - European Space Agency
JAXA - Japanese Aerospace Exploration Agency
MCCH - Mission Control Center Houston

DCS – Deputy Crew Surgeon
FCT – Flight Control Team
BME – Biomedical Engineer

Handling of Medical Information

Provisions of Privacy Act of 1974 is strictly followed. IPs may levy supplemental requirements regarding handling of medical info for their crew.

Release of pre-, in-, and post-flight operational and research data will be managed per Privacy Act of 1974 and NASA Policy Directive (NPD) 7100.8, Protection of Human Research Subjects, NASA Procedural Requirements (NPR) 7100.1, Protection of Human Research Subjects.

IP organizations have access to crew health info and all that impacts crew health during all phases of training and mission.

Requests for health status info from outside nominal working level medical support coordinated with JSC chief, SCOD and IP representative as determined by MMOP

Reference Data

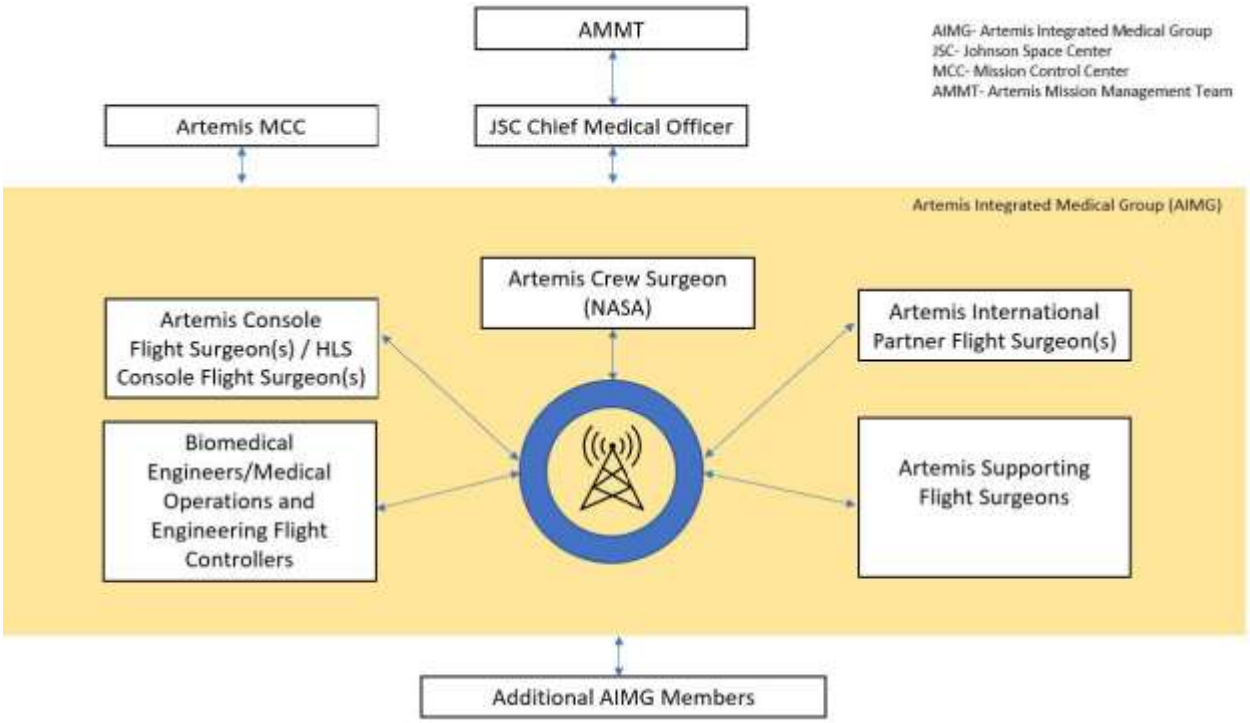
Moon2Mars MORD: Additional medical team roles

BHP Specialist Pre-flight crew and family preparation; in-flight monitoring and support; additional intervention and countermeasures as needed; and post-flight re-adaptation.

Radiation Health Officer Certified radiation health professional is provided as a Radiation Health Officer per agency crew complement to each Artemis mission to ensure crew health and safety with regards to radiation exposure during the mission.

Mission Integration Coordinator Single point of contact designated to track and schedule medical evaluations required to certify crew for flight, as well as coordinate and schedule pre- and post-flight medical testing.

Moon2Mars Medical Team Interfaces



Aerospace Medicine and Occupational Health at Kennedy Space Center

The Moon to Mars Program **shall** provide at the launch site in the Kennedy Space Center, with capability and sizing per Program Requirements Documents and Medical Operations Support Implementation Plan, the following resources:

