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SPACER: THE FIRST ON-ORBIT EMERGENCY ROOM REVOLUTIONIZING SPACE MEDICINE FOR LONG-DURATION MISSIONS

Abstract

The expansion of human presence beyond Earth, from lunar missions to future Mars expeditions, necessitates innovative solutions to address medical emergencies in space. In response to these challenges, we propose **spacER**, a specialized emergency medical module designed to integrate seamlessly with existing space stations and habitats. The module aims to provide rapid, on-site medical intervention, reducing reliance on Earth-based support.

Current spacecraft carry essential medical kits, but they lack comprehensive emergency care solutions tailored for long-duration missions. SpacER is designed to bridge this gap by incorporating cutting-edge medical technologies suited for microgravity environments, including AI-driven diagnostics, advanced telemedicine, UV sterilization, and a suite of specialized equipment. Additional solutions include 3D printing capabilities that enable bioprinting, as well as robotic systems that support the execution of precise surgical operations.

Ensuring astronaut health and mission continuity is a primary concern in deep-space travel. SpacER seeks to enhance in-orbit medical preparedness through a modular and scalable facility capable of responding to medical crises without the need for emergency evacuations to Earth. The SpacER system is designed to dock with existing space habitats, featuring a controlled microgravity medical environment. AI-supported diagnostic tools will assist medical professionals on Earth in guiding astronaut care. The medical bay includes an autonomous monitoring system, sterile surgical tools, and emergency stabilization protocols optimized for space conditions.

Preliminary industry research indicates strong interest in SpacER from space agencies and commercial operators. Comparative analysis with current in-space medical capabilities highlights SpacER's advan-

tages in providing real-time emergency intervention, thereby improving astronaut safety and mission resilience. SpacER represents a transformative step in space medicine, addressing a critical gap in long-duration mission healthcare. Future research will focus on prototype development, validation through analog missions, and strategic collaborations with industry leaders to refine operational viability.