Crew Time Analysis of Planned Medical Activities & Estimate of Time Required for 6 Month Increment

Nicholas Dulin, MD[1], Benjamin Easter, MD[2], Emily Stratton, DO, MPH[3]

[1]*Department of Emergency Medicine, Jefferson Einstein Healthcare Network, Philadelphia, PA,;*

[2]*Exploration Medical Capability Element, NASA Johnson Space Center, Houston, TX*

[3]*University of Texas Medical Branch and KBR*

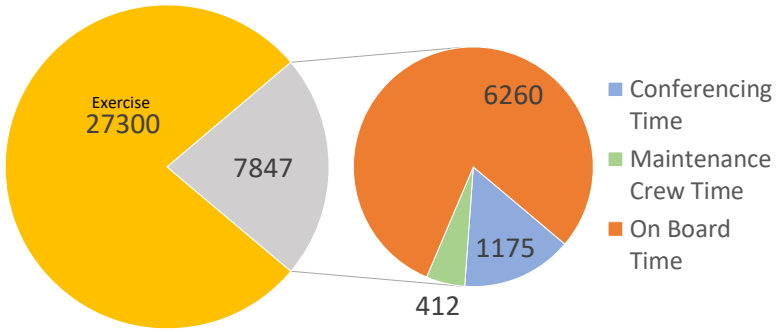
Background

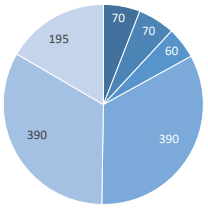
One of the challenges of planning medical care for exploration spaceflight beyond Low Earth Orbit (LEO) is knowing exactly how much time the crew spends on medical activities. As more time is required for medical care, both preventive and emergent, less time is available for other operations, research, and vital crew activities. Understanding this balance is important for planning crew time resources for future long duration exploration missions, and, ultimately, Mars.

Methods

To better estimate this time requirement, we reviewed the activities which contribute to mental and physical well being while aboard the ISS. We then categorized each activity into Exercise, Conferencing Time, Maintenance Time (time spent maintaining medical hardware and software), and On Board Time (defined as active time spent on medical interventions including preventive care). We then divided the total Medical Operations Time by the total available on duty mission time to determine the percentage of mission time devoted to keep crewmembers healthy. Sleep was not defined as medical operations time as per Annex 4 and was therefore excluded from this analysis. Diagnosis and treatment of unplanned medical events were also not considered in this review. Russian activities were also excluded from this analysis.

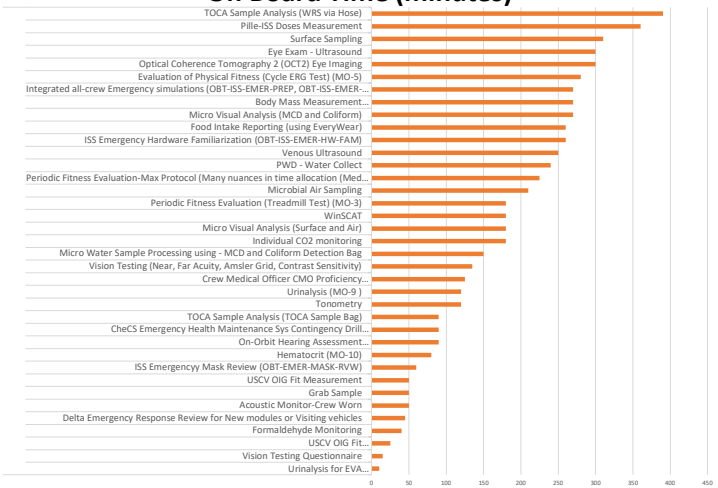
35,147 Medical Operations minutes per Increment per Crewmember = 35.2% of Total On Duty Time Utilized to Keep Crewmembers Healthy = 13.4% of Total Time on Mission Utilized to Keep Crewmembers Healthy

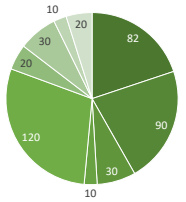




Conferencing Time (minutes)	1175
Periodic Health Status (PHS)	70
PHS EVA (Includes PHS Pre-EVA and PHS post-EVA)	70
Private Exercise Conference (PEC)	60
Private Family Conference (PFC)	390
Private Medical Conference	390
Private Psychological Conference (PPC)	195

On Board Time (minutes)





Maintenance Time (minutes)	412
Acoustic Monitor – Modified Noise Survey	82
Acoustic Monitor-Data Transfer	90
Acoustic Monitor-Static Deploy	30
HMS Stowage Consolidation	10
IMAK Medical Kit Unpack (Resupply and Crew Personal)	120
Max CEVIS Kit Consolidate	20
Pille Pre- and Post-EVA	30
Pille-ISS Flash Card Replacement	10
USCV Crew Identification	20

Discussion

Crewmember time is a high demand commodity aboard the International Space Station (ISS) and optimal delegation of this resource is a challenge for mission planning teams. An accurate assessment of time required to maximize crew readiness is required to best utilize the limited time available in orbit. This analysis was a comprehensive review of NASA ISS guidelines defining Medical Operations Time (MOT) to better estimate time required for medical operations aboard the ISS and for future LEO missions. All ISS planned medical activities should be described in these guidelines which increases the generalizability of this analysis.

Lack of unplanned medical activities (i.e. broken bones, minor injuries) limit generalizability however were outside the scope of this analysis. Future LEO missions will almost certainly require fewer (if any) extravehicular activities and resupplies compared to ISS missions which also limits the accuracy of the time estimate obtained in this analysis. Despite these limitations we believe the data gained from this analysis can be used and refined to provide increasingly accurate estimates of mission requirements for future missions to the moon and beyond.

Future Considerations

- Include and compare data from previous and upcoming ISS missions to better calibrate data
- Use upcoming Artemis mission data to better predict planned medical care for a Mars mission

Sources

International Space Station Program: Increment Definition and Requirements Document for Increment 69 Annex 2: On-Orbit Maintenance Plan and Operations Support SSP 54069 ANX 2 Baseline

International Space Station Program: Increment Definition and Requirements Document for Increment 70, Annex 4: Medical Operations and Environmental Monitoring SSP 54070-ANX4 Baseline

International Space Station Program: Generic Groundrules, Requirements, and Constraints Part 1: Strategic and Tactical Planning SSP 50261-01 Revision M

International Space Station Program: Generic On-Board Training Plan v6.2