SPACE LIFE SCIENCES SYMPOSIUM (A1)
Medical Care for Humans in Space (3)

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MARS-TO-MARS ANALOGUE TELEMEDICINE SIMULATION FOR MEDICAL CRISIS MITIGATION

Abstract

Human space exploration (public and commercial) is evolving rapidly. Capabilities to support life (stabilization, resuscitation, treatment) and avoid evacuation to Earth's surface in the event of a medical crisis currently do not exist. For missions in low earth orbit (i.e. International Space Station), a crew-member may not survive the hemodynamic challenges of re-entry into Earth's atmosphere. For exploration outside this envelope (i.e. Mars mission), the only crisis mitigation strategy is in-situ medical care. The International Space Surgery Consortium (ISSC), a collaborative of specialists in anesthesia/critical care, surgery, and remote medicine, was founded to develop the knowledge base, tools, and protocols for space-based medical delivery and crisis management, a paradigm-shift from LEO-tethered medical care. ISSC undertook a pilot study to assess minimally-trained personnel in a simulated medical crisis, while receiving remote guidance from trained surgeons and anesthesiologists.

Two simulations were conducted on an analogue crew immersed in a 2-week simulated Mars habitat in Utah (Mars Desert Research Station MarsCrew134). Telemedicine support was provided by simulated Mars surface/orbital teams with intermittent, bandwidth-limited communication via video-Skype/satellite (US, France, Antarctic Concordia Station/ESA). The scenario required rescue and stabilization of a de-conditioned astronaut suffering post-traumatic hemorrhagic shock on the Martian surface. Non-medical

crew were guided in resuscitation, general anesthesia with intubation, and surgical stabilization of the injured astronaut (torso-mannequin/software). A laptop-based anesthesia protocol was prepared in advance for the crew, refined to accommodate crisis points identified between simulations.

Pilot simulations were evaluated via video review and participant debriefing.Technical shortcomings included limited crew clinical observation skills, technique, and misidentified/missing instruments. Cognitive and communication problems occurred due to time-delays, bandwidth, medical terminology, international styles, and interactions between lead and assistant surgeon. Video resolution was sometimes insufficient for the telemedicine team to properly direct the Mars crew. Finally, fatigue, psychological stress, and retention limited Mars crew's ability to implement remote medical direction.

ISSC and Concordia focused on improving communications, and developing assessment tools to evaluate the deployable clinical knowledge of crew, technical performance, and crisis resource management. The conduct of simulations in academic simulation centers with varied crew composition, equipment and resources, and differing levels of remote mentoring can complement simulations in longer-duration analogue environments.

ISSC intends to provide leadership in developing and testing space-based medical capabilities, and then integrating these with Earth-based applications. These technologies can then be deployed to deliver telemedicine care to remote (i.e. Antarctica) and underserved populations on Earth.