Task Book Report Generated on: 05/10/2024

| PT Name:   | Fiscal Year:                            | FY 2013   | Task Last Updated:                    | FY 07/11/2013                  |
|--|---|---|---------------------------------------|--------------------------------|
| Project Title:         Fluid Slaths           Division Name:         Human Research           Program/Discipline:         HUMAN RESEARCH           Element/Solubidicyline:         HUMAN RESEARCH—Biomodical countermeasures           Joint Agency Name:         TechPort:         No           Joint Agency Name:         TechPort:         No           Human Research Program Elisentest:         (1) Cardiovascular/Risk of Cardiovascular Adaptations Contributing to Adverse Mission Performance and Health Outcome Cardiovascular Syndrome (SANS)           Space Biology Tensent:         None           Space Biology Special Category:         None           Space Biology Special Category:         None           P1 Email:         student Johnson:         Fax: FY 313 916 9445           P1 Organization Type:         PUBILIC SERVICE         Phone:         313 916 9006           P1 Address 1:         Surgery         Plant Grant June Grant Jun  | PI Name:                                | Dulchavsky, Scott A. M.D., Ph.D.  | A                                     |                                |
| Division Name: Human Research Program/Discipline: HUMAN RESEARCH Program/Discipline-Element/Subdiscipline: HUMAN RESEARCH—Biomedical countermeasures  Joint Agency Name: TechPort: No  Joint Agency Name: TechPort: No  Jumun Research Program Elements: (J) IIIIC-Homan Health Countermeasures  Human Research Program Risks: (D) Cardiovascular-Risk of Cardiovascular Adaptations Contribating to Adverse Mission Performance and Health Outcomes. (2) SANSKisk of Spaceflight Associated Neuro-ocular Syndrome (SANS)  Space Biology Cross-Element None Space Biology Cross-Element None Space Biology Special Category: None PI Email: subtela lighths org: Fax: FY 313 916 9445  PI Organization Type: One PI Email: subtela lighths org: Fax: FY 313 916 9445  PI Organization Name: Henry Ford Health System PI Address 1: Surgery PI Address 2: 2799 W. Grand Boulevard, CFP-1  PI Web Page:  Cliy: Deroit State: MI Zip Code: 48202-2008 Congressional District: 13  Comments:  Project Type: FLIGHT Solicitation / Funding Source: 2011 Crow Health NNJ112SA002NA  Start Date: No. of PhD Candidates: No. of Bachelor's Degrees: No. of PhD Candidates: No. of Mister' Degrees: No. of PhD Candidates: No. of Mister's Degrees: No. of Bachelor's Candidates: No. of Bachelor's Degrees: No. of Master's Candidates: No. of Mister's Degrees: No. of Master's Candidates: No. of Mister's Degrees: No. of Master's Candidates: No. of Mister's Degrees: No. of Bachelor's Candidates: No. of Mister's Degrees: No. of Bachelor's Candidates: Seminifer All Harrenlonaes gov.  Flight Program: IS  Flight Program: IS  Flight Program: IS  Flight Program: No. of No. of Mister's Contact Phone: 281-483-7306  Grant/Contract No.: NNX13AK30G  Performance Goal No.:   | Project Title:                          | • ,   |                                       |                                |
