

Datascope to Enable Earth Independent Medical Operations (EIMO)

Michael Krihak, Ph.D.¹, Jay Lemery, MD², Arian Anderson, MD², Dana Levin, MD MPH³, David Hilmers, MD EE MPH MSEE^{4,5}, Kurt Berens¹

¹KBR, Inc.

²University of Colorado, School of Medicine

³University of Texas Medical Branch

⁴Baylor College of Medicine

⁵Translational Institute for Space Health

BACKGROUND: NASA has amassed sixty years of knowledge and experience relevant to maintenance of crew health and performance in low earth orbit. The Apollo Program introduced the importance of ensuring progressively autonomous operational capability. Earth Independent Medical Operations (EIMO) will require a gradual shift in the balance of medical responsibility, management, and authority from terrestrial to space-based assets. Terrestrial assets will continue to be essential for pre-mission screening and planning in addition to maintenance of crew health and performance. However, new capabilities are needed to enable EIMO, to manage amount of data required to support these systems, and to mitigate the impacts of data transmission delays and reduced bandwidth coupled with lack of cloud-like resources and on-board computing capacity that is currently unclear or operationally insufficient.

OVERVIEW: An important goal of the EIMO project is to consider how artificial intelligence (AI)-based solutions could be leveraged to analyze crew health and performance data utilizing a clinical decision support system (CDSS) to provide crew medical officers (CMO) with the equivalent of real-time, on-board medical consults. The EIMO ecosystem is envisioned as a “system of systems” where embedded reference databases and multiple, real-time data streams continuously assess crew health and performance. EIMO will be designed to make recommendations to the CMO using multi-modal AI-based natural language processing and machine learning methods with interoperability to push/pull data within and between multiple vehicle and habitat architectures.

DISCUSSION: Data flows and storage/retrieval capacity are severely constrained during space missions and the challenges will become even greater during exploration missions. As past programs from Mercury to the International Space Station (ISS) required rethinking the interaction between ground-based controllers and space-based crew, so too will future missions to the Moon and Mars. While the NASA High-Performance Spaceflight Computing Processor project aims to increase computational capacity by 100 times over current spaceflight computers, the projected deliverable still lags considerably behind what will be needed to enable an AI-driven CDSS. Restrictions in processing speed and data storage capacity, coupled with transmission bottlenecks and delays, necessitate definition and optimization of an integrated data architecture to enable a progressively autonomous medical capability.