Challenges of Life Support/Medical Support for Human Missions (8)
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ASTRONAUTS, HEAL THYSELF

Abstract

There are currently plans for human missions to Mars by 2030 by United States and other countries like China and Russia also planning missions by 2040. There have been significant developments in Rocket science engineering to support these missions but successful manned missions also requires robust healthcare technologies. Missions to Mars poses new challenges due to distance and flight duration, limited resources, radio signal time delays (up to 24min) and environmental challenges.

Long-term effects include effects of weightlessness, cardiovascular and radiation risks, isolation, sleep-deprivation, interpersonal conflicts and operational stressors. Mission control assistance becomes challenging in long duration missions due to time delay as they cannot provide timely decisions particularly during emergencies. In addition, mission crew would not be able to cover all medical specialties and would not be able to bring every medical devices and equipment.

The impact of digitalisation of health services has already made profound effects on healthcare systems worldwide by putting patients at the center of their own care. COVID-19 has accelerated that process with increasing uptake of current digital technologies to deliver healthcare services during the pandemic. However, the crew traveling to Mars will require a different set of technologies and supplies in part due to the inability to resupply, lack of real-time communications and quick repatriation home if necessary. Therefore, we need new strategies and systems in place to support crew members on these long duration missions.

Technologies will need to focus on automated or semi-automated technologies which allow astronauts to monitor, diagnose and treat remotely. Examples include virtual reality (VR) to offer psychological support for crew, Artificial Intelligence / Robotics for predictive analytics and performing semiautonomous procedures, and 3D printing for producing medical equipment and biomaterials. The Translational Research Institute for Space Health (TRISH) recent innovations include VisualDX app that combines machine learning with clinical data to provide diagnostics and 1Drop devices to measure biomarkers of cardiovascular/renal function. Astro-3DO device measures muscle composition in space and advanced retinal imager (ARI) provides automated retinal screening. Other developments include digital tattoos and implanted microchips which act as micro-sensors to measure vital signs of crew members. These technologies could be studied on the International Space Station (ISS) for efficacy.

The biggest obstacle in reaching Mars and establishing the conditions of life there will depend on the current state of healthcare technologies and its ability to aid astronauts in taking charge of their own health and manage complications.