Fiscal Year:	FY 2020	**Task Last Updated:**	FY 05/03/2021
PI Name:	Ott, C. Mark Ph.D.		
Project Title:	Spaceflight-Induced Changes in Microbial Virulence and Impact to the Host Immune Response		
Division Name:	Human Research		
Program/Discipline:			
Program/Discipline--Element/Subdiscipline:			
Joint Agency Name:		**TechPort:**	No
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **Microhost**:Risk of Adverse Health Effects Due to Host-Microorganism Interactions		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Comments:			
Project Type:	GROUND	**Solicitation / Funding Source:**	Directed Research
Start Date:	10/01/2019	**End Date:**	09/30/2025
No. of Post Docs:		**No. of PhD Degrees:**	
No. of PhD Candidates:		**No. of Master' Degrees:**	
No. of Master's Candidates:		**No. of Bachelor's Degrees:**	
No. of Bachelor's Candidates:		**Monitoring Center:**	NASA JSC
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Flight Program:			
Flight Assignment:			
Key Personnel Changes/Previous PI:			
COI Name (Institution):	Nickerson, Cheryl Ph.D. (CoPI-- Arizona State University grant 80NSSC20K0016) Barrila, Jennifer Ph.D. (Arizona State University) Oubre, Cherie Ph.D. (NASA Johnson Space Center) Crucian, Brian Ph.D. (NASA Johnson Space Center)		
Grant/Contract No.:	Directed Research		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Over the past 50 years, microorganisms have displayed unexpected responses directly relevant to infectious disease when grown in microgravity (and microgravity analogues), including changes in final cell concentration, biofilm production, stress resistance, antibiotic sensitivity, gene expression, and virulence. The threat to crew health from spaceflight-induced alterations in microbial virulence and pathogenicity is further compounded by dysfunction of the crew immune system. Our knowledge of diminished crew immune functional response comes largely via stimulation of immune cells with various broad spectrum mitogens, specific for a particular type of immune cell. To date, neither healthy terrestrial test subjects nor International Space Station (ISS) crew immune cells have been challenged with either static or microgravity-altered relevant pathogens. The goal of this study is to gain an understanding of which classes or groups of medically-significant relevant ISS microorganisms have altered virulence and the impact of those changes on the immune response of the host. Specific Aims: Aim 1: Characterize the effect of spaceflight analogue culture on microbial pathogenesis related stress responses and in vitro host-pathogen interactions. Analysis will include microbial stress responses as well as colonization and viability following pathogen challenge of three-dimensional (3-D) tissue co-culture models containing immune cells. Aim 2: Characterize the effect of spaceflight analogue culture on the virulence potential of pathogenic microorganisms. Changes in virulence will be assessed using a mouse model of infection. To reduce and refine the use of animals for virulence studies, the selection of microorganisms for Aim 2 will be based on a combination of microbial responses from Aim 1 and previously reported spaceflight and spaceflight analogue experimental data of similar microorganisms. This will be the first study to apply an integrated systematic approach to understand the relationship between spaceflight, immune cell function, and infectious disease risk for the crew. The results from this study will enhance the current infectious disease risk assessment for the crew, elucidate the relationship to clinical disease, and support future development and application of effective countermeasures for treatment and prevention.
Rationale for HRP Directed Research:	The MicroHost research plan aims to determine which microorganisms develop altered virulence when exposed to spaceflight conditions and understand the synergistic effect of altered microbial virulence and dysregulated immunity on crew health risks for deep space missions. Insufficient time for solicitation: Continued delays in initiating the proposed study will continue to impact the schedule and decrease our likelihood of gaining the knowledge needed to close the risk. Note that the delay in this work may impact the Path to Risk Reduction (PRR) color change from yellow to green and put the studies outside of the window for use of the International Space Station (ISS). Two prior solicitations have been released (in 2009 and 2014) for ground-based proposals to understand microbial responses to simulated microgravity. Even though the prior solicitations were written clearly, the selected studies did not focus on identifying the microbial alterations that would gain the understanding needed to inform the risk, and they did not produce the needed ground-based investigations on mechanisms. The 2009 selection addresses collective changes of organisms within the human microbiome, and the 2014 selection addresses viral reactivation. The selected studies will provide information applicable to the gaps Micro-101 to better understand the potential impact of microgravity on microbial virulence and Micro-201 to better understand the contribution of these changes on adverse health events. Completion of the proposed work will provide clear evidence as to the operational applicability of these original microbial virulence data to a variety of microorganisms and will include measurements of host immune responses to microbial challenge. Access to Previous Crew Data: This proposed study will leverage previous microbiology operational and research data as well as previously published immunology research data to provide a better understanding of impacts of microbial changes to the host and to determine the need for countermeasure evaluation as outlined in our PRR.
Research Impact/Earth Benefits:	
Task Progress:	New project for FY2020.
Bibliography Type:	Description: (Last Updated: 11/01/2023)