ARTEMIS II MISSION MEDICAL RISK: A COMPARISON OF THE IMPACT AND IMM MODELING TOOLS

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INTRODUCTION: The Artemis program aims to return astronauts to the Moon to test novel technologies and maintain a long-term presence off planet in preparation for human missions to Mars. NASA has developed modeling tools that predict medical events and outcomes to aid mission planners in the development of medical systems for these complex mission profiles. While the Integrated Medical Model (IMM) tool was operationalized for medical system development on the International Space Station (ISS), it does not have the capability to model lunar surface missions. As a result, NASA recently developed the Informing Mission Planners via Assessment of Complex Tradespaces (IMPACT) tool to meet this need. This presentation aims to compare the IMM and IMPACT results of a simulated Artemis II mission to demonstrate its capabilities.

METHODS: The IMM and IMPACT tools were used to independently model the Artemis II mission. This mission was composed of 4 crewmembers, 1 female 3 males, on a 9-day mission aboard the Orion capsule with a 13.3kg medical system. Outcome metrics for both tools included medical events, crew mortality, medical evacuation, effects on crew performance, and medical resource requirements. Conditions specific to extravehicular activity (EVA), partial gravity, and long duration flight were removed. Both tools were optimized for crew performance with 500,000 trials performed to reach risk metric convergence.

RESULTS: IMM and IMPACT had similar risk profiles for crew mortality (0.0002 vs 0.0001 events/mission) and performance effects (95.64% vs 94.062%), but different rates of medical evacuation (0.003 vs 0.006 events/mission). Outputs from both tools revealed the conditions most likely to impair performance were space adaptation related. Mortality and medical evacuation risk were most influenced by infectious conditions in IMM and environmental exposures in IMPACT.

DISCUSSION: Both tools performed similarly and predicted a very low overall mission medical risk for Artemis II, however both had limitations. IMPACT likely overpredicts conditions for short missions that are typically associated with long duration flight while IMM cannot model more complex profiles. For future missions, the IMPACT tool is anticipated to produce more valuable results for mission planners developing medical systems for missions beyond LEO.

LEARNING OBJECTIVES

1) Understand the utility of medical risk modeling tools
2) Compare and contrast the IMM and IMPACT results
3) Understand the limitations of each tool and how they may be used for future human spaceflight missions