

PRELIMINARY MEDICAL RISK ESTIMATES AND CLINICAL CAPABILITY NEEDS FOR LATE ARTEMIS MISSIONS

Exploration Medical Capability, NASA Human Research Program

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“Expanding the Boundaries of Space Medicine and Technology”

*Investigators' Workshop
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Review results of a late Artemis Mission IMPACT run:

- Representative Artemis DRM
 - Preset parameters of 50 kg and 150L
- Medical condition frequency
- Conditions influencing outcomes:
 - Loss of Crew Life (LOCL)
 - Return to Definitive Care (RTDC)
 - Task Time Lost (TTL)



Problem Space

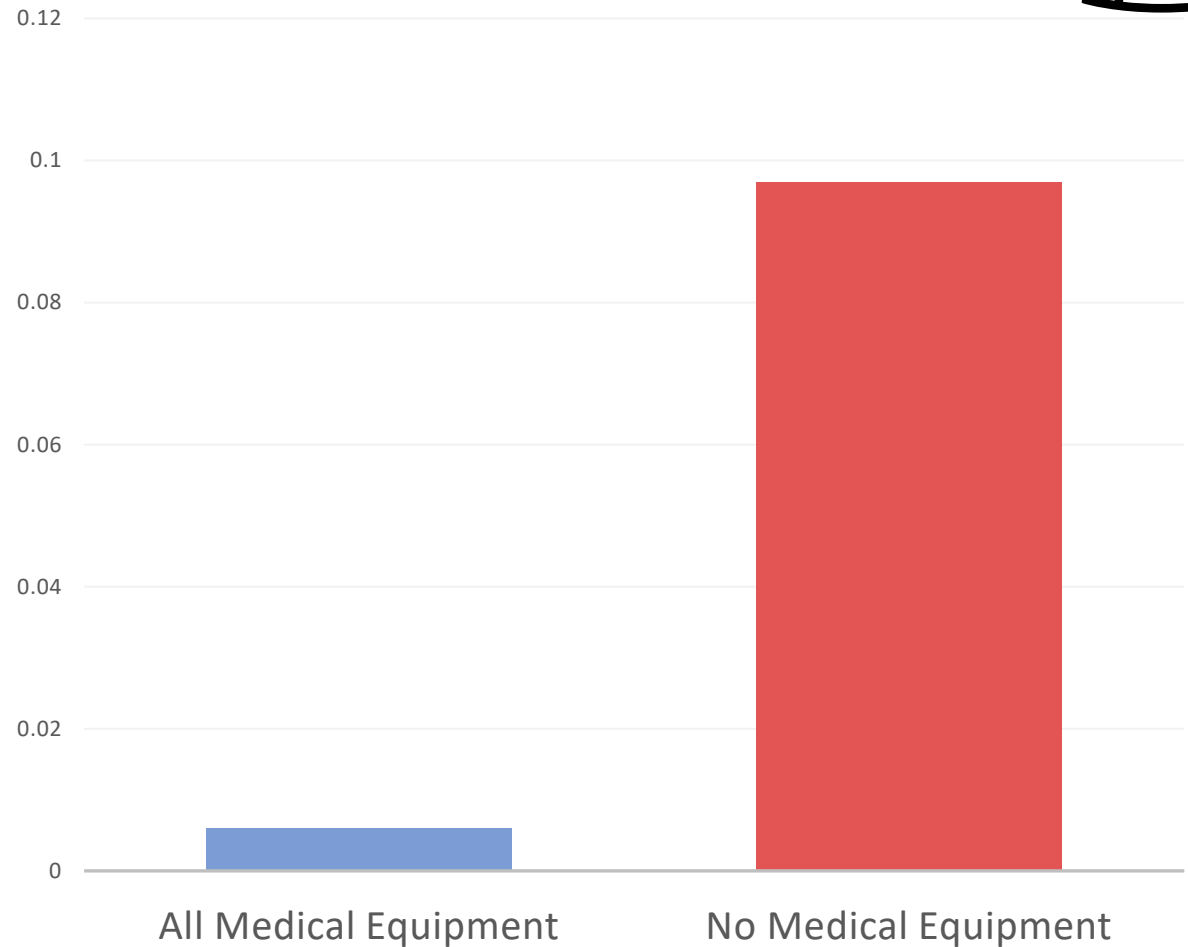
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Loss of Crew Life

- **All Medical Equipment:**
 - *0.006 events/mission*
 - 6 deaths in 1000 missions
- **No Medical Equipment:**
 - *0.097 events/mission*
 - 1 death in ~10 missions



