Fiscal Year:	FY 2012	**Task Last Updated:**	FY 04/03/2012
PI Name:	Dulchavsky, Scott A. M.D., Ph.D.		
Project Title:	Bracelet Investigation		
Division Name:	Human Research		
Program/Discipline:	NSBRI		
Program/Discipline--Element/Subdiscipline:	NSBRI--Smart Medical Systems and Technology Team		
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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Zip Code:	48202-2608	**Congressional District:**	13
Comments:			
Project Type:	Ground	**Solicitation / Funding Source:**	2007 Crew Health NNJ07ZSA002N
Start Date:	07/01/2008	**End Date:**	12/31/2011
No. of Post Docs:	0	**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:**	NSBRI
Contact Monitor:		**Contact Phone:**	
Contact Email:			
Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Sargsyan, Ashot (Wyle Laboratories) Hamilton, Douglas (Wyle Laboratories) Ebert, Douglas (Wyle Laboratories)		
Grant/Contract No.:	NCC 9-58-SMST01602		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Significant changes to the cardiovascular system occur during long duration spaceflight; a reduction in cardiac reserve could impact the ability of a crew-member to fulfill mission requirements or respond to a contingency. Cardiovascular fluid redistribution occurs during equilibration to microgravity and may be partially responsible for changes in cardiovascular performance. The Russian Bracelet-M device is currently manifested on the International Space Station (ISS) to reduce venous return to the heart and simulate a microgravity hypo-volemic state. This system may reduce cardiac preload and increase lower extremity venous pressure causing interstitial fluid shifts and changes in venous compliance. Although subjective improvement has been seen in some users, a quantitative measurement of the cardiovascular and venous effects of this device have not been extensively investigated on the ground or in space. Using the Onboard Proficiency Enhancement (OPE) program developed by the ADUM team and exploiting recent advances in ultrasound technology, the investigation of the acute effects of Bracelet device is possible. We hypothesized that the device increases fluid sequestration in the lower extremities inducing a relative hypo-volemia in the central circulation compared to what is typically observed in a microgravity environment. This proposal enhanced the collaboration of an international team of experts (Russia/USA) in conducting ground, simulated microgravity, and flight experiments to answer three specific aims: 1. Evaluate the vascular and cardiac effects of the Bracelet-M device in ground based studies using ultrasound in combination with the current system of device calibration, user training, and application. 2. Investigate the human factors, level of experience, and training necessary to perform focused vascular and echocardiography exams in a ground and microgravity environment using real-time remote guidance of inexperienced ultrasound operators. 3. Determine the physiologic effects of the Bracelet-M device on the cardiovascular system during simulated microgravity and flight experiment with recommendations for optimal use protocols with a predictable effect and an increased margin of safety. Ultrasound is a terrestrial standard of care for assessing cardiovascular function. This proposal developed just-in-time training methodologies, combined with remote guidance, to allow non-expert operators to use ultrasound to evaluate the cardiovascular system and the effects of the Bracelet device on venous loading, vascular capacitance and cardiac performance. This proposal provided essential medical information and capabilities to facilitate exploration class missions. Specifically this proposal developed and validated procedures for the expanded diagnostic use of ultrasound for cardiovascular medical conditions which may occur on the International Space Station and future exploration class missions. Two primary objectives of this proposal were to obtain baseline information regarding the use of ultrasound to monitor cardiovascular alterations which occur during microgravity exposure and to evaluate the physiologic effects of the Bracelet device. The experimental team developed a rapid training program to allow minimally trained operators to obtain high quality ultrasound images of the cardiac and vascular system, with or without maneuvers to assess the effects of the Braslet device on the vascular system. There was a significant and profound effect of Braslet occlusion on the peripheral and vascular system which caused alterations in cardiac function. This countermeasure device may have therapeutic potential for space adaptation, treatment of vascular disorders in a microgravity environment, and potentially to improve readaptation to a gravity environment.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	PROJECT IMPACT: The medical hazards which are unique to the space environment require the development of novel strategies to maintain crew member health and performance. The ultrasonic diagnostic investigations described in this proposal, which involve the peripheral arterial and venous system as well as focused echocardiography, will provide a clinically relevant increased understanding of cardiovascular physiology and patho-physiology as well as significant advances in space medical capabilities to facilitate exploration-class space missions. Terrestrial benefits of this study are also anticipated including enhanced understanding of the cardiovascular effects of venous occlusion in normal and pathologic states. Development of the high fidelity, CD ROM based training program in cardiovascular ultrasound for use by non-medical personnel will have direct educational application to a broad audience including ultrasound technicians, students, and the lay population. These techniques are readily transferable to training in basic and advanced cardiopulmonary care and CPR training as well as other public health education tasks where non-medical personnel must be introduced to medical concepts in a limited time.
Task Progress:	Major Accomplishments, Findings, and Milestones We have interviewed numerous long duration crewmembers for the optimal human interface for the just-in-time training software for this program. We have conducted 20 baseline examinations with and without the Bracelet device on normal volunteers and optimizing a custom pressure monitoring device for calibration in conjunction with standard methodologies. We have developed a comprehensive methodology, in conjunction with SDTO activities on orbit, to allow non-expert operators to reproducibly conduct cardiac and vascular examinations with or without thigh occlusion devices. We have reliably characterized the profound cardiac, vascular, and optic nerve sheath changes with 6 degree down tilt testing, and the effects of the Bracelet device on intra-vascular volumetric changes.
Bibliography Type:	Description: (Last Updated: 03/14/2025)
Articles in Peer-reviewed Journals	Hamilton DR, Alferova IV, Sargsyan AE, Fincke EM, Magnus SH, Lonchakov YV, Dulchavsky SA, Ebert D, Garcia K, Martin D, Matveev VP, Voronkov YI, Melton SL, Bogomolov VV, Duncan JM. "Right ventricular tissue Doppler assessment in space during circulating volume modification using the Braslet device." Acta Astronaut. 2011 May-Jun;68(9-10):1501-8. http://dx.doi.org/10.1016/j.actaastro.2009.11.015 , May-2011
Articles in Peer-reviewed Journals	Hurst VW, Peterson S, Garcia K, Ebert D, Ham D, Amponsah D, Dulchavsky S. "Concept of operations evaluation for using remote-guidance ultrasound for exploration spaceflight." Aerosp Med Hum Perform. 2015 Dec;86(12):1034-8. http://dx.doi.org/10.3357/AMHP.3244.2015 , Dec-2015

Articles in Peer-reviewed Journals	Sirek AS, Garcia K, Foy M, Ebert D, Sargsyan A, Wu JH, Dulchavsky SA. "Doppler ultrasound of the central retinal artery in microgravity." Aviat Space Environ Med. 2014 Jan;85(1):3-8. https://doi.org/10.3357/asem.3750.2014 ; PMID: 24479252 , Jan-2014