Fiscal Year:	FY 2020	**Task Last Updated:**	FY 07/17/2019
PI Name:	Stenger, Michael Ph.D.		
Project Title:	Distribution of Body Fluids during Long Duration Space Flight and Subsequent Effects on Intraocular Pressure and Vision Disturbance		
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 (2) **SANS**:Risk of Spaceflight Associated Neuro-ocular Syndrome (SANS)		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	michael.b.stenger@nasa.gov	**Fax:**	FY
PI Organization Type:	NASA CENTER	**Phone:**	281-483-1311
Organization Name:	NASA Johnson Space Center		
PI Address 1:	SK3/Biomedical Research and Environmental Sciences Division		
PI Address 2:			
PI Web Page:			
City:	Houston	**State:**	TX
Zip Code:	77058	**Congressional District:**	22
Comments:	NOTE Aug 2018: Previously with KBRwyle at Johnson Space Center		
Project Type:	FLIGHT	**Solicitation / Funding Source:**	2011 Crew Health NNJ11ZSA002NA
Start Date:	10/01/2012	**End Date:**	10/01/2020
No. of Post Docs:	1	**No. of PhD Degrees:**	0
No. of PhD Candidates:	1	**No. of Master' Degrees:**	0
No. of Master's Candidates:	1	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NASA JSC
Contact Monitor:	Norsk, Peter	**Contact Phone:**	
Contact Email:	Peter.norsk@nasa.gov		
Flight Program:	ISS		
Flight Assignment:	ISS NOTE: End date changed to 10/1/2020 as Dr. Steven Laurie took over the project in August 2020 (Ed., 7/15/21) NOTE: End date changed to 1/29/2021 per J. McFather/HRP JSC (Ed., 10/15/18) NOTE: End date is 9/30/2018 per PI (Ed., 7/8/15) NOTE: Risk/Gap changes per IRP Rev E (Ed., 3/24/14)		
Key Personnel Changes/Previous PI:			

COI Name (Institution):	Johnston, Smith M.D. (NASA Johnson Space Center) Lee, Stuart Ph.D. (Wyle Laboratories, Inc.) Martin, David M.S. (Wyle Laboratories, Inc.) Ploutz-Snyder, Robert Ph.D. (Universities Space Research Association, Columbia) Smith, Scott Ph.D. (NASA Johnson Space Center) Soller, Babs Ph.D. (Reflectance Medical Inc.) Laurie, Steven Ph.D. (Wyle Laboratories, Inc.) Marshall-Goebel, Karina Ph.D. (KBRwyle/NASA Johnson Space Center) Ribeiro, Laura Christine (KBRwyle/NASA Johnson Space Center)
Grant/Contract No.:	Internal Project
Performance Goal No.:	
Performance Goal Text:	
Task Description:	The central objective of the proposed work is to characterize the magnitude of the headward fluid shift during long duration space flight and to measure the subsequent compartmentalization of this fluid. The second objective is to correlate in-flight alterations of eye structure, ocular vascular parameters, and vision with headward fluid shifts, vascular dimensions, and flow patterns. Finally, the third objective is to determine systemic and ocular factors of individual susceptibility to the development of these inflight alterations. In order to determine the effect of space flight on the headward fluid shift and subsequent redistribution across fluid compartments, biochemical, ultrasound, and other non-invasive cardiovascular measures will be performed before launch, during flight, and after landing. Total body water, extracellular, and intracellular fluid volume will be determined by biochemical dilution techniques. Ultrasound will be used to assess upper vs. lower body interstitial fluid and vascular flow and structure changes, ocular dimensions and optic nerve sheath diameter, and jugular venous pressure. Near infrared spectroscopy will be used to measure lower vs. upper body local tissue hydration, and total peripheral resistance will be calculated from noninvasively acquired blood pressure and cardiac output. It is currently unclear why only some astronauts experience vision disturbances with space flight. It is hypothesized that astronauts respond differently to the fluid shift inflight and that this impacts changes in ocular structure and function changes. The goal of this study is to test this hypothesis. In doing so, this proposal directly addresses the Integrated Research Plan Gap Cardiovascular (CV)7: How are fluids redistributed in-flight? and Gap Vision Impairment and Intracranial Pressure (VIIP)1: What is the etiology of visual acuity and ocular structural and function changes seen in-flight and post-flight? The research proposed here will determine the effect of long duration space flight on fluid shifts and subsequent redistribution across fluid compartments and attempt to discern the contribution of these adaptations to changes in ocular structure and function. NOTE: This study was merged with investigations from Dr. Alan Hargens (Fluid distribution before, during and after prolonged space flight) and Dr. Scott Dulchavsky (Microgravity associated compartmental equilibration) resulting in a comprehensive study titled “Fluid Shifts Before, During and After Prolonged Space Flight and Their Association with Intracranial Pressure and Visual Impairment” (short title: Fluid Shifts).
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	An early hypothesis considered elevated intracranial pressure (ICP) as a cause for space flight associated neuro-ocular syndrome. Because of this, novel noninvasive ICP techniques, included tympanic membrane displacement and otoacoustic emissions are being investigated to determine ICP changes associated with space flight. Knowledge gained from this study may inform medical professionals treating and studying patients suffering from idiopathic intracranial hypertension, a debilitating condition with some characteristics in common with that experienced by astronauts.
Task Progress:	Within this reporting period, 1 subject withdrew for reasons not related to the study. As a result an additional subject enrolled in the study. Within this reporting period 2 preflight, 4 inflight, and 2 post-flight tests were completed. To date, all pre/in/post-flight data collection has been completed on the first 10 subjects for this experiment. The final 3 subjects will require a total of 4 more inflight sessions and 7 more post-flight sessions. This is expected to be completed by September of 2020. Data collected as a part of this project were included in two presentations and 3 posters at the Human Research Program Investigators' Workshop in Galveston, TX, an oral presentation at the International Society for Gravitational Physiology conference in Nagoya, Japan, a poster at the American Society for Gravitational and Space Research conference in Washington, D.C., and as two oral presentations and a poster at the Association for Research in Vision and Ophthalmology annual conference in Vancouver, Canada. Preliminary results from this investigation have been shared with the Human Health and Countermeasures Element, which have informed the Risk status and guided other grant solicitations.
Bibliography Type:	Description: (Last Updated: 05/20/2022)
Articles in Peer-reviewed Journals	Huang AS, Stenger MB, Macias BR. "Gravitational influence on intraocular pressure: Implications for spaceflight and disease." J Glaucoma. 2019 Aug;28(8):756-64. Epub 2019 May 31. https://doi.org/10.1097/IJG.0000000000001293 ; PubMed PMID: 31162175; PubMed Central PMCID: PMC6786882 , Aug-2019