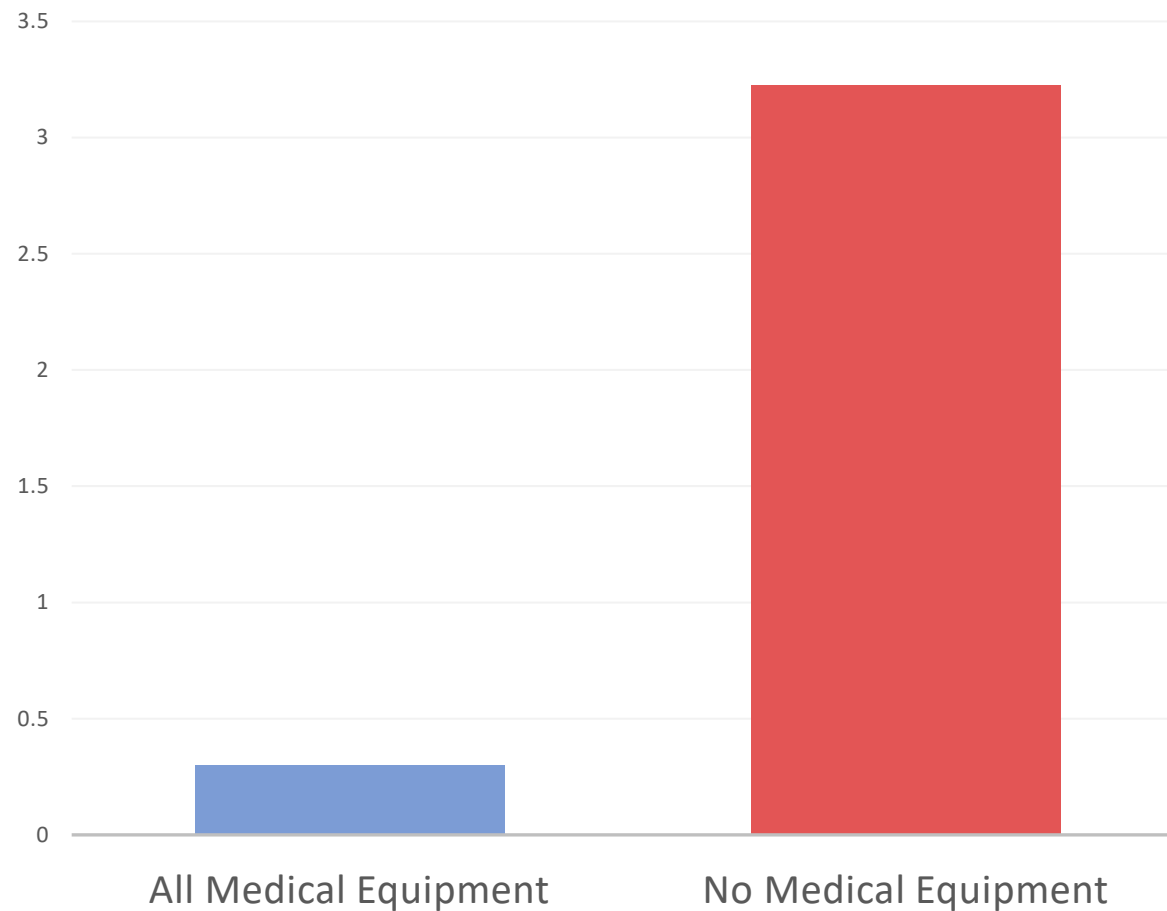
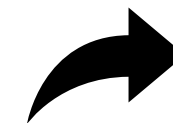
Risk of Loss of Crew Life



Return to Definitive Care

- **All Medical Equipment:**
 - *0.3 events/mission*
 - Risk of RTDC 1 every 3 missions
- **No Medical Equipment:**
 - *3.22 events/mission*
 - Risk of RTDC 3x per mission

