Fiscal Year:	FY 2016	**Task Last Updated:**	FY 08/27/2015
PI Name:	LeBlanc, Adrian Ph.D.		
Project Title:	Bisphosphonates as a Countermeasure to Space Flight Induced Bone Loss: SMO-021		
Division Name:	Human Research		
Program/Discipline:	HUMAN RESEARCH		
Program/Discipline--Element/Subdiscipline:	HUMAN RESEARCH--Biomedical countermeasures		
Joint Agency Name:		**TechPort:**	Yes
Human Research Program Elements:	(1) **HHC**:Human Health Countermeasures		
Human Research Program Risks:	(1) **Bone Fracture**:Risk of Bone Fracture due to Spaceflight-induced Changes to Bone (2) **Osteo**:Risk Of Early Onset Osteoporosis Due To Spaceflight		
Space Biology Element:	None		
Space Biology Cross-Element Discipline:	None		
Space Biology Special Category:	None		
PI Email:	adleblanc2@gmail.com	**Fax:**	FY
PI Organization Type:	NON-PROFIT	**Phone:**	281-244-2012
Organization Name:	Universities Space Research Association		
PI Address 1:	Division of Space Life Sciences		
PI Address 2:	3600 Bay Area Blvd		
PI Web Page:			
City:	Houston	**State:**	TX
Zip Code:	77058	**Congressional District:**	22
Comments:			
Project Type:	FLIGHT	**Solicitation / Funding Source:**	Directed Research
Start Date:	10/01/2006	**End Date:**	03/31/2017
No. of Post Docs:	0	**No. of PhD Degrees:**	0
No. of PhD Candidates:	0	**No. of Master' Degrees:**	0
No. of Master's Candidates:	0	**No. of Bachelor's Degrees:**	0
No. of Bachelor's Candidates:	0	**Monitoring Center:**	NASA JSC
Contact Monitor:	Maher, Jacilyn	**Contact Phone:**	
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Flight Program:	ISS		
Flight Assignment:	ISS NOTE: End date changed to 3/31/2017 due to PI's retirement (Ed., 8/2/17) NOTE: End date changed to 2/03/2018 per HRP technology information (Ed., 9/2/14) NOTE: End date is 8/31/2015 per HRP Master Task List dtd 7/12/11 (Ed., 8/4/11) NOTE: Extended to 9/30/2013 per PI (Ed., 11/5/2010)		
Key Personnel Changes/Previous PI:	August 2013 Report: Dr. Joyce Keyak (University of California at Irvine) has been added as a Co-Investigator. Dr. Keyak provides expertise in the area of Finite Element Modeling using hip QCT scans, and she is a co-author of presentations and publications resulting from this flight study. Toshio Matsumoto, M.D., Ph.D., is the Japanese Co-Principal Investigator of this study, a joint project between NASA and JAXA. Dr. Matsumoto is affiliated with the Department of Medicine and Regulatory Sciences, University of Tokushima Graduate School of Medicine. His contact information is: Phone 81-88-633-7119/Fax 81-88-633-7407; Toshimat@clin.med.tokkushima-u.ac.jp .		

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Grant/Contract No.:	Directed Research
Performance Goal No.:	
Performance Goal Text:	
Task Description:	The purpose of this Supplementary Medical Objective is to determine whether bisphosphonates, in conjunction with the routine in-flight exercise program, will protect International Space Station (ISS) crewmembers from the regional decreases in bone mineral density documented on previous ISS flights. Two dosing regimens will be tested: (1) an oral dose of 70 mg alendronate taken weekly during flight and (2) and I.V. dose of zoledronic acid 4 mg, administered just once approximately 45 days before flight. Our rationale for including both alendronate and zoledronic acid is that two dosing options will: maximize crew participation, increase the countermeasure options available to flight surgeons, increase scientific opportunities, and minimize the effects of operational and logistical constraints. Use of both oral and I.V. options can accommodate both crew and flight surgeon preferences (e.g., based on individual drug sensitivity, relevant health conditions, or other considerations). Operational and logistical constraints may favor one option versus the other. For example, stowage limits may limit use of alendronate on certain flights, while the ability to titrate the in-flight dose in response to on-orbit measurements of bone resorption would favor the weekly dosing regimen. Long-duration (e.g., 2+ year) missions would require in-flight re-dosing of I.V. zoledronic acid. The purpose of this study is not to test one dosing option versus the other. Rather, we intend to show that bisphosphonates-plus-exercise will have a measurable effect versus exercise alone in preventing space flight induced bone loss. Secondary goals will be to document the return to normal bone remodeling post-flight in crewmembers who took bisphosphonates.
