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Using the ISS to Prepare for Exploration (01)
ISS as the Foundation for Exploration (1)

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BIOMEDICAL ASPECTS OF SIMULATED INTERPLANETARY TRANSITS USING THE INTERNATIONAL SPACE STATION

Abstract

Preparation for future astronaut missions to Mars and Near Earth Asteroids (NEA) will require utilization of all practical analogs for research, verification of technologies, and training of flight crews and ground support personnel. The International Space Station (ISS) might be an appropriate analog to simulate a Mars mission. A group of subject matter experts considered the physiological, psychological and medical operations aspects of such ISS missions including simulated interplanetary communication delays, and validation of biomedical technologies and countermeasures.

They determined that ISS missions would most usefully mimic the outbound, Earth-departure portion of interplanetary flights, given the astronauts' recent departure from Earth and their rapid accommodation to the space flight environment.

The Human Research Program was constituted in 2005 specifically to provide human health and performance countermeasures, knowledge, technologies, and tools to enable safe, reliable, and productive human space exploration beyond low Earth orbit. Therefore, everything HRP has done is directly related to that goal. Those activities comprise two major categories of space life sciences activities capitalizing on ISS capabilities. The first requires access to spaceflight, typically for prolonged weightlessness, and includes many investigations, such as the documentation of losses in muscle and bone integrity, cardiovascular function and sensory-motor capability, and development of appropriate countermeasures. The second includes studies that do not strictly require such spaceflight conditions but can exploit it to maximize scientific return much more efficiently and productively than in ground-based simulations. For these studies, ISS offers a high fidelity analog to simulate the effects of distance and limited accessibility on crew selection, operational tasks and workload, real-world risk, isolation and mission control performance. Work has already begun on a new investigation in this category which will examine the effects of a significant lag in communications (mimicking that expected on a transit toward Mars) on astronaut performance aboard ISS.

In addition, extension of the current ISS increment duration from 6 months to 9 or even 12 months would provide opportunities for expanded research relevant to long duration missions.

Finally, while presenting major logistical challenges, a post-ISS simulation of Mars surface exploration using an analog terrestrial facility, possibly including Antarctica, could provide quantitative and qualitative evidence of surface exploration capabilities in an actual mission.

The use of ISS to simulate aspects of Mars and NEA missions seems practical, and additional study has already begun, in consultation with all international partners.