| Program/Discipline: HUMAN RESEARCH Program/Discipline- Element/Subdiscipline- Element/Subdiscipline- Element/Subdiscipline- Joint Agency Name: TechPort: No Human Research Program Elements: (1) HHC-Human Health Countermeasures  (1) Cardiovascular-Risk of Cardiovascular Adaptations Contributing to Adverse Mission Performance and Health Outcomes (2) SANS-Risk of Spaceflight Associated Neuro-neular Syndrome (SANS)  Space Biology Cross-Element None Space Biology Cross-Element None Space Biology Cross-Element Space Biology Special Category: None PI Email: subdishal ishalts org Fax: FY 313 916 9445  PI Organization Type: PUBLIC SERVICE Phone: 313 916 9306  Organization Name: Henry Ford Health System  PI Address 1: Surgery PI Address 2: 2799 W. Grand Boulevard, CFP-1  PI Web Page:  City: Detroit State: MI  Zip Code: 4820 2-2608 Congressional District: 13  Comments:  Project Type: FLIGHT Solicitation / Funding Source: 2011 Crow Health NVII12SA002NA  Start Date: 05/16/2013 Fad Date: 09/30/2018  No. of Post Does: No. of Master' Degrees: No. of Master's Candidates: No. of Master's Degrees: No. of Master's Candidates: No. of Master's Degrees: No. of Bachelor's Candidates: No. of Master's Degrees: No. | ď                                       |   |                                       |                                |
| Program/Discipline-  Element/Suddiscipline-  District Plane (Suddiscipline-  Program Elements)   Program Elements   Program E   | Division Name:                          | Human Research  |                                       |                                |
| Element/Subdiscipline:  Joint Agency Name:  None  None  Space Biology Cross-Felment  None  Space Biology Cross-Felment  None  Space Biology Cross-Felment  None  Space Biology Special Category:  None  PI Email:  Joint Agency Name:  Heavy Food Health System  PI Address 2:  Joya W. Grand Boulevard. CFP-1  PI Web Page:  City:  Detroit  Agency State:  Joint Agency Name:  Project Type:  FLIGHT  Solicitation / Funding Source:  Joint Jose Josephan Degrees:  No. of Pab Degrees:  No. of Pab Degrees:  No. of Master's Degrees:  No. of Master's Degrees:  No. of Bachelor's Candidates:  No. of Master' Degrees:  No. of Master' Degrees:  No. of Master's Degrees:  No. of Maste | Program/Discipline:                     | HUMAN RESEARCH  |                                       |                                |
| Human Research Program Elements: (1) HHC:Human Health Countermeasures  (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:  Space Biology Special Category:  None  Space Biology Special Category:  None  PI Email:  Space Biology Special Category:  PO Corganization Type:  PURLIC SERVICE:  Phone: 313 916 9445  PUPLIC SERVICE:  Phone: 313 916 9445  PUPLIC SERVICE:  Phone: 313 916 9306  PUBLIC SERVICE:  Ploate:  Surgery  PI Address 1:  Surgery  PI Address 2:  2799 W. Grand Boulevard, CFP-1  PI Web Page:  City:  Detroit  State: MI  Zip Code:  48202-2608  Congressional District:  13  Comments:  Project Type:  FLIGHT  Solicitation / Funding Source:  2011 Crew Health NNJ11ZSA002NA  Start Date:  No. of Post Desc:  No. of Post Desc:  No. of Master's Candidates:  No. of Master's Candidates:  No. of Master's Candidates:  No. of Bachelor's Candidates:  No. of Master's Candidates:  No. of Master's Candidates:  No. of Bachelor's  |   | HUMAN RESEARCHBiomedical counter  | ermeasures                            |                                |
| Human Research Program Risks:  (1) Cardiovascular-Risk of Cardiovascular Adaptations Contributing to Adverse Mission Performance and Health Outcomes (2) SANS Risk of Spacellight Associated Neuro-ocular Syndrome (SANS)  Space Biology Cross-Element Discipline:  Space Biology Cross-Element Discipline:  Space Biology Special Category:  None  PI Email:  Space Biology Cross-Element  Space Biology Special Category:  None  PI Email:  Space Biology Special Category:  None  PI Email:  Space Biology Special Category:  None  PI Email:  Space Biology Cross-Element  Space Biology Special Category:  None  PI Email:  Space Biology Special Category:  None  Profect Type:  PI Gategory:  Profect Type:  Prof | Joint Agency Name:                      |   | TechPort:                             | No                             |
