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## **2013 Bone and Muscle Risks Standing Review Panel Status Review**

### **Statement of Task for:**

*The Risk of Bone Fracture,  
The Risk Of Early Onset Osteoporosis Due To Spaceflight,  
The Risk of Impaired Performance Due to Reduced Muscle Mass, Strength and Endurance,  
The Risk of Intervertebral Disk Damage,  
The Risk of Reduced Physical Performance Capabilities Due to Reduced Aerobic Capacity, and  
The Risk of Renal Stone Formation*

### **Comments to the Human Research Program, Chief Scientist**

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2013 Bone and Muscle Risk Standing Review Panel (SRP) Status Review WebEx/teleconference  
Participants:

#### **SRP Members:**

Julie Glowacki, Ph.D. (co-Chair) – Brigham and Women's Hospital  
Robert Gregor, Ph.D. (co-Chair) – University of Southern California  
Diane Cullen, Ph.D. – Creighton University  
Almond Drake, M.D. – ECU Brody School of Medicine  
Roger Enoka, Ph.D. – University of Colorado  
Edward Hanley, M.D. – Carolinas Medical Center  
Peter Raven, Ph.D. – University of North Texas Health Sciences Center at Fort Worth  
D. Rick Sumner, Ph.D. – Rush Medical College

#### **NASA Johnson Space Center (JSC):**

Pam Baskins  
David Baumann  
Ronita Cromwell, Ph.D.  
Linda Loerch  
Carol Mullenax, Ph.D.  
Peter Norsk, M.D.  
Michele Perchonok, Ph.D.  
Lori Ploutz-Snyder, Ph.D.  
Jeff Ryder, Ph.D.  
Cedric Senter, M.D.  
Mark Shelhamer, Sc.D.  
Jean Sibonga, Ph.D.  
LaRona Smith, MSN, RN  
Susan Steinberg, Ph.D.  
Lisa Stephenson

#### **NASA Headquarters (HQ):**

Bruce Hather, Ph.D.  
Victor Schneider, M.D.

#### **NASA Research and Education Support Services (NRESS):**

Tiffin Ross-Shepard

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On December 3, 2013, the Bone and Muscle Risk SRP, participants from the JSC, HQ, and NRESS participated in a WebEx/teleconference. The purpose of the call (as stated in the Statement of Task) was to allow the SRP members to:

1. Receive an update by the HRP Chief Scientist or Deputy Chief Scientist on the status of NASA's current and future exploration plans and the impact these will have on the HRP.
2. Receive an update on any changes within the HRP since the 2012 SRP meeting.
3. Receive an update by the Element or Project Scientist(s) on progress since the 2012 SRP meeting.
4. Participate in a discussion with the HRP Chief Scientist, Deputy Chief Scientist, and the Element regarding possible topics to be addressed at the next SRP meeting.

Based on the presentations and the discussion during the WebEx/teleconference, the SRP would like to relay the following information to Dr. Shelhamer, the HRP Chief Scientist.

**General Comments:**

- The SRP thought the bone and muscle discipline leads did a very good job of updating the SRP on the status of current projects since 2012 and the presentations helped detail some of these accomplishments.
- The SRP members unanimously agreed that the two-hour WebEx/teleconference format was not sufficient for what the SRP was trying to do. There was no time for discussion or any level of deeper understanding of how the tasks were progressing. The SRP agreed it would have been helpful to receive a report with major summaries of progress ahead of time and then use the teleconference to discuss this information in greater detail. The two-hour teleconference format could focus on major gains, concerns, and losses. Even though it was a status review, after the two-hour teleconference, the SRP did not come away with full knowledge of everything accomplished in the last year.
- The SRP suggests receiving updates of important activities (conferences/summits, literature updates, etc.). This would allow for a more efficient update during the status review WebEx/teleconference, allowing for greater focus on major concerns for SRP inputs.
- As the SRP members have discussed in previous reports, updates about cross-Element and within-Element progress would be very helpful and beneficial. The SRP would like to know more about how the other HRP Elements/disciplines interact and how their progress relates to the bone and muscle disciplines. The SRP members think that progress related to other interdependent topics (nutrition, radiation, extravehicular activity (EVA), inflammation/immune, etc.) should be summarized and discussed annually.
- The SRP thinks it would be helpful to have one document with the complete list of citations for newly published studies or one compiled .pdf containing those publications. As the information is currently given to the SRP, it takes a lot of effort to find the original items (and often, the authors are not even listed).
  - The SRP would like to see more data and/or receive copies of papers submitted or published. It seems that several papers have been published and it would be very informative if the SRP received copies of those papers to assess progress on filling gaps. Although tasks or projects within tasks are being completed, it is not possible

