Fiscal Year:	FY 2016	**Task Last Updated:**	FY 06/10/2016
PI Name:	de Lemos, James Andrew M.D.		
Project Title:	Improving Cardiovascular Risk Prediction		
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline--Element/Subdiscipline:	NSBRI--Cardiovascular Alterations Team		
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	(1) **ExMC**:Exploration Medical Capabilities		
Human Research Program Risks:	(1) **Cardiovascular**:Risk of Cardiovascular Adaptations Contributing to Adverse Mission Performance and Health Outcomes (2) **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		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	75390	**Congressional District:**	30
Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	2013 HERO NNJ13ZSA002N-Crew Health (FLAGSHIP & NSBRI)
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No. of PhD Candidates:	0	**No. of Master' Degrees:**	0
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No. of Bachelor's Candidates:	0	**Monitoring Center:**	NSBRI
Contact Monitor:		**Contact Phone:**	
Contact Email:			
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Levine, Benjamin M.D. (The University of Texas Southwestern Medical Center) Khera, Amit M.D. (The University of Texas Southwestern Medical Center) Hundley, William (Wake Forest University Health Sciences) Wang, Thomas M.D. (Vanderbilt University) Ballantyne, Christie M.D. (Baylor College of Medicine) Berry, Jarett M.D. (The University of Texas Southwestern Medical Center)		
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Performance Goal Text:			

Task Description:	The most likely cause of a non-traumatic life- or mission-threatening medical event in astronauts would be from acute cardiovascular disease (CVD). Current risk prediction models utilize only traditional atherosclerosis risk factors and focus narrowly on coronary heart disease events rather than global cardiovascular risk, ignoring outcomes such as heart failure or atrial fibrillation that could also be potentially mission-threatening. Numerous studies have evaluated novel risk markers in an attempt to improve CVD risk prediction, with several promising imaging and blood-based biomarkers identified. Most of these studies have investigated the incremental predictive value of a single biomarker added to a traditional risk factor model, with a few reporting combinations of biomarkers. Moreover, few studies have evaluated strategies for risk prediction that cross testing modalities. Such a multi-modality approach has the potential to markedly improve CVD risk prediction among potential and existing astronauts, and would have direct relevance to the general population. Our primary objective is to develop a consortium of biomarker and aerospace medicine leaders, with expertise in multiple different testing modalities, and with access to robust existing databases, to identify and validate novel strategies to enhance global CVD risk prediction over two time windows: 1) 10-20 years, representing the full career of the astronaut and 2) 2-5 years, representing the planning and operational phase of a manned mission to Mars. The Biomarker Consortium will provide real time advice to NASA on the design of existing screening programs, the status of new biomarkers, and the interpretation of test results. The team of collaborative investigators has pooled data from multiple existing cohort studies to develop two distinct multi-modality risk prediction tools, one based on 10-year global CVD risk and one based on 3-year CVD risk. These models will sequentially evaluate novel testing modalities on top of standard risk factors, including coronary calcium (a measure of the extent of coronary atherosclerosis), multiple blood based protein biomarkers that reflect inflammation, cardiac injury, and cardiac stress, as well as imaging-based assessments of cardiac function. Finally, we are working directly with NASA researchers in the Human Research Program to explore the feasibility of transforming the Longitudinal Study of Astronaut Health into a prospective state-of-the-art cohort study of the astronaut corps. We will utilize the expertise of the Biomarker Consortium to design a novel program for study of the effects of training and spaceflight on astronaut health. Significant progress has been made towards each of the four aims during year 2 of the grant, most notably the two scientific aims (Aims 2 and 3). With regard to Aim 1, the biomarker consortium had several teleconferences to 1) finalize a protocol for treating acute MI (myocardial infarction) in Space and 2) provide recommendations for implementing preliminary findings from this project on current astronaut screening. The primary scientific aims of the grant required pooling of data from large cohort studies. Each of these studies has a unique regulatory structure, scientific proposal system, and approval process. The goals of the first year of funding were to obtain the necessary approvals and data transfer agreements to begin the data pooling process. This was accomplished during the first year, when we obtained approval for data transfer from the Dallas Heart Study (DHS), MESA, Atherosclerosis Risk in Communities Study (ARIC), and the Framingham Heart Study. The goal for the second year of funding was to secure data transfer, construct the consolidated database, and perform harmonization of data elements. This goal was successful accomplished by the end of 2015, ahead of schedule. Thus, we have already begun in depth data analyses for Aim 2, and will soon begin analyses for Aim 3. The analyses for Aim 2 have yielded very strong preliminary data, which were presented at the 2016 Human