

Fiscal Year:	FY 2004	Task Last Updated:	FY 12/01/2005
PI Name:	Klerman, Elizabeth B. M.D., Ph.D.		
Project Title:	Mathematical Modeling of Circadian/Performance Countermeasures		
Division Name:	Human Research		
Program/Discipline:	NSBRI Teams		
Program/Discipline--Element/Subdiscipline:	NSBRI Teams--Human Performance Factors, Sleep, and Chronobiology Team		
Joint Agency Name:		TechPort:	Yes
Human Research Program Elements:	(1) BHP :Behavioral Health & Performance (archival in 2017)		
Human Research Program Risks:	(1) BMed :Risk of Adverse Cognitive or Behavioral Conditions and Psychiatric Disorders (2) Sleep :Risk of Performance Decrements and Adverse Health Outcomes Resulting from Sleep Loss, Circadian Desynchronization, and Work Overload		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
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Zip Code:	02115-5804	Congressional District:	8
Comments:			
Project Type:	GROUND	Solicitation / Funding Source:	2003 Biomedical Research & Countermeasures 03-OBPR-04
Start Date:	06/01/2004	End Date:	05/31/2008
No. of Post Docs:	0	No. of PhD Degrees:	
No. of PhD Candidates:	0	No. of Master' Degrees:	
No. of Master's Candidates:	0	No. of Bachelor's Degrees:	
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):			
Grant/Contract No.:	NCC 9-58-HPF00405		
Performance Goal No.:			
Performance Goal Text:			

Task Description:	Objective neurobehavioral performance, subjective alertness and mood, and sleep are critically important to astronaut health and the success of space missions. Neurobehavioral performance, alertness and mood are affected by circadian rhythms, homeostatic sleep regulation, sleep inertia, and interactions of these processes. Countermeasures to ensure optimal neurobehavioral performance, subjective alertness, and quality sleep therefore are required for space missions, during which circadian rhythms and sleep are disrupted. We have developed and validated a mathematical model of the human circadian pacemaker and neurobehavioral performance and alertness that includes these three key processes. A previous version of this model, with a focus on light-dark scheduling, has been used by NASA to design astronaut pre-launch schedules. We propose to extend this model to be useful in testing emerging countermeasures for neurobehavioral problems due to space missions. Since the potential countermeasures, singly or in combination, are different for each crewmember on each mission, it would be difficult, time consuming and expensive to conduct all the experimental protocols required to mimic all combinations of possible situations and proposed countermeasures received by any given crewmember. A mathematical model, on the other hand, is a powerful tool for the design of countermeasures because there are no limits to the number of patterns of astronaut light exposure or sleep/wake schedules and countermeasures that can be efficiently assessed. Our model is available for use via a user-friendly software program for users to test countermeasures. We propose to extend the current model so that it will include: (1) melatonin markers of circadian amplitude and phase; (2) chronic sleep restriction and its effects on neurobehavioral performance; and (3) the effects of specific wavelengths of light on the circadian pacemaker. Then we will amend our current software to include schedule assessment and countermeasure design components. We will cooperate with other members of the selected NSBRI Human Performance Factors team: simulating their protocols, modeling the data and adjusting and re-validating the model as required. The mathematical modeling of circadian rhythms, sleep, subjective alertness and mood, and neurobehavioral performance is a vital and effective component of design and testing of potential countermeasures for optimal astronaut health and mission success.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	
Task Progress:	This record represents the first year of this task (FY 2004). The first progress report is due in FY 2005.
Bibliography Type:	Description: (Last Updated: 10/26/2023)