to see if these completed studies are providing answers that address the gaps in knowledge. The SRP thinks it would be very helpful to see specific data/conclusions listed for each task, as the data become available.

- Some problems and or hurdles were presented in both the bone and muscle disciplines, but the SRP members are unclear whether any solutions were achieved. There was no interaction time to discuss any of these problems.
- The SRP members think that astronaut participation is good and access to and use of astronaut databases is on target. Of note, it is especially prudent to have the opportunity of consenting twins to address specific research questions.
- From a strategic level, the SRP members think that the HRP has defined the current evidence, risks, gaps, and planned further research/tasks to address the risks/gaps very well. The SRP is also impressed with the balance and complementary use of experiments on the International Space Station (ISS), flight analog studies, and ground-based lab studies to address the risks/gaps as efficiently as possible, especially with the innovative use of data from "low n" experiments to maximize knowledge gained from in-flight studies.

#### **Comments Specific to the Bone Risks (Fracture, IVD, Osteo, and Renal Risks)**

- Overall, the SRP members were impressed with the presentations and with the progress made in the past year in refining the bone risks/gaps and in addressing these with tasks that have begun to provide some initial answers.
- The SRP thinks that the work/progress on the standards for bone health/density/strength has been well focused and the work on testing effective countermeasures for mitigating bone loss during long-term exposure to the microgravity environment has been impressive. The SRP members think that additional work is needed to define the expected range of the dynamic loads on bone and muscle during typical activities to be performed on a particular mission; this information would help fill the "gap" in knowledge concerning actual fracture risk during a prolonged mission (particularly when analyzed in conjunction with the level of bone density/bone strength loss anticipated with countermeasures being followed during a long-term mission).
- The ground-based work on the effect of microgravity/simulated spaceflight conditions on fracture healing provides information that may address concerns about bone fracture and repair during a mission.
- It is a concern that there needs to be greater access to the health database for epidemiology studies. The SRP members hope that current data collection is being standardized and integrated across all HRP disciplines.
- The SRP members appreciated the "Deliverables" table that Dr. Sibonga presented and suggest that it should be used to organize results. In other words, instead of only listing the tasks, there needs to be a statement explicitly explaining how the task filled the intended gap. This would not just be a beneficial tool for the SRP, but for management as well to see how the tasks are moving towards addressing a knowledge gap.

- The SRP found a number of studies published this year that were not in the report provided by Dr. Sibonga (e.g., see attached paper on Hindlimb Unloading (HLU) and Botox). The SRP also found a recently published paper that was generated from the 2010 Bone Summit. The SRP members were not aware until the 2013 SRP teleconference that there was a more recent Bone Summit.
- The SRP restates the concern that there will be reduced power to detect an effect of bisphosphonates (BP) on a subsequent HLU cycle because there was so much less bone loss after repeat cycles (see attached paper on multiple cycles of HLU).
- The SRP supports maintaining Fracture and Osteo as two independent risks.

**Comments Specific to the Muscle Risks (Aerobic and Muscle Risks)**

- Dr. Ploutz-Snyder did a good job providing an update to the SRP on the muscle risks, but appeared to be rushed given the time allowed for presentation of a large amount of material. For example, problems with the Advanced Resistive Exercise Device (ARED) are major and will affect other areas of concern, such as, monitoring activity to personalize conclusions made about gains (or not) by each astronaut in outcome measures used to evaluate the effect of selected interventions.
- The SRP agreed with the idea of using smaller sensors to estimate external loads. There have been several other projects related to the use of smaller, wearable sensor packages that may need to be revisited. The "shoes" presented in the discussion seemed to be very cumbersome and potentially a risk factor but the rationale for using smaller and maybe more reliable sensors is good.