

TURNING LIMITATIONS INTO OPPORTUNITIES IN THE DEVELOPMENT OF THE ORION MEDICAL SYSTEM: INCORPORATION OF mHEALTH DEVICES

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INTRODUCTION: Selection of medical devices for the Orion medical system is a complex task which is dependent on the current state of terrestrial technology. In this work we review the interplay between NASA requirements, constraints, and opportunities for synergy during the development of the Orion medical system.

METHODS: The “plan to treat” list of conditions, and subsequently the medical resource list for the Orion Artemis II lunar flyby mission was completed using semi-quantitative methods. During this process, some medical resources were excluded to comply with mass and volume limits, while other resources applicable to multiple medical requirements were prioritized for inclusion. Choices were also examined considering NASA level of care standards for the Artemis design reference missions. As a means to optimize capabilities in spite of mass and volume constraints, ideas for integration of multiple devices into a single platform were explored, including a ‘hackathon’ challenge which was conducted to generate and evaluate concepts for combining medical devices into a single app-based mobile device (ultrasound, ECG, etc.).

RESULTS: The Orion team identified 128 medical conditions that we “plan to treat”, with 139 unique medical resources to address these conditions, including 5 digital diagnostic devices (ECG, otoscope, stethoscope, pulse oximeter, and blood pressure monitor). During selection of these digital devices the team noted that miniaturized medical devices often use mobile device platforms (mHealth), some displaying and transmitting data exclusively via mobile device. Of the 5 initially selected devices, all are capable of mobile connection, one which cannot function without a mobile device (ECG). Furthermore, only one of these devices connects natively to a Windows platform, which is currently the only operating system available on Orion.

DISCUSSION: Significant savings in mass and volume as well as training and usability improvements can be achieved by leveraging mHealth technologies. However, the platform presents significant challenges for deployment within the Artemis Program including lack of internet connectivity, incompatible operating systems, and radiation concerns. Each of these drawbacks are surmountable with investment in the supporting vehicle architecture, which may become necessary to support the technology trends seen in commercially available medical devices today.

Objective:

Learn about the opportunities and challenges of leveraging mHealth devices in the development of medical capabilities for austere environments.

Learn about the constraints of the NASA spaceflight environment with regards to digital medical device integration.

MOC Questions:

- 1) True or False: limitations due to programmatic requirements and mass/volume restrictions always lead to a reduced medical capability.

Answer: False: creative use of imposed limitations can result in more capability than would otherwise be expected.

- 2) Mission parameters that affect medical kit design include:
- a. organizational requirements
 - b. mass and volume limitations
 - c. operational environment
 - d. operator skill
 - e. all of the above

Answer: e. all of the above

- 3) Which of the following are not advantages of mHealth devices in spaceflight applications?
- a. reduced mass and volume
 - b. ease of training
 - c. ease of use
 - d. cloud connectivity

Answer: d. cloud connectivity; this is a problem that needs to be solved in order to fully harness the advantages of mHealth for spaceflight