NASA SBIR 2020 Phase I Solicitation

H12.05 Autonomous Medical Operations

Lead Center: JSC

Participating Center(s): ARC, GRC

Technology Area: TA6 Human Health, Life Support and Habitation Systems

Scope Title
Autonomous Medical Operations

Scope Description

Current medical operations on the International Space Station (ISS) rely significantly on the Mission Control Center (MCC) and telemedicine to enable Crew Health and Performance (CHP). Near real-time communications allow MCC staff (Flight Surgeons, Flight Controllers, etc.) to guide the crew when a medical scenario exceeds the crew's knowledge, skills or abilities. Prior to launch, crew are trained in the basic operation of the medical assets on the ISS and use detailed procedures to respond to a variety of planned and unplanned events. The training and procedures, however, are limited and do not adequately address the breadth of medical situations that may arise in flight. MCC expertise extends these capabilities allowing the crew to respond to an even larger set of events. Despite this, it is possible that some events will exceed the crew's and MCC's ability to respond and will require the crew to rapidly return to earth and seek definitive medical care in a hospital.

Mars missions, however, will not have real-time communications with MCC nor will they have a rapid return capability. Round trip communications between the surface of Mars and Earth is approximately 40 minutes and the return trip will be months, which significantly complicates NASA's current medical operations. Communication bandwidth considerations may also limit data transmission between the crew and MCC even in the event of high acuity medical situations. More specifically, a variety of existing ISS medical operations require the crew to 'Contact MCC' or 'Notify Surgeon' for additional instructions, a capability that will be significantly reduced on Mars. Examples of existing ISS medical operations can be found within the links found in the references section.

NASA requires new technologies that will enable a greater degree of autonomy and self-reliance for the crew and allow them to operate in a progressively Earth independent manner. These technologies should also be dual-purposed to enable MCC to better monitor and predict adverse conditions. Ideally, these solutions should require minimal mass, volume, power and/or crew time. Examples of technology developments can include, but are not limited to, advanced just-in-time training modalities, enhanced procedure execution technologies (augmented reality), autonomous physiologic monitoring and trend prediction, automated and in-situ diagnostic and image interpretation, multipurpose medical supplies and devices, etc. The best technology solutions will 1) maximize crew autonomy and self-reliance across a wide range of medical operations, 2) demonstrate how technology could be leveraged to prevent adverse medical conditions, and 3) extend the amount of time needed before MCC intervention is required.

References

http://spaceref.com/iss/medical.ops.html

https://www.nasa.gov/hrp/elements/exmc

Expected TRL or TRL range at completion of the project 2 to 4

Desired Deliverables of Phase II

Prototype, Hardware, Software

Desired Deliverables Description

Phase I Deliverable - Conceptual prototype of a monitoring device/algorithm and final report detailing the conceptual prototype and hardware/software development plans.

Phase II Deliverable - Completed monitoring device/algorithm, and final report on the development, testing, and validation of the tool.

State of the Art and Critical Gaps

There are a variety of innovative technologies that are being developed, but the bulk of this technology is either not yet in clinical practice or has not been translated to a clinical domain.

Relevance / Science Traceability

A significant portion of ISS Medical Operations procedures require MCC to properly execute a medical procedure. Contacting MCC on Mars will be significantly limited and technologies need to be developed that allow the crew to operate for longer periods of time without direct MCC interaction.