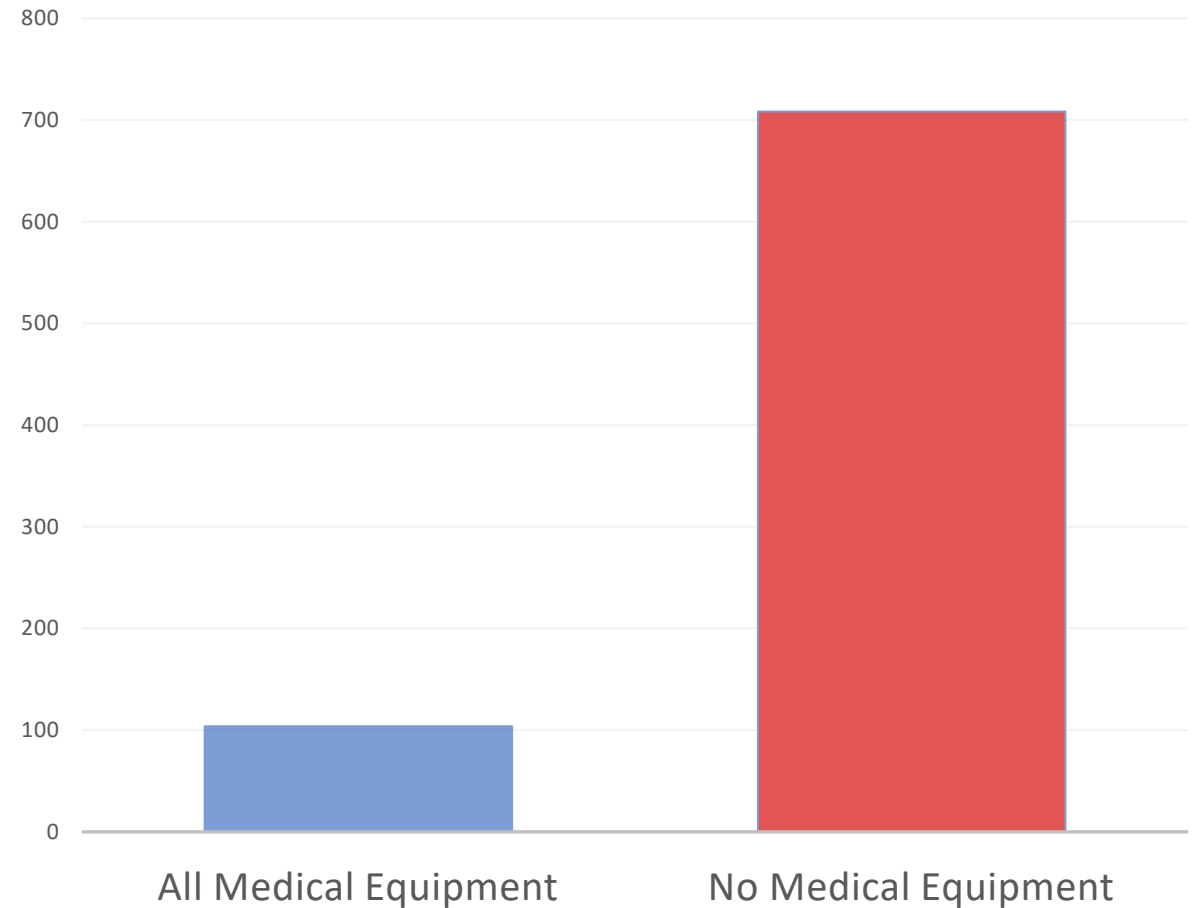
Return to Definitive Care



Task Time Lost

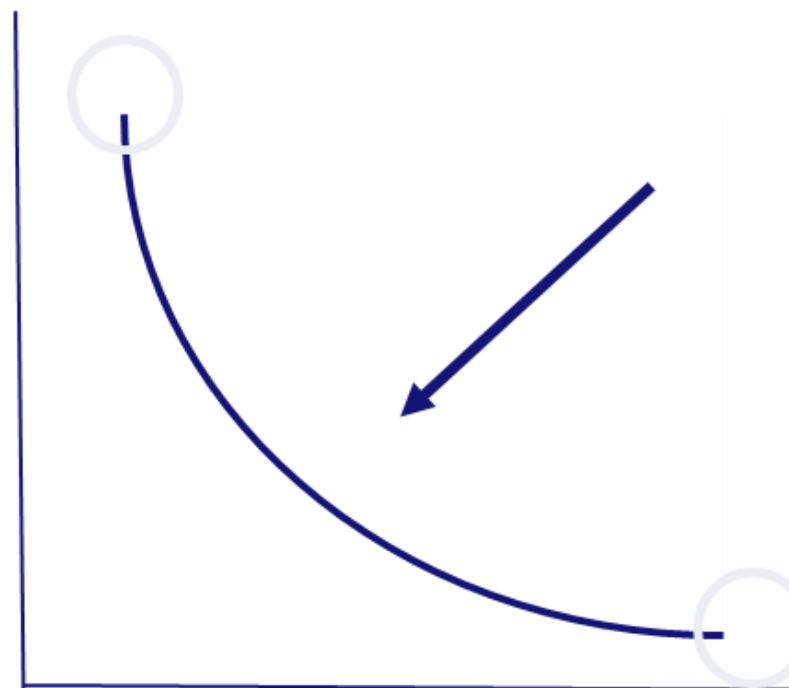
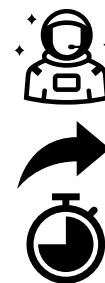
- **All Medical Equipment:**
 - *103d/mission*
 - 103 days of crew time will be affected by illness/injury
- **No Medical Equipment:**
 - *708d/mission*
 - 708 days of crew time will be affected by illness/injury

Task Time Lost



- **Optimal System Size?**
 - Identify inflection points in medical risk
 - System size reasonable for 9 month mission
 - Did not select clinical threshold
 - Acceptable risk of LOCL = 0

Risk

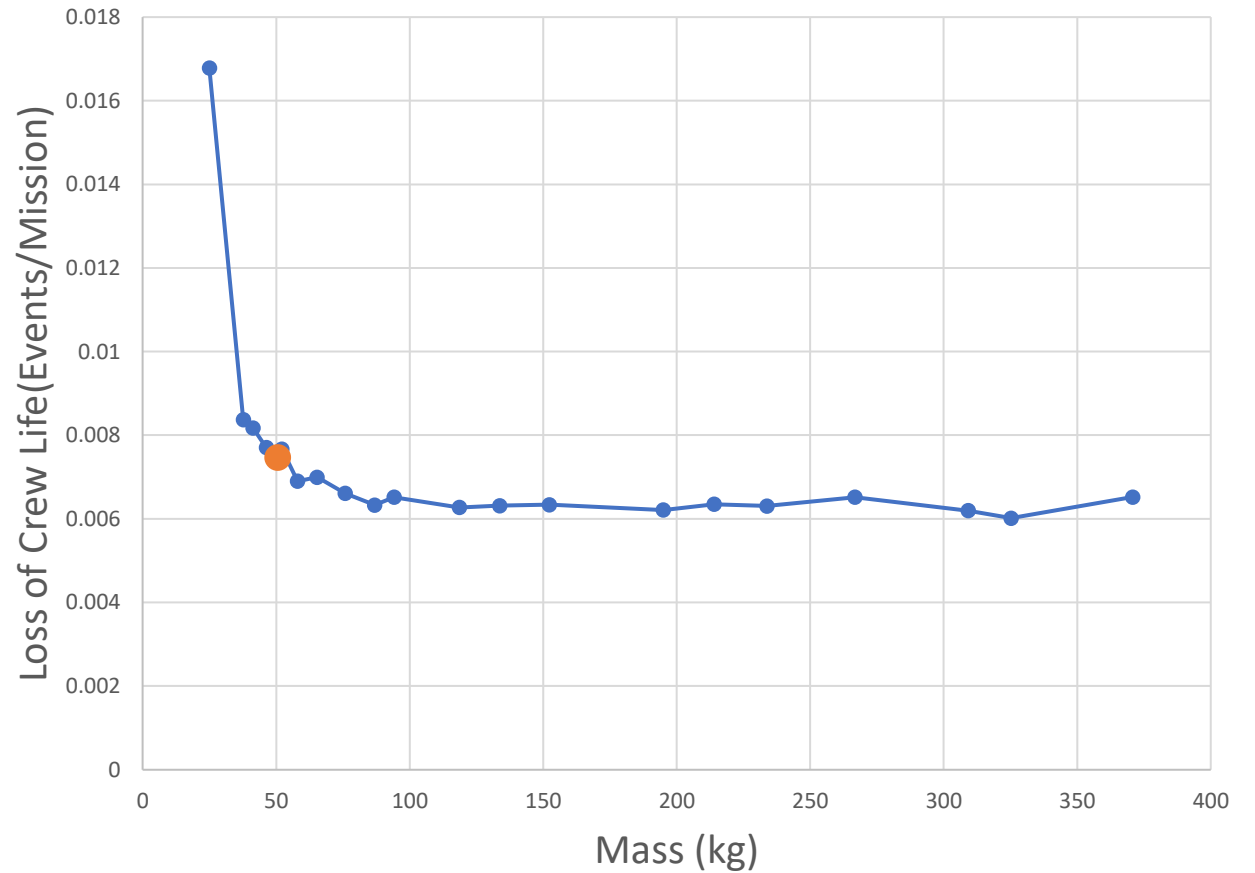


Medical System Size
(mass and volume)

