

Task Load Management in Earth Independent Medical Operations

Dana Levin, MD MPH¹, Jay Lemery, MD³, Arian Anderson, MD³, Michael Krihak, Ph.D.⁴, Kurt Berens⁴, David Hilmers, MD EE MPH MSEE^{2,5}

¹University of Texas Medical Branch

²Baylor College of Medicine

³University of Colorado, School of Medicine

⁴KBR, Inc.

⁵Translational Institute for Space Health

BACKGROUND: Medical care in spaceflight carries a high task load and can easily overwhelm a small crew. Present day operations in low Earth orbit (LEO) offload most medical tasks to ground teams in mission control. This team includes dozens of flight surgeons, specialists, and engineers and supports the on-orbit crew in monitoring environmental systems, tracking medications, guiding procedures, providing expert advice, and many other tasks. However, the physical limitations of the speed of light and technical limitations of bandwidth, channel capacity, and signal processing mean that missions beyond LEO cannot rely on this level of telemedical support. The further we travel from Earth the more these tasks will fall on the shoulders of the crew and the greater the risk of task saturation to the wellbeing of the crew and the success of the mission. Exploration class space crews will need progressively more robust systems for managing task load as they progress further out in space.

OVERVIEW: Medical task management systems will need to assist with two broad categories of tasks; cognitively intensive tasks and procedure execution tasks. In both cases the goal is for the systems to operate in the background with minimal human-in-the-loop intervention. To accomplish this such systems will need to be designed with careful consideration for human factors and human systems integration to maximize efficiency, minimize alarm fatigue, and avoid inadvertently increasing task loads. Finally, the key domains of space medicine tasking can be used to map present day and near future technologies to the areas where they are best suited to support and identify gaps which can be targeted for research and development.

DISCUSSION: Task load is a major challenge for Earth Independent Medical Operations to overcome. It will require careful coordination between experts in a variety of fields paying attention to human factors and human systems integration as well as technical and medical expertise. If done well medical task management systems can handle many of the tasks currently run by humans in mission control and enable human crews to maintain terrestrial standards of care in the extraterrestrial environment.