A Year in Space: Early Results and Lessons Learned from the First Year-long Expedition Aboard the International Space Station

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Two ISS crewmembers recently completed the first year-long orbital stay in two decades. International cooperation was central to the success of Mikhail Kornienko from Russia and Scott Kelly from the United States. Their expedition leveraged current mission experience and capitalized on recent advances in health monitoring technology.

This unique effort began in 2012 when the program managers of the ISS partner nations adopted two separate goals: greater multilateral cooperation to increase efficiency of inflight research and a year-long expedition to gain familiarity with in-flight durations approaching that required for a Mars mission. These goals were unified when a set of bilateral Russian and American human research investigations was assigned to the year-long mission, augmented by additional investigations from Europe and Japan. For example, Kelly was assigned 18 investigations (twice the complement on standard six-month missions) including two joint U.S.-Russian studies, and two Russian and two Japanese studies.

The core set of American investigations was a repetition of six studies Kelly had done on his previous six-month ISS mission, to allow a direct comparison of physiological and behavioral responses of the longer and shorter durations in this single individual. The remainder of his assignments plus those of Kornienko were drawn from currently active national investigations documenting human adaptation to long-duration spaceflight factors or effectiveness of countermeasures against known deleterious adaptations.

The two joint U.S.-Russian investigations were the flagship biomedical studies of the year-long expedition. The “Fluid Shifts” study collocated American research equipment alongside a Russian operational stressor device to document the pattern and impacts of the headward fluid shift long known to occur in weightlessness, including its role in ocular changes recently observed in some astronauts. The “Field Test” study investigated the ability of the astronaut and cosmonaut to perform rudimentary tasks requiring sensorimotor coordination immediately after landing to define human capabilities soon after landing on Mars after an extended transit. Both investigations were highly successful in large part to the thorough integration of the implementation processes of the two partners.

Kelly’s assignment as the one-year crewmember also provided a serendipitous opportunity for the “Twins Study” comparing changes in his body at the genetic level with those occurring on Earth in his identical twin brother Mark Kelly.

Data analysis from this expedition will commence in earnest after frozen in-flight samples are delivered to Earth in May aboard a commercial cargo spacecraft.

Detailed results are expected in early 2017. Preliminary results and implementation improvements will be reviewed in this presentation.