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UTILIZING VIRTUAL, HYBRID, AND AUGMENTED REALITY TO ENHANCE SURGICAL TRAINING AND PREPAREDNESS FOR LONG-DURATION SPACE MISSIONS

Abstract

BACKGROUND: Surgical disease poses a significant threat to the health of crews on long-duration expeditions in a multitude of austere environments, including deep space. The Space Medicine community has enjoyed a boom in research and understanding of the biomedical implications of spaceflight exposure in recent years; nearly every physiologic system of the body is impacted, and many of the effects are time-dependent, rendering crews embarking on multi-year exploration-class missions at increased risk of surgical illness or injury. To manage surgical disease as it arises, Crew Medical Officer (CMO) proficiency in a series of invasive medical procedures will be necessary. Virtual, hybrid, and augmented reality platforms offer valuable and versatile alternatives to standard terrestrial medical instruction modalities, with particular relevance to the domain of surgical care.

OVERVIEW: Medical readiness for austere missions demands that a CMO be prepared to intervene procedurally in the event of emergency. While the field of Aerospace Medicine has reaped great benefits from the digitization of medical care and training in recent years, further reduction of astronaut health risk can be achieved by streamlining and fortifying CMO preparedness for surgical care in the exploration-class space mission setting. An effective tool aimed at ensuring readiness to respond to both medical and surgical emergencies should include key invasive procedures – such as percutaneous drain placement for management of intraperitoneal abscess due to perforated appendicitis – to allow for treatment of high-risk conditions as they arise. Platforms that incorporate virtual, hybrid, and augmented reality offer low-power, low-mass, and low-volume training solutions with fully immersive experiences, providing a realistic opportunity for crews to reap the benefits of skill sharpening and maintenance throughout the course of a long-duration mission.

DISCUSSION: Communication delays on upcoming exploration-class space missions will inhibit real-time interaction with ground-based resources during surgical emergencies, and engineering design constraints will limit the availability of standard terrestrial training tools inflight. To optimize crew health and performance on long-duration missions, a concise and effective surgical training program that minimizes demands on available mass, power, and volume in a spacecraft is necessary. This presentation will highlight opportunities to leverage existing VR/HR/AR technologies in support of crew medical and surgical health and readiness for future space exploration.