Research Program Investigators' Workshop in Galveston, TX, and are now being prepared for publication. These findings, developed in the DHS and replicated in MESA, demonstrate that 5 screening tests (coronary calcium screening by CT, left ventricular hypertrophy by ECG, and elevated levels of NT-proBNP, hs-cTnT, and hs-CRP) markedly improve global CVD risk prediction compared with standard risk assessment strategies. We have created a simple score, consisting of the number of abnormal CVD screening tests. In both DHS and MESA a >25-fold gradient of risk for CVD is seen across the range of scores. Of particular relevance for NASA, participants with zero abnormal tests results have an extremely low risk for any CVD outcome over 10 years of follow-up. The findings replicate extremely well across the two distinct cohort studies. We are pleased that we are ahead of schedule with regard to Aim 2 and on track to begin analyses for Aim 3 soon. Aim 4 remains exploratory, designed to explore the feasibility of transforming the Longitudinal Study of Astronaut Health (LSAH) into a prospective state-of-the-art cohort study of the astronaut corps. A meeting was held in Dallas on May 19, 2015, that included Greg Hundley, MD, the director of this Aim, and LSAH leadership. This was a productive meeting, but much work remains before determining if such an ambitious study is feasible in the future.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The outcome of this research program will have widespread benefits and Earth based applications. Identifying optimal combinations of biomarkers to improve cardiovascular risk assessment is one of the holy grails of preventive cardiology, as the vast majority of CV deaths continue to occur in individuals NOT previously considered high risk. Because the absolute number of low risk individuals is so large, it is impractical to treat every person with aggressive medical therapy, not just for cost and compliance issues, but because of the possibility of side-effects of even the safest medicines. Therefore refinement of the algorithms to reclassify patients into higher risk categories is essential for optimization of medical management and reduction of morbidity and mortality from cardiovascular disease. As only one example, the Astro-CHARM being developed by Drs. Khera, Locke, and Levine is likely to be used widely in routine clinical medicine. Optimizing such scores to include modern biological assessments (biomarkers, advanced imaging, and genomics) will make such risk assessment and personalized therapy even more effective. The publications from this project will directly inform population screening for CVD, and we believe that if cost-effective strategies can be identified in the astronaut core, they would be immediately applicable in primary care practice.
	Our primary objective is to identify and validate novel strategies to enhance global cardiovascular disease (CVD) risk prediction over two time windows: 1) 10-20 years, representing the full career of the astronaut and 2) 2-5 years, representing the planning and operational phase of a manned mission to Mars. The team of collaborative investigators is pooling data from multiple existing cohort studies to develop two distinct multi-modality risk prediction tools, one based on 10-year global CVD risk and one based on 3-year CVD risk. These models will evaluate novel testing modalities on top of standard risk factors, including coronary calcium, multiple blood based protein biomarkers, as well as imaging-based assessments of cardiac function. Significant progress has been made towards each of the study aims during year 2 of the grant. With regard to Aim 1, the biomarker consortium had several teleconferences to 1) provide expert advice regarding a protocol for treating acute MI in Space and 2) provide recommendations for implementing preliminary findings from this project on current astronaut screening strategies. The primary scientific aims of the grant

Task Progress:	required pooling of data from large cohort studies. The goals of the first year of funding were to obtain the necessary approvals and data transfer agreements to being the data pooling process. This was accomplished during the first year, when we obtained approval for data transfer from the Dallas Heart Study, MESA, and ARIC, and the Framingham Heart Study. The goal for the second year of funding was to secure data transfer, construct the consolidated database, and perform harmonization of data elements. This goal was successful accomplished by the end of 2015, ahead of schedule. We have already completed preliminary data analyses for Aim 2, and will soon begin analyses for Aim 3. The analyses for Aim 2 have yielded very strong preliminary data, which were presented at the Galveston meeting and are now being prepared for publication. These findings, developed in the DHS and replicated in MESA, demonstrate that 5 screening tests markedly improve global CVD risk prediction compared with standard risk assessment strategies. The results of these analyses will be of direct relevance not only for astronaut screening but also for population screening in routine clinical practice. Overall, we are slightly ahead of schedule with regard to Aim 2 and on track to begin analyses for Aim 3 soon. Aim 4 remains exploratory, designed to explore the feasibility of transforming the Longitudinal Study of Astronaut Health into a prospective state-of-the-art cohort study of the astronaut corps. A meeting was held in Dallas on May 19, 2015, that included Greg Hundley, MD, the director of this Aim, and LSAH leadership.
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