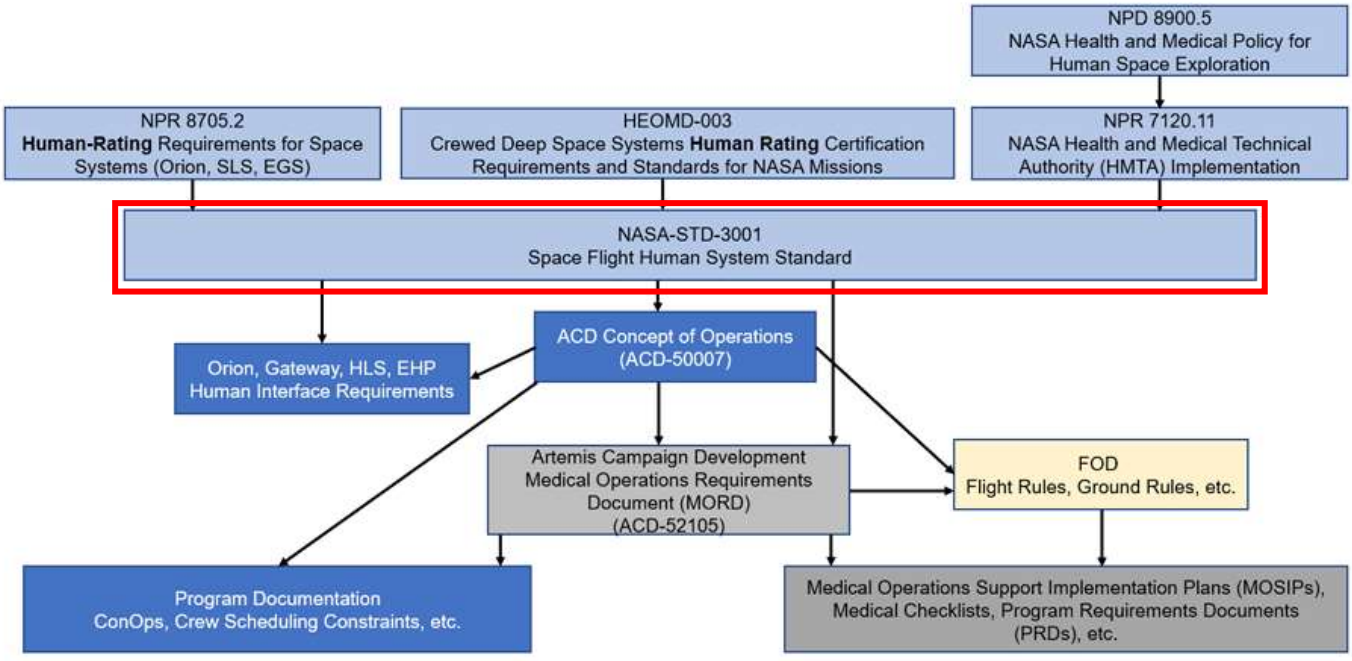
- A health stabilization program in accordance with the latest revision of JSC 22538, Flight Crew Health Stabilization Program (HSP)
- Emergency medical services dedicated to crew for hazardous operations involving crewmembers
- Occupational medicine and environmental health support

Application– Artemis MORD document

Artemis Campaign Development (ACD) Medical Operations Requirements Document (MORD)
The ACD MORD defines the medical operations requirements for all phases of ground, flight, extravehicular activity (EVA), and payload/experiment-related oversight activities. These cross-program operational requirements pertain to the development of medical monitoring; response capability for in-flight medical events; EVA medical events; support of individual and crew behavioral health and performance; countermeasures definition and implementation; environmental monitoring; Emergency Medical Services (EMS) support; establishment of a process for training and certification of crewmembers on Artemis missions, Flight Surgeons (FS), and other medical support personnel; and preflight activities such as reconditioning. operational requirements (e.g., medical intervention and care, countermeasures, environmental health, radiation health and exposure monitoring, contingency operations, procedural training), of the flight support system and crew for Artemis and subsequent missions in accordance with NASA-STD-3001, NASA Space Flight Human System Standard documents and in accordance with the responsibilities assigned by applicable NASA Policy Directives, Standards, Code of Federal Regulations, Artemis Programs charters, Artemis Programs commercial partner agreements, and Memoranda of Understanding (MOU).

Requirements in this document are intended to be tailored and flowed to individual Programs per systems engineering processes. Because these requirements are operational requirements, it is expected that they will flow to Program operational products such as flight rules, crew scheduling constraints, mission timelines, console handbooks, and training plans.

Relationship of the ACD MORD to Other Documents



Reference List

1. Artemis Campaign Development (ACD) Medical Operations Requirements Document (MORD): ACD-52105. (2022). *National Aeronautics and Space Administration*. View at: https://govtribe.com/file/government-file/atta11-acd-52105-acd-mord-dot-pdf
2. International Space Station Medical Operations Requirements Documents (ISS MORD): SSP 50260 Revision B. (2003). *National Aeronautics and Space Administration*. View at: https://docplayer.net/5556963-International-space-station-medical-operations-requirements-documents-iss-mord-international-space-station-program.html
3. David et al, A history of the NASA operational spaceflight Surgeon:1958 – Present – Acta Astronautica Jan 2023

Referenced Technical Requirements

View the current versions of NASA-STD-3001 Volume 1 & Volume 2 on the OCHMO Standards website

NASA-STD-3001 Volume 1 Revision C

This technical brief is inclusive of NASA-STD-3001 Volume 1 as a whole.

[V1 6008] Crew Health Operations and Concept Document The program(s) shall develop a crew health concept of operations document to define the medical and health care concepts during all phases of the spaceflight program.

[V1 6009] Medical and Crew Health Technical Requirements Document The program(s) shall develop a medical and crew health technical requirements document based on the concepts outlined in the program-specific crew health operations concept (CHOC) document and NASA-STD-3001.

NASA-STD-3001 Volume 2 Revision E

[V2 7043] Medical Capability A medical system shall be provided to the crew to meet the medical requirements of NASA-STD-3001, Volume 1.