

Fiscal Year:	FY 2020	Task Last Updated:	FY 01/08/2021
PI Name:	Yule, Steven J. Ph.D.		
Project Title:	Simulation-Based Countermeasure Development to Mitigate Team and System Vulnerabilities During Medical Event Management on Long Duration Space Missions		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline-- Element/Subdiscipline:			
Joint Agency Name:	TechPort:	No	
Human Research Program Elements:	(1) HFBP : Human Factors & Behavioral Performance (IRP Rev H)		
Human Research Program Risks:	(1) BMed : Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders (2) HSIA : Risk of Adverse Outcomes Due to Inadequate Human Systems Integration Architecture (3) Medical Conditions : Risk of Adverse Health Outcomes and Decrements in Performance Due to Medical Conditions that occur in Mission, as well as Long Term Health Outcomes Due to Mission Exposures (4) Team : Risk of Performance and Behavioral Health Decrements Due to Inadequate Cooperation, Coordination, Communication, and Psychosocial Adaptation within a Team		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Comments:			
Project Type:	GROUND	Solicitation / Funding Source:	2017 HERO 80JSC017N0001-Crew Health and Performance (FLAGSHIP1, OMNIBUS). Appendix A-Flagship1, Appendix B-Omnibus
Start Date:	03/26/2019	End Date:	03/25/2020
No. of Post Docs:	No. of PhD Degrees:		
No. of PhD Candidates:	No. of Master' Degrees:		
No. of Master's Candidates:	No. of Bachelor's Degrees:		
No. of Bachelor's Candidates:	1	Monitoring Center:	NASA JSC
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Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Lipsitz, Stuart Sc.D. (Brigham and Women's Hospital, Inc.) Pozner, Charles M.D. (Brigham and Women's Hospital, Inc.) Robertson, Jamie Ph.D. (Brigham and Women's Hospital, Inc.) Smink, Douglas M.D. (Brigham and Women's Hospital, Inc.) Thorgrimson, Joelle M.D. (Northern Ontario School of Medicine, Canada) Doyle, Thomas Ph.D. (McMaster University, Canada) Musson, David M.D., Ph.D. (Northern Ontario School of Medicine, Canada) Dias, Roger M.D., Ph.D. (Brigham and Women's Hospital, Inc.)		
Grant/Contract No.:	80NSSC19K0745		