| Human Research Program Risks:  Questioned Space Biology Element:  None  Space Biology Cross-Element Disciplines:  Space Biology Cross-Element Disciplines:  Space Biology Cross-Element Disciplines:  Space Biology Special Category:  None  PI Email:  solutchal führfüs.org:  Fax: FY 313 916 9445  Pl Organization Type:  PL BLIC SERVICE: Phone: 313 916 9306  Organization Name:  Henry Ford Health System  PI Address 1:  Surgery  PI Address 2:  2799 W. Grand Boulevard, CFP-1  PI Web Page:  City:  Detroit:  State: MI  Zip Code:  48202-2608 Congressional District: 13  Comments:  Project Type:  FLIGHT Solicitation / Funding Source: 2011 Crew Health NNJ11ZSA002NA  Start Date:  0516-2013 End Date: 0930-2018  No. of Pab D Degrees:  No. of Pab D Candidates: No. of Master' Degrees:  No. of Master' Degrees:  No. of Bachelor's Candidates: No. of Bachelor's Candidates: No. of Bachelor's Candidates: No. of Bachelor's Candidates:  No. of Bachelor's Candidates:  No. of Bachelor's Candidates:  No. of Bachelor's Candidates:  No. of Bachelor's Contact Monitor:  Contact Monitor:  Villareal, Jennifer Contact Monitor:  Contact Master's Candidates:  Service Contact Monitor:   | <b>Human Research Program Elements:</b> | (1) <b>HHC</b> :Human Health Countermeasures  |                                       |                                |
| Space Biology Cross-Element Discipline:   None   Space Biology Special Category:   PUBLIC SERVICE   Phone: 313 916 9306   Phone:    | Human Research Program Risks:           | Outcomes  |                                       |                                |
| Discipline: None Space Biology Special Category: None PI Email: sduksha@hfhs.org Fax: FY 313 916 9445 PI Organization Name: Henry Ford Health System PI Address 1: Surgery PI Address 2: 2799 W. Grand Boulevard, CFP-1 PI Web Page: City: Detroit State: MI Zip Code: 48202-2608 Congressional District: 13 Comments: Project Type: FLIGHT Solicitation / Funding Source: 2011 Crew Health NNJ11ZSA002NA Start Date: 05/16/2013 End Date: 09/30/2018 No. of Post Does: No. of PhD Degrees: No. of Master's Candidates: No. of Bachelor's Degrees: No. of Bachelor's Candidates: No. of Bachelor's Degrees: No. of Bachelor's Candidates: Villarreal, Jennifer Contact Phone: 281-483-7306 Contact Monitor: Villarreal, Jennifer Contact Phone: 281-483-7306 Contact Email: jennifer V311 larreal@mass.gov Flight Program: ISS Flight Assignment: Key Personnel Changes/Previous PI:  Ebert, Douglas (Wyle Laboratories, Inc.) Garcia, Kahlbern (Wyle Laboratories, Inc.) Hamilton, Douglas (Wyle Laboratories, Inc.) Hamilton, Douglas (Wyle Laboratories, Inc.) Garcia, Kahlbern (Wyle Laboratories, Inc.) Killu, Keith (Henry Ford Health Nystem) Surgeyan, Ashot (Wyle Laboratories, Inc.) Grant/Contract No.: NNX13AK30G Performance Goal No.:  | Space Biology Element:                  | None  |                                       |                                |
| PI Email: sdulchal@hfhs.org Fax: FY 313 916 9445 PI Organization Type: PUBLIC SERVICE Phone: 313 916 9306 Organization Name: Henry Ford Health System PI Address 1: Surgery PI Address 2: 2799 W. Grand Boulevard, CFP-1 PI Web Page: City: Detroit State: MI Zip Code: 48202-2608 Congressional District: 13 Comments: Project Type: FLIGHT Solicitation / Funding Source: 2011 Crew Health NNJ11ZSA002NA Start Date: 05/16/2013 End Date: 09/30/2018 No. of Post Does: No. of PhD Degrees: No. of PhD Candidates: No. of Master' Degrees: No. of Master's Candidates: