

## **PRELIMINARY MEDICAL RISK ESTIMATES AND CLINICAL CAPABILITY NEEDS FOR ARTEMIS IV**

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### **BACKGROUND**

Human exploration spaceflight missions to the Moon and Mars present unprecedented challenges for in-mission medical care. Compared with the ISS, the greater distance from Earth will mean increased mission durations, communication delays, limited to no resupply opportunities, and significant limitations on the evacuation of ill or injured crew. Spacecraft mass, volume, and power will be curtailed while higher demands will be placed on the crew's knowledge, skills, and abilities.

In this higher risk environment, it is important to: a) quantitatively estimate human system risk attributable to medical conditions, a process known as Probabilistic Risk Analysis, and b) use these estimates to inform medical system design.

IMPACT (Informing Mission Planning via Analysis of Complex Tradespaces) is a PRA and medical trade space analysis tool developed by NASA to advance exploration mission medical system design. IMPACT v1.0 improves upon and will soon replace NASA's existing tool, the Integrated Medical Model, with: a novel evidence base baselined to exploration environments; an expanded list of 119 medical conditions; a significant increase in the number of medical resources that can be utilized and in the flexibility of their use; and the modelling of time lost performing mission-specific tasks due to medical conditions.

### **METHODOLOGY:**

This abstract will present IMPACT estimates of medical system risk and clinical capability needs for the Artemis IV mission. Artemis IV is currently scheduled for 2026 and will visit the Gateway space station in lunar orbit prior to the second lunar landing of the Artemis program.

The baseline Artemis IV mission that was modeled was 28 days in duration with phases including Orion outbound, 4 days on the Gateway space station in lunar orbit, 2 crew on the surface of the Moon for approximately one week, an additional 5 days on Gateway, and then return to Earth. This baseline was compared to two alternative 34-day design reference missions (DRMs) that shifted the lunar sortie earlier or later in the mission profile. Assumptions included 2 female and 2 male crew and a notional medical system mass of 25 kg.

Medical system risk estimates include loss of crew life (LOCL), consideration of medical evacuation (known as return to definitive care – RTDC), and an estimate of crew time lost due to medical conditions (Task Time Lost – TTL). The presentation will also describe the medical conditions that are the greatest drivers of risk as well as the clinical capabilities and resources that have the largest effect on risk.

### **RESULTS:**

All three DRMs had very low probability of LOCL from medical conditions, primarily due to short duration. RTDC was also similar across the DRMs. In contrast, TTL was higher in the early lunar sortie DRM due to earlier occurrence of EVA-related medical conditions. Taken as a whole, there was no clinically significant difference in medical risk across the three missions.

Results for clinical capabilities and an example medical equipment list will be discussed but were similar across DRMs.