Fiscal Year:	FY 2022	**Task Last Updated:**	FY 02/15/2022
PI Name:	Levine, Benjamin D M.D.		
Project Title:	Coronary Anatomy and Physiology During 1 Year in Space		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **Cardiovascular**:Risk of Cardiovascular Adaptations Contributing to Adverse Mission Performance and Health Outcomes		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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City:	Dallas	**State:**	TX
Zip Code:	75231-5129	**Congressional District:**	5
Comments:			
Project Type:	Flight	**Solicitation / Funding Source:**	2019 HERO 80JSC018N0001-HHCHFBP: Human Health Countermeasures, Human Factors, Behavioral Performance. Appendix D
Start Date:	04/20/2020	**End Date:**	04/19/2034
No. of Post Docs:	2	**No. of PhD Degrees:**	0
No. of PhD Candidates:	0	**No. of Master' Degrees:**	0
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	2	**Monitoring Center:**	NASA JSC
Contact Monitor:	Brocato, Becky	**Contact Phone:**	
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Flight Program:			
Flight Assignment:	NOTE: End date is now 4/19/2034 per HHC element and NSSC information (Ed., 6/21/21)		
Key Personnel Changes/Previous PI:	PI Benjamin D. Levine, MD ; CoI Michael W. Bungo, MD ; CoI Jonathan R. Lindner, MD [Note Linda Loerch is no longer CoI]		
COI Name (Institution):	Bungo, Michael M.D. (University of Texas Health Science Center at Houston) Lindner, Jonathan R. M.D. (Oregon Health & Science University)		
Grant/Contract No.:	80NSSC20K0987		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Since the majority of experienced astronauts are middle aged, they are at risk for developing serious cardiovascular events such as a myocardial infarction or sudden cardiac death, especially during high intensity exertion. Studies led to the current flight medicine practice of screening all astronaut candidates (and following all active crew members) with coronary artery calcium (CAC) scoring. However, atherosclerosis is a progressive process. The development of vascular calcification may be preceded by substantial non-calcified plaque, which may be most prone to rupture and cause an acute coronary syndrome. Radiation and inflammation may exacerbate this natural history. Coronary atherosclerosis impairs coronary endothelial function which can then both initiate and stimulate progression of atherosclerosis. Recent flight studies have suggested that non-coronary vascular beds may stiffen with reduced vascular reserve during 6-month International Space Station (ISS) missions, and ground-based studies have identified the surprising capacity for coronary atherosclerosis to evolve rapidly under extreme stress. In addition, the Principal Investigator (PI) team recently completed the Integrated CardioVascular (ICV) study that demonstrated: a) although cardiac arrhythmias did not increase in space in most astronauts, unexpectedly, left atrial (LA) size increased out of proportion to the changes in left ventricular (LV) size; and b) there was a subset of crew (1/13 or 8%) who had substantial increases in both ventricular and atrial arrhythmias. These data raise the specter of increased risk for atrial fibrillation (AF), the most common arrhythmia in the US which occurs a decade earlier in astronauts than in the general population. We speculate that the combination of spaceflight plus exercise countermeasures could magnify LA dilation and lead to AF during a 2-3 yr Mars mission. AF in astronauts is a particular concern with prolonged spaceflight because of limited access to care and the risk of impaired exercise performance, poorly controlled ventricular response, deterioration of ventricular function, and arterial emboli (including stroke).
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Learning more about the natural progression of atherosclerosis in the spaceflight environment may have "spin-off" benefits for characterizing these processes in terrestrial populations. In addition, out exploratory aim in this project is to determine if a blood biomarker panel might be predictive of alterations in the atherosclerotic process. Should this prove useful, the direct benefit to clinical care on Earth would be significant.
Task Progress:	This past year has marked the transition to full integration within the Complement of Integrated Protocols for Human Exploration Research (CIPHER) complement of experiments. Key accomplishments include: 1). Regular meetings with CIPHER team, including NASA Research Operations and Integration (ROI), NASA Johnson Space Center (JSC) Cardiovascular Lab, and the Principal Investigator (PI) teams 2). Completion of Science Verification Test for all planned experiments 3). Completed and maintained Institutional Review Board (IRB) approval for all experiments 4). Development of detailed step by step protocols for pre- and post-flight experiments to be performed in conjunction with the JSC Cardiovascular lab. These protocols focused on two major activities: a) the myocardial contrast echo (MCE) experiments, and b) the development of strategies to increase stability and adherence of the electrocardiogram (ECG) patch monitor. a). MCE experiments: i. all needed equipment and drugs were identified, purchased, and are now stored onsite at JSC; ii. after much back and forth, finalized the use of Philips Epiq 7 as the primary echocardiographic machine for all experiments; iii. accomplishment of both in-person and virtual training of David Martin, JSC sonographer with Dr. Lindner to ensure adequate skill acquisition; iv. scheduling of both "dry" and "wet" runs for practice experiments to be performed just prior to the first baseline data collection sessions (BDCs). b). Patch monitor: i. identified and customized a system called "Not Just A Patch" (NJAP) to ensure adequate skin adherence during all normal astronaut activities, both on earth and on the ground; ii. practiced application with JSC ROI team to ensure adequate training; iii. performed practice experiments and verified high quality data can be acquired and analyzed by the PI team using this approach 5). Obtained site IRB approval for all imaging experiments to be performed at Baylor College of Medicine (coronary computed tomography angiography/CTA and magnetic resonance imaging/MRI experiments) for pre- and post-flight experiments. Developed detailed timelines to ensure all experiments can be obtained within the proposed time requirements. Scheduled practice runs for the imaging experiments using non-astronaut volunteers. 6). Developed informed consent documents in conjunction with ROI team. Created video clips to be integrated by JSC team, reviewed draft version, and established a collaboration between JSC and University of Texas Southwestern Medical Center (UTSW) expert media teams to improve immune checkpoint blockage (ICB) quality and understanding.
Bibliography Type:	Description: (Last Updated: 05/20/2025)