Fiscal Year:	FY 2020	**Task Last Updated:**	FY 03/02/2021
PI Name:	Buckey, Jay C. M.D.		
Project Title:	Ultra-Compact Device for Monitoring Bone Loss and Kidney Stone Risk		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **ExMC**:Exploration Medical Capabilities		
Human Research Program Risks:	None		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	03756-0001	**Congressional District:**	2
Comments:	Address updated 9/2008		
Project Type:	GROUND	**Solicitation / Funding Source:**	2018 HERO 80JSC018N0001-Crew Health and Performance (FLAGSHIP, OMNIBUS). Appendix A-Flagship, Appendix B-Omnibus
Start Date:	09/01/2019	**End Date:**	08/31/2021
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:	1	**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
Contact Monitor:	Lehnhardt, Kris	**Contact Phone:**	281.244.0524
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Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:	Principal Investigator (PI) Jay Buckey, MD, became the main PI when the project started; original PI in the proposal was Aleksandra Stankovic, PhD.		
COI Name (Institution):	Phillips, Scott Ph.D. (Creare Incorporated) Knaus, Darin Ph.D. (Creare Incorporated)		
Grant/Contract No.:	80NSSC19K1632		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Slowing bone loss and preventing kidney stone formation are critical for successful spaceflight. The capability to track bone loss and kidney stone risk while in space would provide the ability to track these risks directly and individualize the countermeasure program as needed. At present, post-flight measurements are used to establish the effectiveness of the in-flight bone loss/kidney stone prevention program. A preventive approach would be preferable, where ongoing in-flight measurements of countermeasure effectiveness allow for adjustments in the countermeasure program during the flight. Urinary calcium excretion is a reliable marker of bone loss and kidney stone formation risk. Urinary calcium excretion is often measured with a 24-hour urinary collection, but measuring just the calcium concentration in the first void of the day provides similar information to a 24-hour collection. Spot measurements of urinary calcium taken when an astronaut is voiding anyway, could provide key operational information with minimal impact on crew time, power, or stowage. The goal of this project is to provide an ultra-compact, robust, urinary calcium measurement system that could be used in space to assess whether urinary calcium levels are increasing inflight to a point where action is needed. We plan to measure urinary calcium concentration fluorimetrically using the fluorescent tracer calcein. The same robust assay was implemented in space during the Biosatellite 3 primate flight. Calcium binds with calcein to form a fluorescing complex and the magnitude of the fluorescence signal is proportional to calcium concentration for calcium-calcein mixtures. Urinary calcium is typically measured clinically using a clinical chemistry analyzer with colorimetric indicators. For spaceflight, fluorometry is preferred because the instrumentation can be extremely compact and simple. Laboratory chemical assays typically involve either significant disposables or washing of labware. In space, neither is desirable. We plan to develop an assay with an ultra-compact disposable based on a small capillary tube with the calcein reagent coated onto the interior wall of the capillary tube. Urine will be drawn into the tube using a sampling adapter on the urine funnel. The capillary tube, containing a fixed amount of urine and reagent, will then be inserted into a compact handheld fluorimeter to measure urinary calcium concentration. The proposed technology could provide a small, practical, in flight capability to monitor for bone loss and offer data on kidney stone risk.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	Urinary calcium monitoring is important for kidney stone prevention and for tracking the effects of drugs for osteoporosis.
Task Progress:	Reporting Period Covered: September 2019-Summer 2020. The goal of this project is to develop a prototype, ultra-compact, space-toilet-compatible, disposable, urinary calcium measurement device. The plan is to measure urinary calcium fluorometrically via calcein using a capillary tube coated with calcein on the inner surface (an optrode). The ultimate goal is to have an optrode that can be dipped in urine to acquire a small sample and then the calcium level determined using a compact fluorometer. Calcium binds with calcein to form a fluorescing complex, and the magnitude of the fluorescence signal is proportional to calcium concentration for calcium-calcein mixtures. Urinary calcium is typically measured clinically using a clinical chemistry analyzer with colorimetric indicators. For spaceflight, fluorometry is preferred because the instrumentation can be extremely compact and simple. Laboratory chemical assays typically involve either significant disposables or washing of lab ware. In space, neither is desirable. During the reporting period, the prototype fluorometer was fabricated and an approach for coating the capillary tubes with calcein was developed.
Bibliography Type:	Description: (Last Updated: 03/18/2024)
Articles in Peer-reviewed Journals	Ren J, Stankovic AS, Knaus DA, Phillips SD, Kynor DB, Buckey JC. "Urinary calcium for tracking bone loss and kidney stone risk in space." Aerosp Med Hum Perform. 2020 Sep 1;91(9):689-96. https://doi.org/10.3357/AMHP.5606.2020 ; PMID: 32867898 , Sep-2020