Fiscal Year:	FY 2012	**Task Last Updated:**	FY 07/29/2011
PI Name:	Shea, Steven Ph.D.		
Project Title:	Identification of cardiometabolic vulnerabilities caused by effects of synergistic stressors that are commonly encountered during space missions		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Biomedical countermeasures		
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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PI Web Page:			
City:	Boston	**State:**	MA
Zip Code:	02115-5804	**Congressional District:**	8
Comments:	NOTE: PI currently at Oregon Health & Science University as of June 2016.		
Project Type:	GROUND	**Solicitation / Funding Source:**	2009 Crew Health NNJ09ZSA002N
Start Date:	10/01/2010	**End Date:**	09/30/2014
No. of Post Docs:	1	**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:	0	**Monitoring Center:**	NASA JSC
Contact Monitor:	Baumann, David	**Contact Phone:**	
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Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:	We added Yusef Mohamed to the study staff (role: Research Assisant). We removed Jenny Marks from the study staff (role: Research Assistant). We added Melanie Rueger, Ph.D. as a Co-I.		
COI Name (Institution):	Barger, Laura (Brigham And Women's Hospital, Inc.) Lockley, Steven (Brigham And Women's Hospital, Inc.) Scheer, Frank Ph.D. (Brigham And Women's Hospital, Inc.) Wang, Wei (Brigham And Women's Hospital, Inc.) Rueger, Melanie (Brigham and Women's Hospital, Inc.)		
Grant/Contract No.:	NNX10AR10G		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	The risk of adverse cardiac events has been listed as Priority 1 in the NASA Bioastronautics Roadmap (Risk Areas 5 and 6; 2005; http://bioastroroadmap.nasa.gov). Under extremely physiologically challenging circumstances, i.e. microgravity, astronauts are expected to perform tasks that add additional physical and mental stress to their cardiovascular system such as space walks or robotic operations during EVAs. To date we know little to nothing about the synergetic effects of chronic sleep restriction, circadian misalignment, and physical and mental stressors on cardiovascular functioning. The main goals of this four year NASA project are (1) to characterize the alterations (and potential maladaptations) of cardiovascular function (i.e. hemodynamic, autonomous nervous functioning, cardiac vulnerability) associated with chronic sleep restriction and circadian misalignment potentially occurring during space missions; (2) to characterize the effects of different types of stressors (postural, exercise, and mental stressors; except microgravity) on cardiovascular functioning; and (3) to identify the synergetic effects of chronic sleep restriction, circadian misalignment, and different stressors, potentially identifying in vulnerable periods with an increased likelihood of adverse cardiac events during space missions. During space missions astronauts are exposed to unusual light-dark cycles (e.g. Martian day length: 24.65 hrs) that would be expected to cause circadian misalignment resulting in sleep disturbances, sleep loss, and poor quality sleep. In addition, almost all astronauts report chronic sleep curtailment due to mission requirements such as working 'slam shifts' before EVAs and extended shifts during EVAs. The sleeping conditions on the ISS, e.g. cramped crew quarters, noise, and heat, also add to the reported sleep curtailment. Data from laboratory and epidemiological studies have shown that chronic sleep curtailment and circadian misalignment changes endocrine, inflammatory, and cardiovascular function; changes that potentially result in adverse health events, including cardiac arrhythmias, myocardial and peripheral vascular dysfunction, risk of syncope, hypertension, diabetes, and metabolic syndrome. Moreover, adverse cardiac events show a clear day-night pattern, with a peak in the morning. In addition, it is well know than microgravity itself impacts cardiovascular functioning resulting in decreased circulating blood volume, decreased central venous blood pressure, increased stroke volume and increased cardiac output, potentially leading to cardiac rhythm disturbances that have been documented during spaceflight previously. With the anticipated return of humans to the moon in 2020 and the preparation for human explorations of Mars and other destinations in the solar system it becomes imperative to determine the cardiovascular risks for crew members on these missions, and develop countermeasures to limit or alleviate those risks.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	The risk of adverse cardiac events has been listed as Priority 1 in the NASA Bioastronautics Roadmap (Risk Areas 5 and 6; 2005; http://bioastroroadmap.nasa.gov). Several factors impact cardiovascular functioning in space, microgravity, sleep loss, physical and mental stress amongst them. The project will identify the independent contributions of sleep loss, circadian misalignment, and varied stressors on cardiovascular alterations, as well as their synergetic effects, thereby simulating many of the physiological stresses that occur throughout long missions. Characterizing these effects on hemodynamic and autonomic function may help us to develop appropriate countermeasures to limit and/or alleviate adverse cardiovascular function during long and short duration space missions. Identifying vulnerable periods in which sleep deprivation, circadian misalignment, and different stressors lead to vulnerabilities of the cardiovascular system will also be beneficial to improving work schedules and life-style interventions for shift workers as circadian misalignment and sleep deprivation are hallmarks of shift work.
Task Progress:	To date there are no group results to report. After obtaining IRB approval in August 2011 we have trained our staff intensively on the procedures and techniques we are employing to collect the cardiovascular measures, i.e. the 60 and 80 degrees tilt tables test, 12-lead Holter Monitor, 3-led ECG, Portapress. Intensive training will ensure that these sensitive physiological measurements are carried out in a standardized fashion and with as little as possible inter-individual variability as possible. After completion of staff training, we started recruiting subjects and a total of 23 subjects so far have given their consent to start the screening process. Of those 23, 18 subjects were found ineligible based on test and/or examination results. Of the remaining five, three subjects gave informed research consent to enroll in the inpatient part of the protocol. Starting in the first quarter of 2011, we initiated inpatient studies in two of those three subjects, of which one subject withdrew from the study on day 4 of the inpatient protocol due to experiencing side effects (nausea and light-headedness) during the tilt table test. The second subject is currently completing his second inpatient stay and the third subject is scheduled to admit to the lab at the end of August 2011. There are two more subjects currently screening for the study. It is our goal to complete a total of 6 subjects by the end of this calendar year.
Bibliography Type:	Description: (Last Updated: 08/14/2018)