No. of Master' Degrees: No. of Bachelor's Candidates: No. of Bachelor's Degrees: No. of Bachelor's Candidates: No. of Bachelor's Degrees: No. of Bachelor's Candidates: Monitoring Center: NASA JSC Contact Monitor: Villarreal, Jennifer Contact Phone: 281-483-7306 Contact Email: jennifer 311 larreal@nasa.gov Flight Program: ISS Flight Assignment: Key Personnel Changes/Previous PI: COI Name (Institution): Carcia, Kathleen (Wyle Laboratories, Inc.) Larmiton, Douglas (Wyle Laboratories, Inc.) Larmiton, Douglas (Wyle Laboratories, Inc.) Carcia, Kathleen (Wyle Laboratories, Inc.) Larmiton, Douglas (Wyle Laboratories, Inc.) Carcia, Kathleen (Wyle Laboratories, Inc.) Larmiton, Douglas (Wyle Laboratories, Inc.) Larmiton, Douglas (Wyle Laboratories, Inc.) Cornance Goal No.:   |   | None  |                                       |                                |
| PI Organization Type: PUBLIC SERVICE Phone: 313 916 9306 Organization Name: Henry Ford Health System PI Address 1: Surgery PI Address 2: 2799 W. Grand Boulevard, CFP-1 PI Web Page: City: Detroit State: MI Zip Code: 48202-2608 Congressional District: 13 Comments: Project Type: FLIGHT Solicitation / Funding Source: 2011 Crew Health NNJ11ZSA002NA Start Date: 05/16/2013 End Date: 09/30/2018 No. of Post Docs: No. of PhD Degrees: No. of PhD Candidates: No. of Master' Degrees: No. of Master' Degrees: No. of Master' Degrees: No. of Bachelor's Degrees: No. of Bachelor's Candidates: Monitoring Center: NASA JSC Contact Monitor: Villarreal, Jennifer Contact Phone: 281-483-7306 Contact Email: jennifer 3/11 Jarreal@nass.gov. Flight Assignment: Key Personnel Changes/Previous PI: COI Name (Institution): Ebert, Douglas (Wyle Laboratories, Inc.) Garcia, Kathleen (Wyle Laboratories, Inc.) Garcia, Kathleen (Wyle Laboratories, Inc.) Sargsyan, Ashot (Wyle Laboratories, Inc.)  | Space Biology Special Category:         | None  |                                       |                                |
| Organization Name: Henry Ford Health System  PI Address 1: Surgery  PI Address 2: 2799 W. Grand Boulevard, CFP-1  PI Web Page:  City: Detroit State: MI  Zip Code: 48202-2608 Congressional District: 13  Comments:  Project Type: FLIGHT Solicitation / Funding Source: 2011 Crew Health NNJ11ZSA002NA  Start Date: 05/16/2013 End Date: 09/30/2018  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  Contact Monitor: Villareal, Jennifer Contact Phone: 281-483-7306  Contact Email: jennifer.v311larreal@inasa.gov  Flight Program: ISS  Flight Assignment:  Key Personnel Changes/Previous PI:  COI Name (Institution): Ebert, Douglas (Wyle Laboratories, Inc.) Garcia, Kathleen (Wyle Laboratories, Inc.) Hamilton, Douglas (Wyle Laboratories, Inc.)  Killu, Keith (Henry Ford Health System) Sargsyun, Ashot (Wyle Laboratories, Inc.)  Grant/Contract No.: NNX13AK30G  Performance Goal No.:  | PI Email:                               | sdulcha1@hfhs.org   | Fax:                                  | FY 313 916 9445                |
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| PI Address 2: 2799 W. Grand Boulevard, CFP-1 PI Web Page:  City: Detroit State: MI  Zip Code: 48202-2608 Congressional District: 13  Comments:  Project Type: FLIGHT Solicitation / Funding Source: 2011 Crew Health NNJ11ZSA002NA  Start Date: 05/16/2013 End Date: 09/30/2018  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: No. of Bachelor's Degrees: No. of Bachelor's Candidates: Contact Monitoring Center: NASA JSC  Contact Monitor: Villarreal, Jennifer Contact Phone: 281-483-7306  Contact Email: jenniferx/31 Harreal@nasa.gov  Flight Program: ISS  Flight Assignment:  Key Personnel Changes/Previous PI:  Ebert, Douglas (Wyle Laboratories, Inc.) Garcia, Kahleen (Wyle Laboratories, Inc.) Hamilton, Douglas (Wyle Laboratories, Inc.) Killu, Keith (Henry Ford Health System) Sargsyan, Ashot (Wyle Laboratories, Inc.) Grant/Contract No.: NNX13AK30G  Performance Goal No.:  | Organization Name:                      | Henry Ford Health System  |                                       |                                |