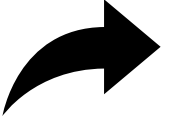


- **Loss of Crew Life**
 - Inflection Point: ~50kg

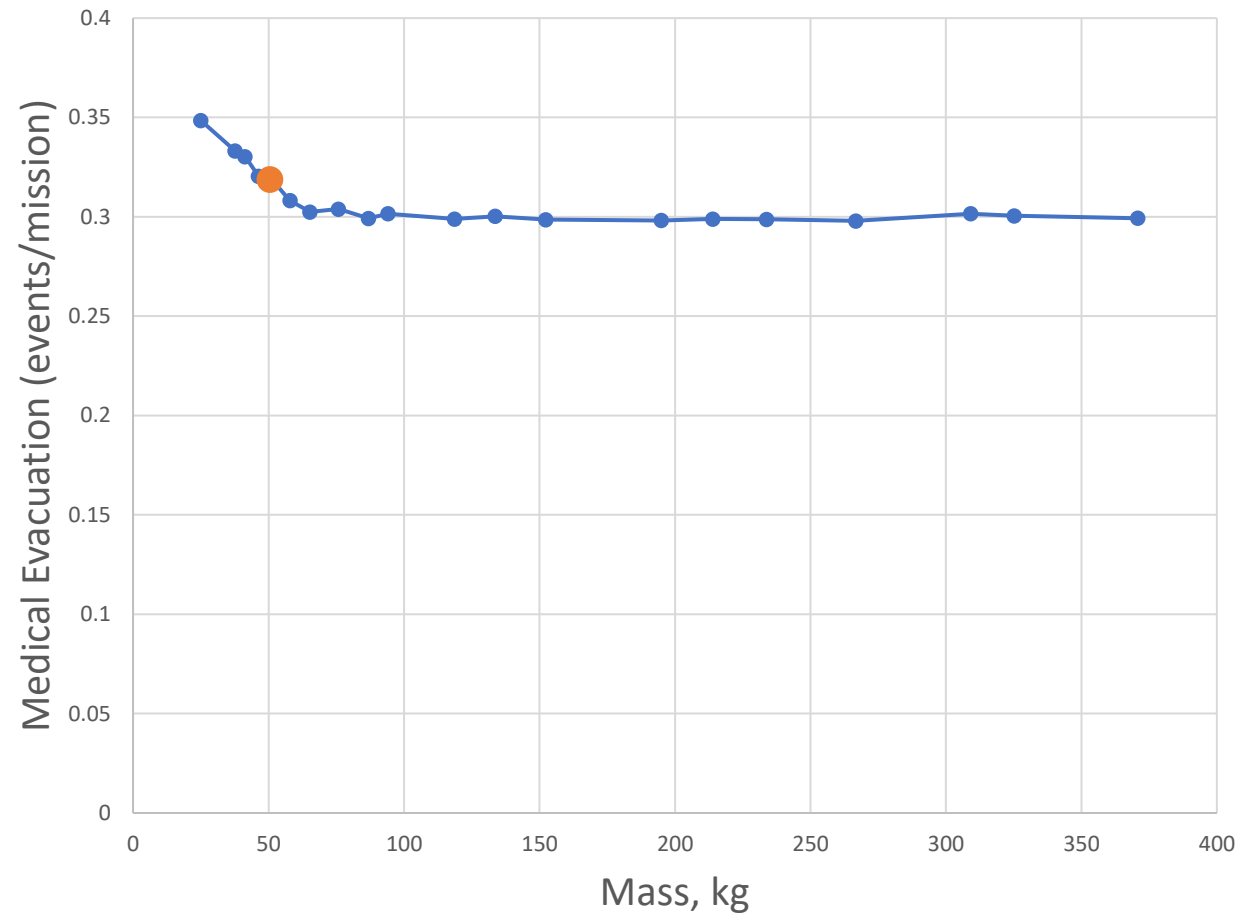
Risk of Loss of Crew Life



- **Return to Definitive Care**