Rationale for HRP Directed Research:	
Research Impact/Earth Benefits:	While the primary purpose of this research is to develop a countermeasure to protect crewmembers against bone loss during long duration space flight, this research may provide insight into the mechanisms and prevention of bone atrophy in other disuse conditions.
Task Progress:	The original intent of this study was to test 10 long-duration crewmembers taking one of two bisphosphonate regimens: either 70 mg per week alendronate or a single infusion of 4 mg of zoledronic acid. After the study began testing in 2009, the Johnson Space Center (JSC) Committee for the Protection of Human Subjects (CPHS) determined that only alendronate would be offered to U.S. crewmembers, while both dosing options could be offered to International Partners. It was further stipulated that only 7 alendronate subjects would be allowed. We have now completed testing on all 7 of these alendronate subjects. No further subjects will be tested with bisphosphonates. All scheduled testing sessions for the 7 treated subjects—pre-flight, in-flight, and post-flight--have been completed. Dual-energy X-ray absorptiometry (DXA), pQCT (peripheral QCT), quantitative computed tomography (QCT), and blood and urine data have been collated and analyses of the major parameters of interest have been performed through R+30, including statistical analyses. These results were published in June 2013 in the journal Osteoporosis International (LeBlanc A, Matsumoto T, Jones J, Shapiro J, Lang T, Shackelford L, Smith SM, Evans H, Spector E, Ploutz-Snyder R, et al. (2013). Bisphosphonates as a supplement to exercise to protect bone during long-duration space flight. Osteoporosis International 24(7): 2105-2114). Preliminary results of R+12-month testing (DXA and QCT) on this group were presented at the 2014 Meeting of the American Society for Bone and Mineral Research in Houston, TX, (September 2014) and at the NASA Human Research Program Investigators' Workshop in Galveston, TX, (February 2015). In 2011, the study obtained approval to add a new control group, consisting of approximately 10 International Space Station (ISS) crewmembers not taking bisphosphonates, but otherwise participating in essentially the same pre-, in-, and post-flight testing as the 7 treated subjects. The new control group should allow us to distinguish the relative effects of bisphosphonates vs. the confounder of Advanced Resistive Exercise Device (ARED) exercise, particularly at the level of trabecular vs. cortical bone. (All treated subjects in this study have used the ARED device, whereas our previous control group used the older IRED or other resistive exercise device, capable of much lower loads than ARED.) Testing on this new control group began in 2012, and, to date, 9 crewmembers have consented to participate. Of these, 8 crewmembers have returned from ISS flights. Five of these have completed all post-flight testing through R+1 year and the remaining 3 have completed post-flight testing through R+30 days. One additional subject will return from ISS in December 2015. Informed consent briefings continue in an effort to recruit a 10th control subject. It is anticipated that the control group will complete testing in ~late 2017. Preliminary results (DXA and QCT) for the first 5 of these control subjects were presented at the 2014 Meeting of the American Society for Bone and Mineral Research in Houston, TX, (September 2014). All testing to date for the first 8 control subjects, including QCT, DXA, pQCT, abdominal ultrasound, and blood and urine testing, has been completed on schedule and without incident. ISS sample return is complete for the first 5 control subjects.
Bibliography Type:	Description: (Last Updated: 06/29/2023)