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| No. of Master's Candidates:  No. of Bachelor's Degrees:  No. of Bachelor's Candidates:  Monitoring Center: NASA JSC  Contact Monitor:  Villarreal, Jennifer  Contact Phone: 281-483-7306  Contact Email:  jennifer.v311larreal@nasa.gov  Flight Program:  ISS  Flight Assignment:  Key Personnel Changes/Previous PI:  Ebert, Douglas (Wyle Laboratories, Inc.) Garcia, Kathleen (Wyle Laboratories, Inc.) Hamilton, Douglas (Wyle Laboratories, Inc.) Killu, Keith (Henry Ford Health System) Sargsyan, Ashot (Wyle Laboratories, Inc.)  Grant/Contract No.:  NNX13AK30G  Performance Goal No.:   | No. of Post Docs:                       |   | No. of PhD Degrees:                   |                                |
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| Contact Email: jennifer.v311larreal@nasa.gov  Flight Program: ISS  Flight Assignment:  Key Personnel Changes/Previous PI:  COI Name (Institution): Ebert, Douglas (Wyle Laboratories, Inc.) Garcia, Kathleen (Wyle Laboratories, Inc.) Hamilton, Douglas (Wyle Laboratories, Inc.) Killu, Keith (Henry Ford Health System) Sargsyan, Ashot (Wyle Laboratories, Inc.)  Grant/Contract No.: NNX13AK30G  Performance Goal No.:  | No. of Bachelor's Candidates:           |   | <b>Monitoring Center:</b>             | NASA JSC                       |
| Flight Program:  Flight Assignment:  Key Personnel Changes/Previous PI:  Ebert, Douglas (Wyle Laboratories, Inc.) Garcia, Kathleen (Wyle Laboratories, Inc.) Hamilton, Douglas (Wyle Laboratories, Inc.) Killu, Keith (Henry Ford Health System) Sargsyan, Ashot (Wyle Laboratories, Inc.)  Grant/Contract No.:  NNX13AK30G  Performance Goal No.:   | Contact Monitor:                        | Villarreal, Jennifer  | Contact Phone:                        | 281-483-7306                   |
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| Key Personnel Changes/Previous PI:    Ebert, Douglas (Wyle Laboratories, Inc.)     Garcia, Kathleen (Wyle Laboratories, Inc.)     Hamilton, Douglas (Wyle Laboratories, Inc.)     Killu, Keith (Henry Ford Health System)     Sargsyan, Ashot (Wyle Laboratories, Inc.)     Grant/Contract No.:   NNX13AK30G     Performance Goal No.:   | Flight Program:                         | ISS   |                                       |                                |
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| Garcia, Kathleen (Wyle Laboratories, Inc.) Hamilton, Douglas (Wyle Laboratories, Inc.) Killu, Keith (Henry Ford Health System) Sargsyan, Ashot (Wyle Laboratories, Inc.)  Grant/Contract No.:  NNX13AK30G  Performance Goal No.:   | Key Personnel Changes/Previous PI:      |   |                                       |                                |
| Performance Goal No.:  | COI Name (Institution):                 | Garcia, Kathleen (Wyle Laboratories, Ind<br>Hamilton, Douglas (Wyle Laboratories, I<br>Killu, Keith (Henry Ford Health System | c.)<br>(nc.)                          |                                |
|  | Grant/Contract No.:                     | NNX13AK30G  |                                       |                                |
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Task Book Report Generated on: 05/10/2024