 - Inflection point: 50kg

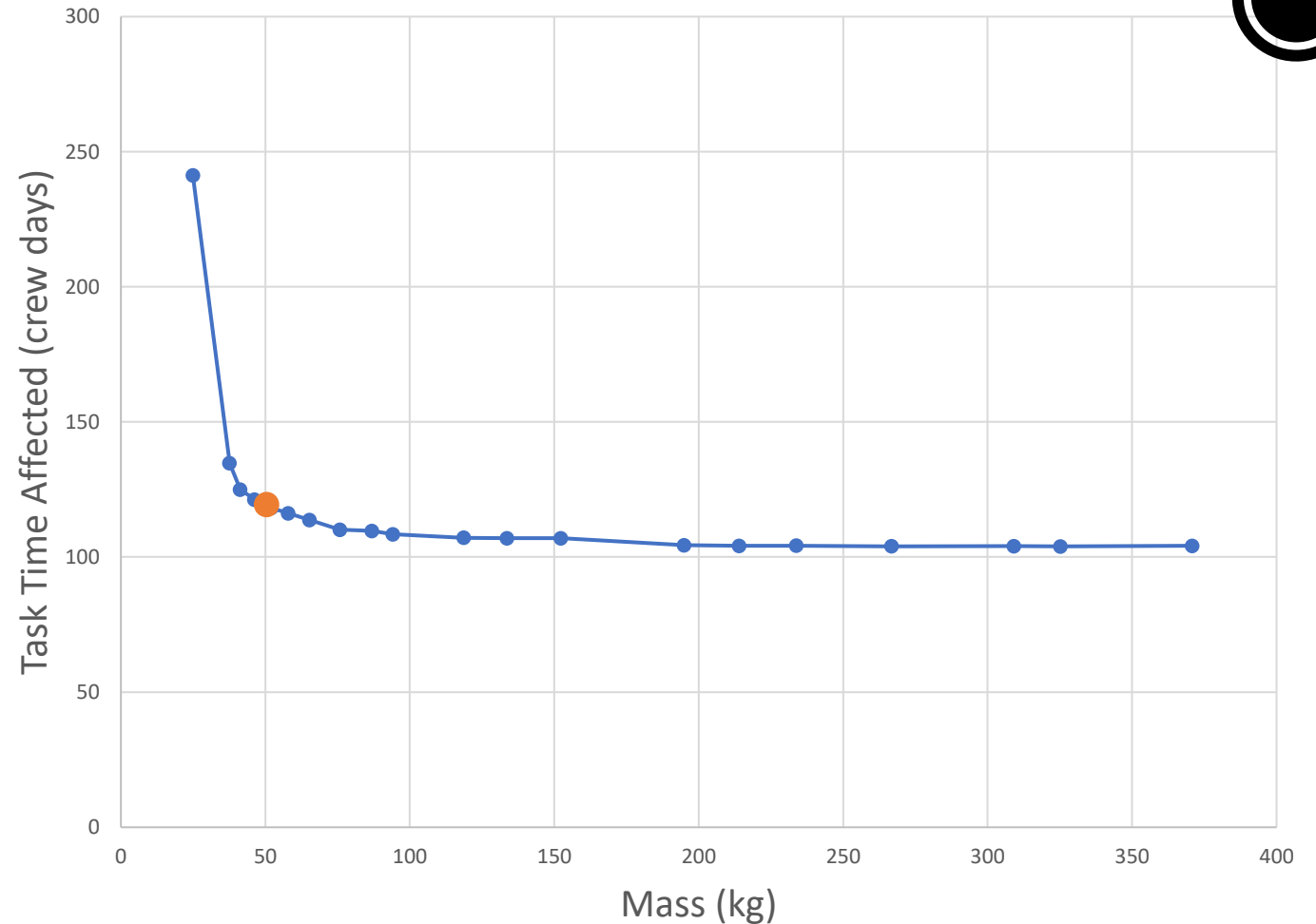


Return to Definitive Care

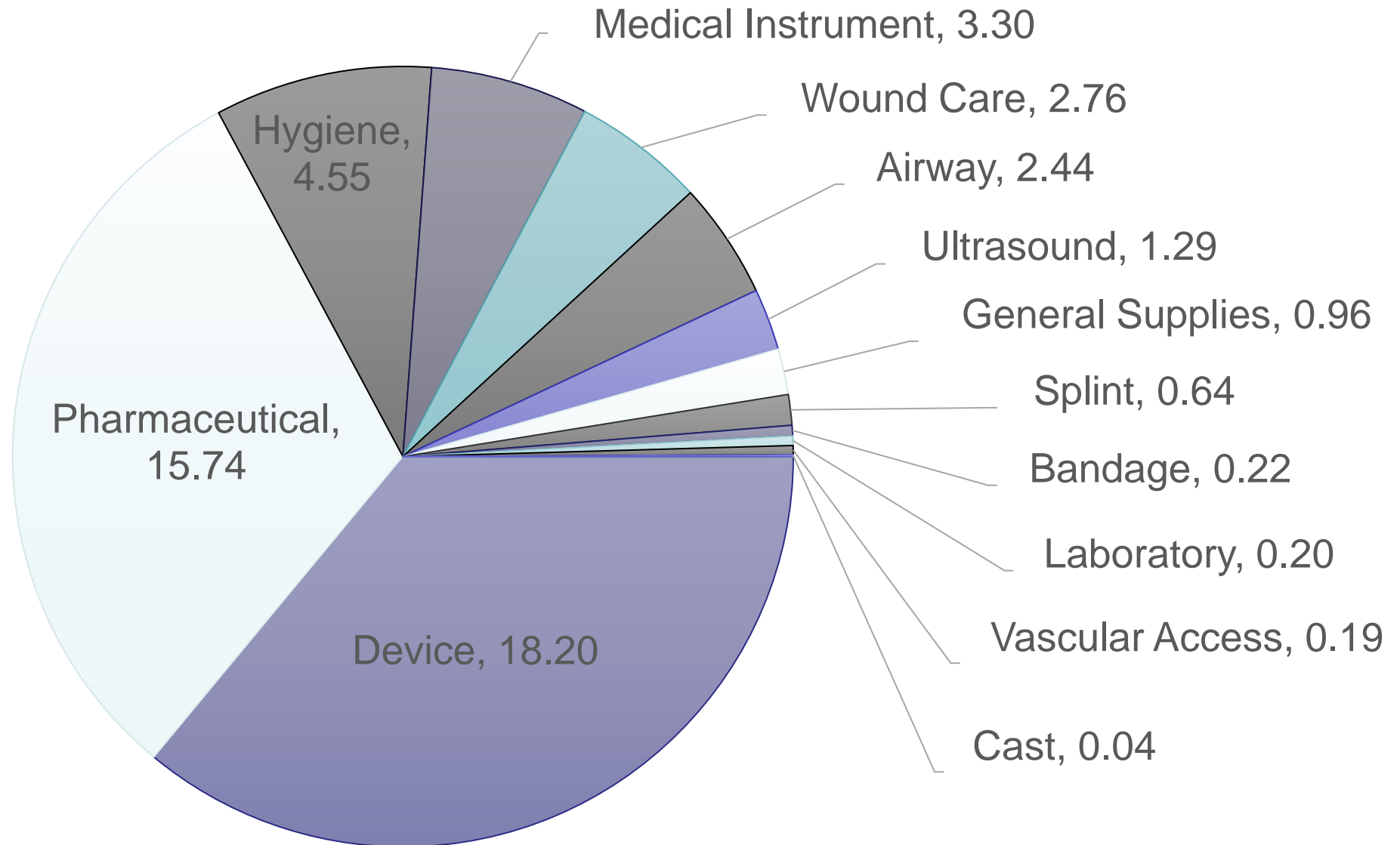


- **Task Time Lost**
 - Inflection point: 50kg

Task Time Lost

