Supply and Resource Management to Progressively Enable EIMO

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BACKGROUND: Current medical operations in Low Earth Orbit (LEO) allow for real-time audio-video communication with a flight surgeon at mission control, resupply, and medical evacuation to earth on the order of hours. As mission profiles change from LEO to the Moon, Mars, and beyond, medical risk as a contribution to overall mission risk is anticipated to rise substantially. Concurrently, due to the distance, the medical systems on board vehicles proposed for these mission types are expected to have reduced mass and volume allocation. Together, astronaut crews will be at a higher risk of major medical events, be required to perform a broader set of tasks, and have substantially reduced resources and support to do so. Earth Independent Medical Operations (EIMO) aims to identify and fill the gaps present in this progressively changing paradigm.
OVERVIEW: Medical supplies, resources, and skills are central to spaceflight medical systems. Vehicles used for non-LEO missions are anticipated to be smaller and thus the medical system will also need to have reduced mass, volume, and power. Medical resources are another form of consumable and may need resupply or pre-deployment to meet crew needs. One particular concern is the degradation of medications which become less efficacious and potentially toxic with time, particularly given environmental conditions such as temperature, humidity, oxygen, and radiation which have not yet been fully studied. Supply and resource management in LEO is dependent on resupply, however the supply chain of transporting equipment does not yet have a clear infrastructure for missions beyond LEO.
DISCUSSION: EIMO is intended to systemically identify and fill these gaps with forward-looking solutions. In mission monitoring of resources with technology like RFID, improving medical resource longevity, targeted resupply and careful pre-mission planning will be central to facilitate crew health and performance. One approach to optimizing resources is the Informing Mission Planning via Analysis of Complex Tradespaces (IMPACT) tool, which uses probabilistic risk assessment (PRA) to quantitatively predict medical risk and identify resources and skills that mitigate this risk. This evidence based, quantitative analysis prediction tool and several other approaches to meeting the challenge of supply and resource management are discussed.