Performance Goal No.:	
Performance Goal Text:	
Task Description:	<p>One of the risks of long duration exploration missions that needs further investigation is the potential for unanticipated medical events to affect crew health and capacity in-flight, and potentially compromise mission success. Like technical problem solving, medical emergencies require rapid diagnosis of probable cause, concurrent treatment, and containment of problems. Effective crew dynamics are essential to both. However, when there is a medical emergency one of the team members is incapacitated by the nature of the event, crew members must rapidly coordinate themselves to deal with an ill-defined event that may be outside of their primary technical expertise, and the impact of time delay means that real-time communications and data flow between crew and medical emergency specialists on Earth may not be possible.</p> <p>The central objective of our proposal is to provide guidance for the development of evidence-based countermeasures against these vulnerabilities. This is important to determine so we can add the right behavioral skills to astronaut training. We plan to implement the study and measure interactions during a medical emergency in a space analog setting that replicates some features of long-term isolation, crew autonomy, and time-delay as experienced on long duration missions. We propose to do this by studying capacity to manage medical emergencies in space using a range of methods. We will use high fidelity simulation to study how the astronaut crew performs together to resolve simulated medical emergencies in a lab setting. We will measure adherence to key processes, team behavior, mental workload, and physiological metrics to better understand the demands faced by space crew and ground personnel.</p>
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	<p>We developed and implemented four simulation scenarios for acute medical conditions that may be used for training crew (team) behavioral skills in rural and remote settings, or medical contexts with limited/ variable resources: a. Pneumothorax; b. Eye injury; c. Cardiac arrhythmia; d. Smoke inhalation.</p> <p>These scenarios include detailed and standardized running orders with triggers, patient vitals, patient cues, expected participant actions, and facilitator notes. Variants of the scenarios to include available communications with/ without mission control are included. The focus is on crew coordination and behavioral skills rather than medical or technical proficiency. The method used for scenario creation is scalable and could be used to develop scenarios for medical crew training in terrestrial settings.</p> <p>The second impact with relevance to Earth is the development of a multimodal method to integrating multiple sources of data (physiological, video, observational, survey) for measurement and support of crew performance.</p>
Task Progress:	<p>FINAL REPORTING JUNE 2020 (Ed., compiled December 2020 from final progress report)</p> <p>A total of 59 subjects were enrolled in this study, including graduate and undergraduate students from STEM (Science, Technology, Engineering, and Mathematics) disciplines, paramedics, and emergency medical technicians (EMT). A total of 16 teams were randomly assigned to one of two conditions: 08 teams with support from flight surgeon (with FS) vs 08 teams without support from flight surgeon (without FS). Each team was composed of 4 participants, from which 3 members at a time were assigned to participate in 4 consecutive simulated scenarios.</p> <p>We planned and implemented this study to measure interactions during a medical emergency in a space analog setting that replicates some features of long-term isolation, crew autonomy, and time-delay as experienced on long duration missions. By using high fidelity simulation, we were able to study how the astronaut crew performs together to resolve simulated medical emergencies in a lab setting. We gathered video recordings of 16 flight crews each managing 4 unique medical events in a spacecraft simulator. Our primary aim was to understand how teams performed with and without support from a flight surgeon at mission control center. We assessed differences in behavioral skills, technical performance, and cognitive load between groups.</p> <p>ANNUAL REPORTING JANUARY 2020</p> <ol style="list-style-type: none"> 1. Developed and designed 4 medical event simulation scenarios 2. Conducted dry run and debugged each scenario 3. Upgraded space medicine simulator to include resources consistent with International Space Station (ISS) medical checklist 4. Trained an actor to participate in the scenarios as injured crew member 5. Recruited 16 multidisciplinary teams (N = 60) to participate in the study 6. Gathered multimodal data (personality, physiological, video) for subsequent analysis.
Bibliography Type:	Description: (Last Updated: 11/09/2023)
Abstracts for Journals and Proceedings	<p>Dias RD, Robertson JM, Doyle T, Mormann B, Smink DS, Musson D, Pozner C, Yule S. "Development of a Space Simulator for Studying Team Performance and Behaviors During In-Flight Medical Emergencies." International Meeting on Simulation in Healthcare, San Diego, CA, January 18, 2020 - January 22, 2020.</p> <p>Abstracts. International Meeting on Simulation in Healthcare, San Diego, CA, January 18, 2020 - January 22, 2020. , Jan-2020</p>
Abstracts for Journals and Proceedings	<p>Dias RD, Robertson JM, Mormann B, Thorgrimson JL, Suresh R, Smink DS, Lipsitz S, Doyle T, Musson D, Pozner C, Yule S. "Investigating Autonomous Crew Performance and Behavioral Skills During In-Flight Medical Event Management." 2020 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 27-30, 2020.</p> <p>Abstracts. 2020 NASA Human Research Program Investigators' Workshop, Galveston, TX, January 27-30, 2020. , Jan-2020</p>

Abstracts for Journals and Proceedings	Mormann B, Dias RD, Yule S. "Using Deep Learning-Enabled Computer Vision to Measure Team Dynamics During Simulated Medical Emergencies in Space: A Feasibility Study." 91st Aerospace Medicine Association Meeting, Atlanta, GA, May 2020. NOTE meeting was later cancelled; abstract was accepted for eventual meeting in 2021. 91st Aerospace Medicine Association Meeting, Atlanta, GA, May 2020. NOTE meeting was later cancelled; abstract was accepted for eventual meeting in 2021. , May-2020
Abstracts for Journals and Proceedings	Dias RD, Doyle T, Robertson JM, Thorgrimson JL, Gupta A, Mormann B, Pozner C, Smink DS, Lipsitz S, Musson D, Yule S. "Development of a Web-Based Rating Platform for Measurement of Crew Behavioral Skills During Simulated Medical Emergencies in Space." 90th Aerospace Medicine Association Meeting, Las Vegas, NV, May 5-19, 2019. Aerospace Medicine and Human Performance. 2019 Mar;90(3). , Mar-2019
Articles in Peer-reviewed Journals	Yule S, Robertson JM, Mormann B, Smink DS, Lipsitz S, Abahuje E, Kennedy-Metz L, Park S, Miccile C, Pozner CN, Doyle T, Musson D, Dias RD. "Crew autonomy during simulated medical event management on long duration space exploration missions." Hum Factors. 2023 Sep;65(6):1221-34. https://doi.org/10.1177/00187208211067575 ; PMID: 35430922 ; PMCID: PMC10466940 , Sep-2023