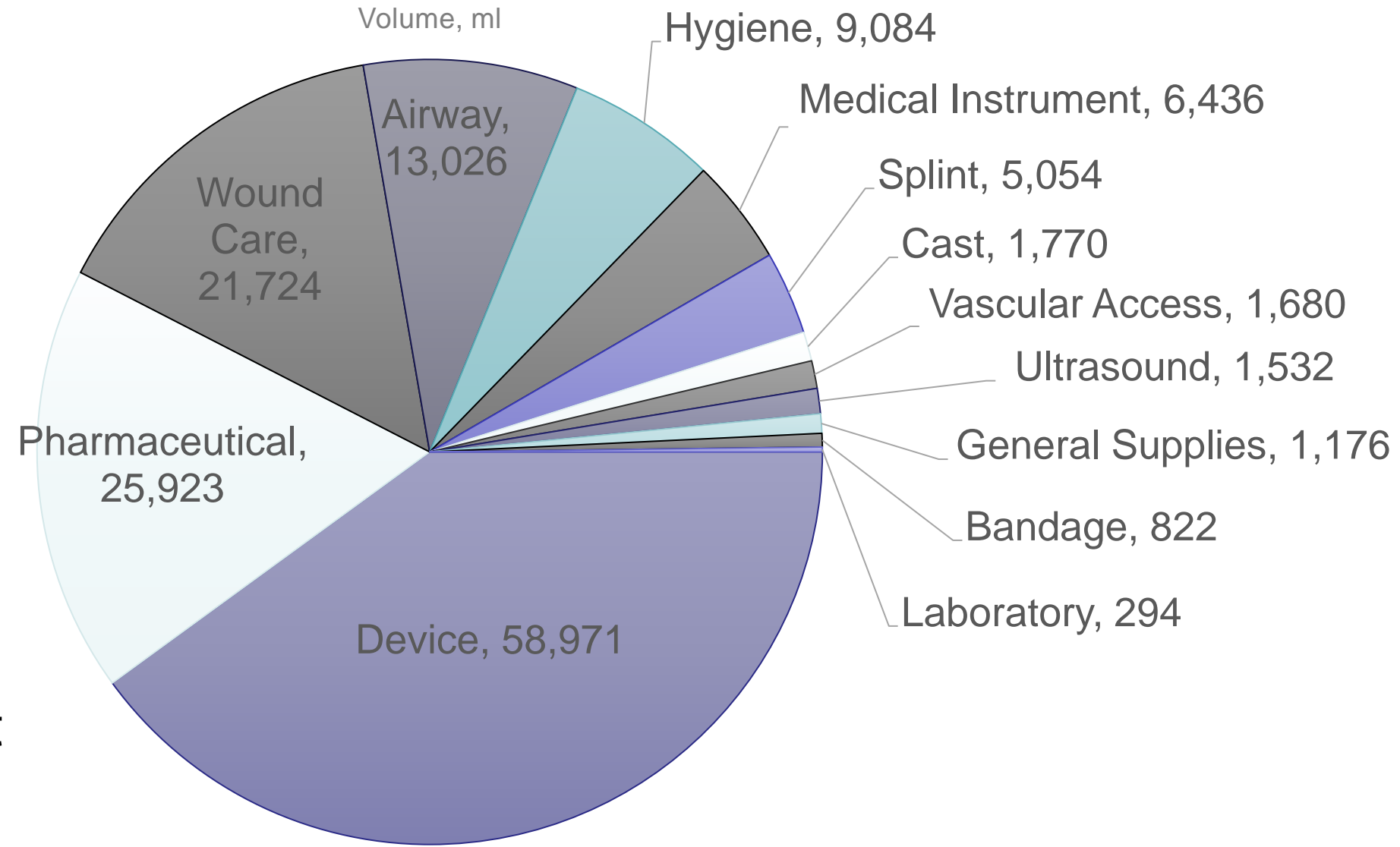


Overview of Resources by Mass in the Medical System



Total Mass
Limit of 50 kg

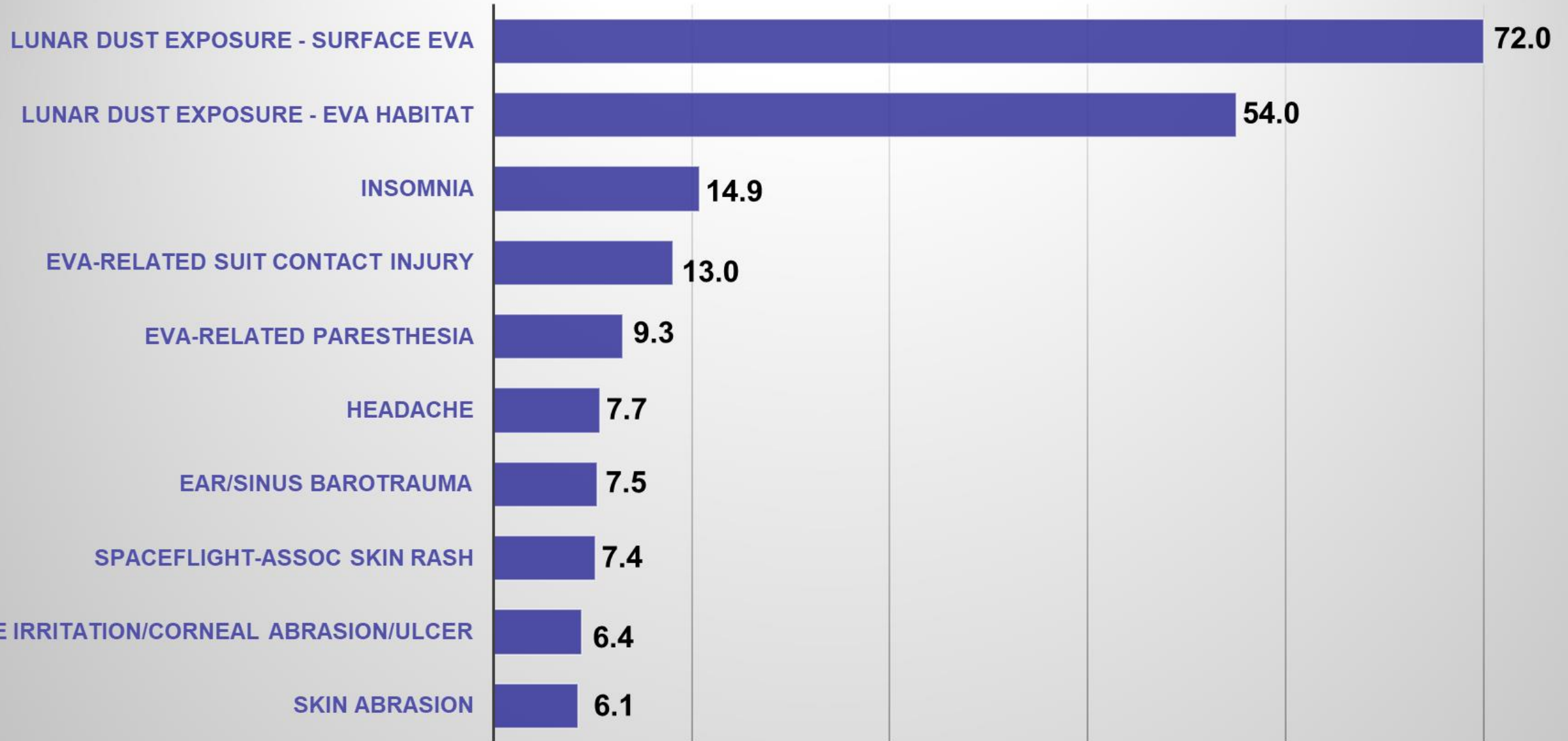
Overview of Resources by Volume in the Medical System