Editor's Note (7/11/2013): NOTE THIS IS A CONTINUATION OF FUNDING FOR NNX13AB42G (Microgravity Associated Compartmental Equilibration (MACE)) WITH THE SAME PRINCIPAL INVESTIGATOR. Recent evidence suggests that a preexisting subclinical pathology or risk factor may determine whether microgravity fluid shifts alone or in combination with other factors causes pathological increases in intracranial pressure (ICP) and sequelae thereof (visual acuity changes, cognitive impairment, retinal pathology). Furthermore, this malady may persist in some crewmembers beyond the rehabilitation phase after flight. Space medicine is therefore facing a an occupational medical hazard, with a number of contributing factors challenging to quantify and examine independently (ie., resistive exercise vs. microgravity fluid shifts).

Over years, the U.S. and the Russian space programs have implemented extensive research to understand the alterations in neurological and cardiovascular physiology secondary to fluid shifts that are induced by microgravity. The investigator team proposes to meet, through this study, the challenge of "how do we understand the effect of fluid shift on cerebrospinal fluid (CSF) dynamics when gold-standard terrestrial technologies are invasive and the true magnitude of microgravity fluid shifts and their pathophysiological effects are not well understood?"

Recent on-orbit long duration studies performed by this team have shown that cephalad venous fluid shifts are permanent in all crewmembers and that external jugular pressures are increased, so that aggressive intra-thoracic pressure maneuvers (i.e., Mueller maneuver) have very little effect on extracranial venous dimensions in all crewmembers examined in space (n=6). Preliminary data from the Braslet Investigation Grant ground experiment (ongoing) find terrestrial supine position to be very different in this regard.

In microgravity, cephalad fluid shifts seem to cause a relative extra-cranial (and therefore intracranial) venous insufficiency and subsequent lymphedema (facial puffiness, loss of olfactory and gustatory sense); several crew members have anecdotally mentioned that Russian thigh venous occlusion cuffs (Braslet, Kentavr nauka, Russian Federation) improve these changes and "help think clearer and perform procedures better." In our experience, venous insufficiency indeed improved when the cuffs were worn for at least 15 minutes: Mueller maneuver was much more readily causing a decrease in jugular venous dimension; cardiac preload was significantly diminishing when measured with echocardiography on-orbit.

The venous thigh occlusion cuffs therefore, though altering the fluid shifts and reducing venous insufficiency, also may effect a change in CSF dynamics in space (that would explain the improvement in cognition and well-being).

The investigators plan to use multiple non-invasive technologies to assess fluid shifts quantitatively, with a commensurate focus on the likelihood and severity of ocular and CSF fluid dynamic changes in microgravity, and identify markers of susceptibility to the development of pathological changes.

Research questions/ Specific Aims:

- 1. Determining the magnitude and time course of fluid in continuous microgravity.
- 2. Determining the physiological and potential health effects of microgravity-associated fluid redistribution on the cardiovascular and central nervous (CNS) systems.
- 3. Assessing the acute fluid volumetric effects of the Braslet and Lower Body Negative Pressure (LBNP) countermeasures on central, peripheral vascular systems and CNS/ocular systems.
- 4. Determining best combinations of non-invasive technologies related to fluid shifts and ICP elevation that are most predictive in estimating the absolute ICP and trends thereof during space flight.

NOTE: This study was merged with investigations from Dr. Alan Hargens (Fluid distribution before, during and after prolonged space flight) and Dr. Michael Stenger (Distribution of Body Fluids during Long Duration Space Flight and Subsequent Effects on Intraocular Pressure and Vision Disturbance) 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: New project for FY2013. Editor's Note (7/11/2013): NOTE THIS IS A CONTINUATION OF FUNDING FOR NNX13AB42G (Microgravity Associated Compartmental Equilibration (MACE)) WITH THE SAME PRINCIPAL INVESTIGATOR. Bibliography Type: Description: (Last Updated: 02/23/2023)

**Task Description:**