Bisphosphonates as a Countermeasure to Space Flight Induced Bone Loss
A LeBlanc (USRA), T Matsumoto (U of Tokushima), J Jones (BCM), J Shapiro (Kennedy Krieger), T Lang (UCSF); L Shackelford (NASA); S Smith (NASA), H Evans (Wyle); E Spector (Wyle), R Ploutz-Snyder (USRA), J Sibonga (NASA), T Nakamura (U of Occupational Environ Health), K Kohri (Nagoya City U.), H Ohshima (JAXA)

Experiment Hypothesis
The combined effect of anti-resorptive drugs plus in-flight exercise regimen will attenuate space flight induced loss in bone mass and strength and reduce renal stone risk.

Experiment Status
• To date 7 out of 10 subjects are enrolled -- all taking alendronate
• 4 crewmembers have completed ISS long duration missions without incident and will be reported here
• 3 additional crewmembers are scheduled to complete the flight portion of the protocol this year

Experiment Measurements
Bone Loss
• PRIMARY ENDPOINT: Hip trabecular BMD by QCT
• Calculated bone strength of the hip by Finite Element Modeling
• Whole body and regional BMD by DXA
• Lower leg BMD by pQCT
• Serum markers of bone turnover
• Urine markers of bone turnover

Renal Stone Risk
• Serum and urine renal stone parameters
• Abdominal ultrasound for renal stones

Results
Compared to previous ISS crewmembers (n=14) not taking alendronate, DXA measurements of the total hip BMD were significantly changed from -1.1 ± 0.5%/mo to 0.04 ± 0.3%/mo (p<0.01); QCT-determined trabecular BMD of the total hip was significantly changed from -2.3 ± 1.0%/mo to -0.3 ± 1.6%/mo (p<0.01). Significance was calculated from a one-tailed t-test. While these results are encouraging, the current n (4) is small, and the large SDs indicate that while the means are improved there is still high variability in individual response.

Conclusion
Current results support the hypothesis that adding an anti-resorption agent will be beneficial for bone protection -- reducing remodeling rate, bone loss, and urinary Ca and protecting bone strength.

Need more data to:
• Clarify impact of bisphosphonate countermeasure on bone strength
• Define compartmental bone loss (cortical vs. trabecular)
• Understand impact of changing exercise prescription on conclusions
• Improve precision, i.e., the predictive value for calculating benefit/risk for individual crewmembers