Total Volume Limit of 150,000 mL

Most Likely Conditions

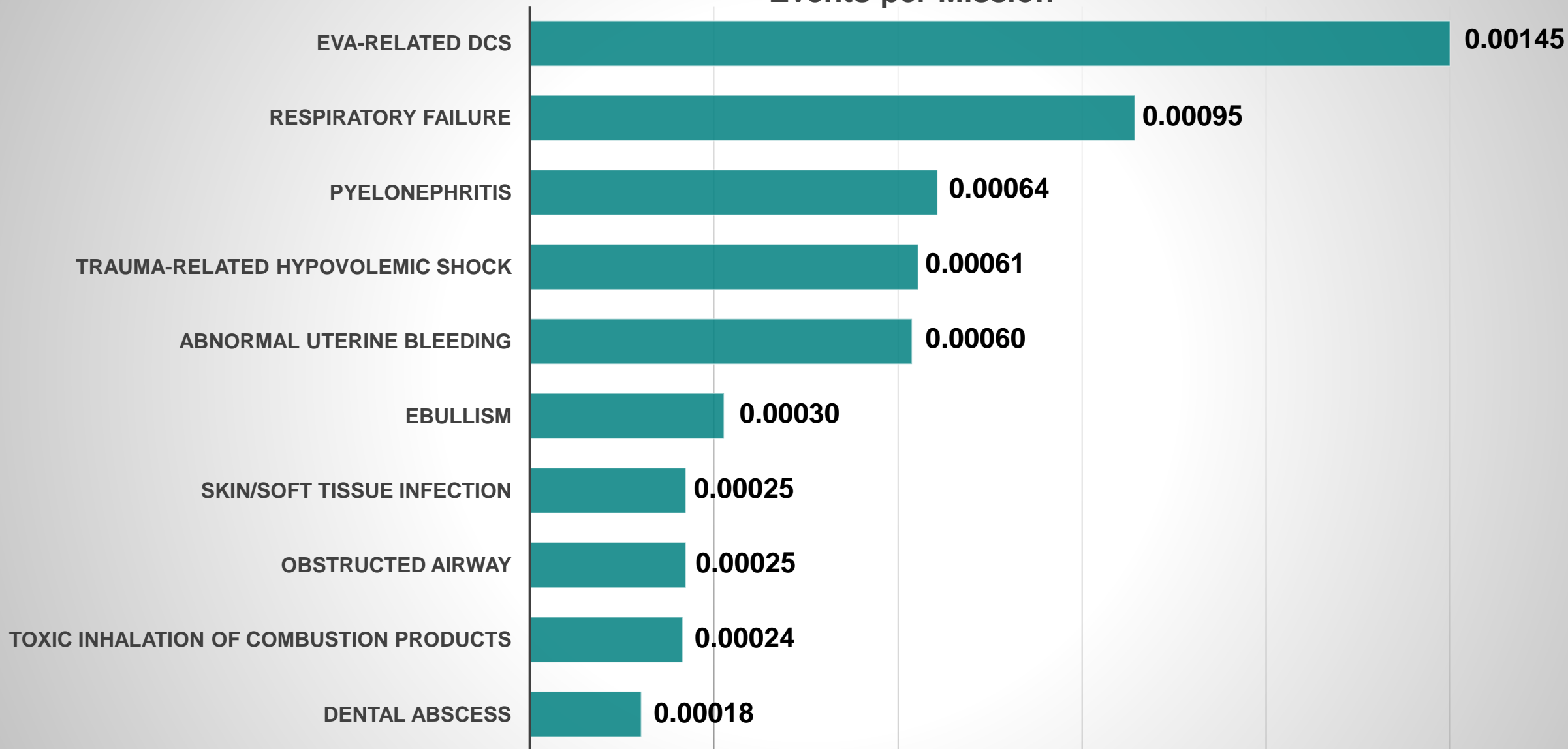
Number of Events Per Mission



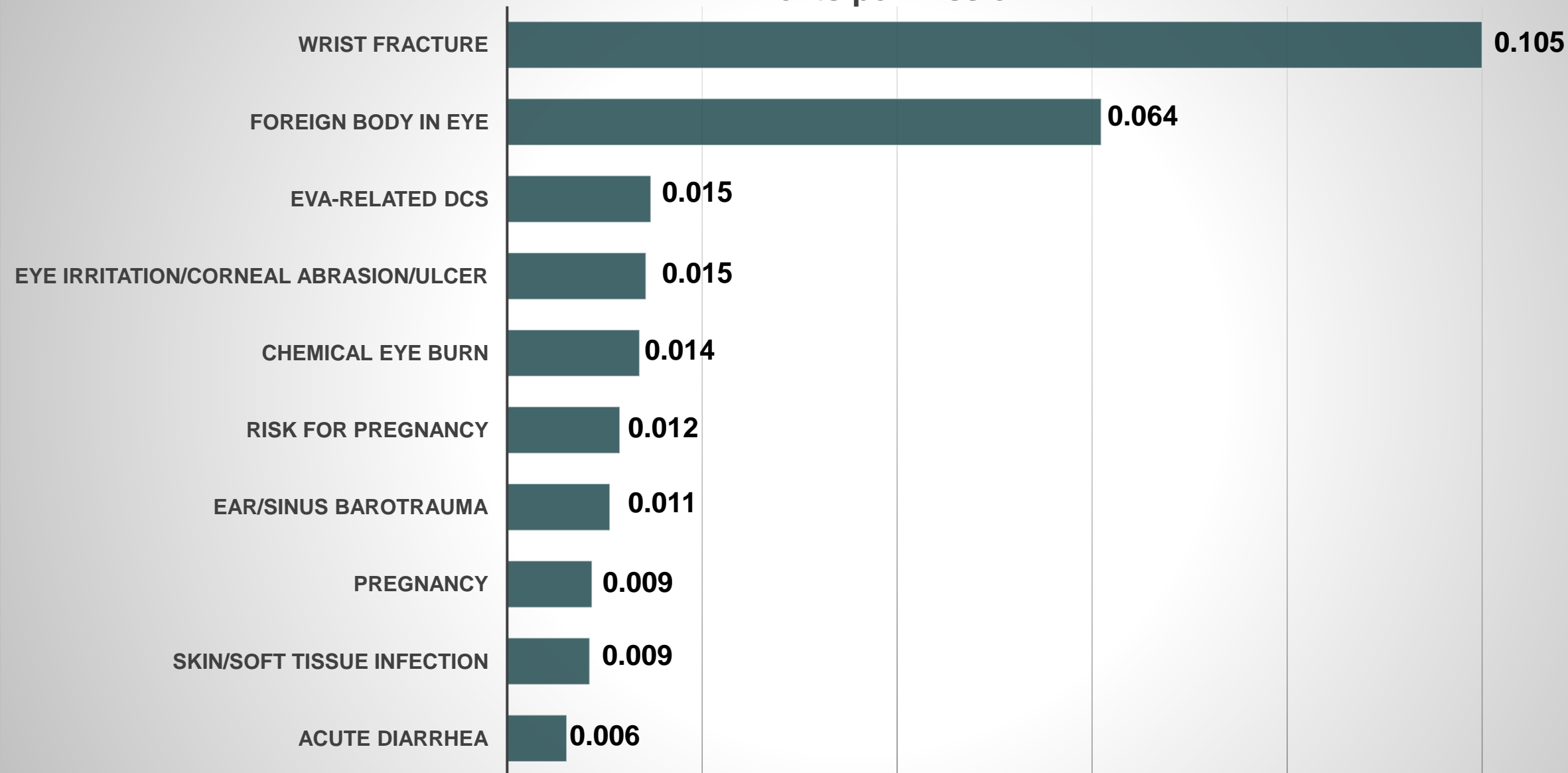


CONDITIONS INFLUENCING RISK

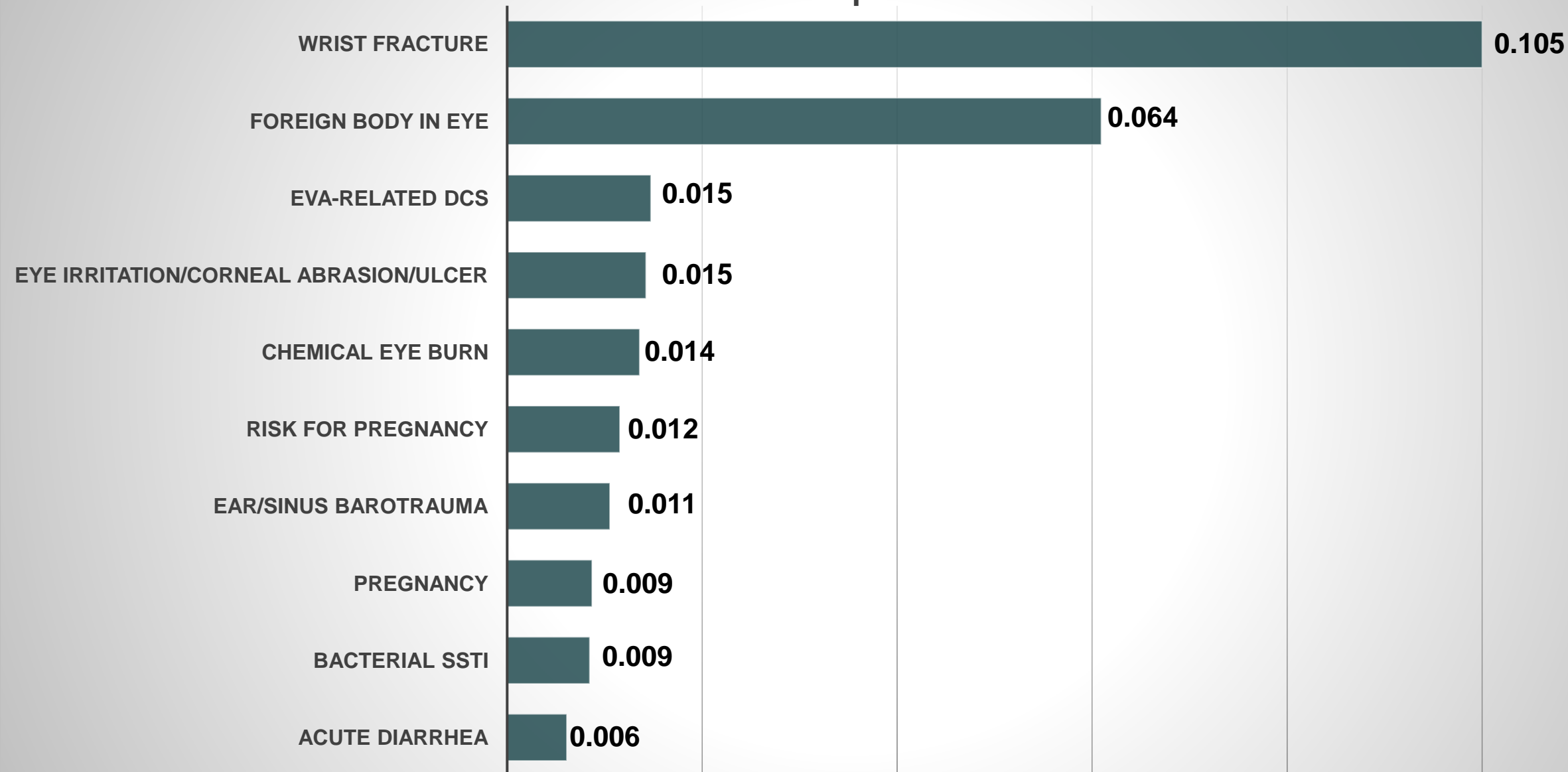
Events per Mission



Events per Mission

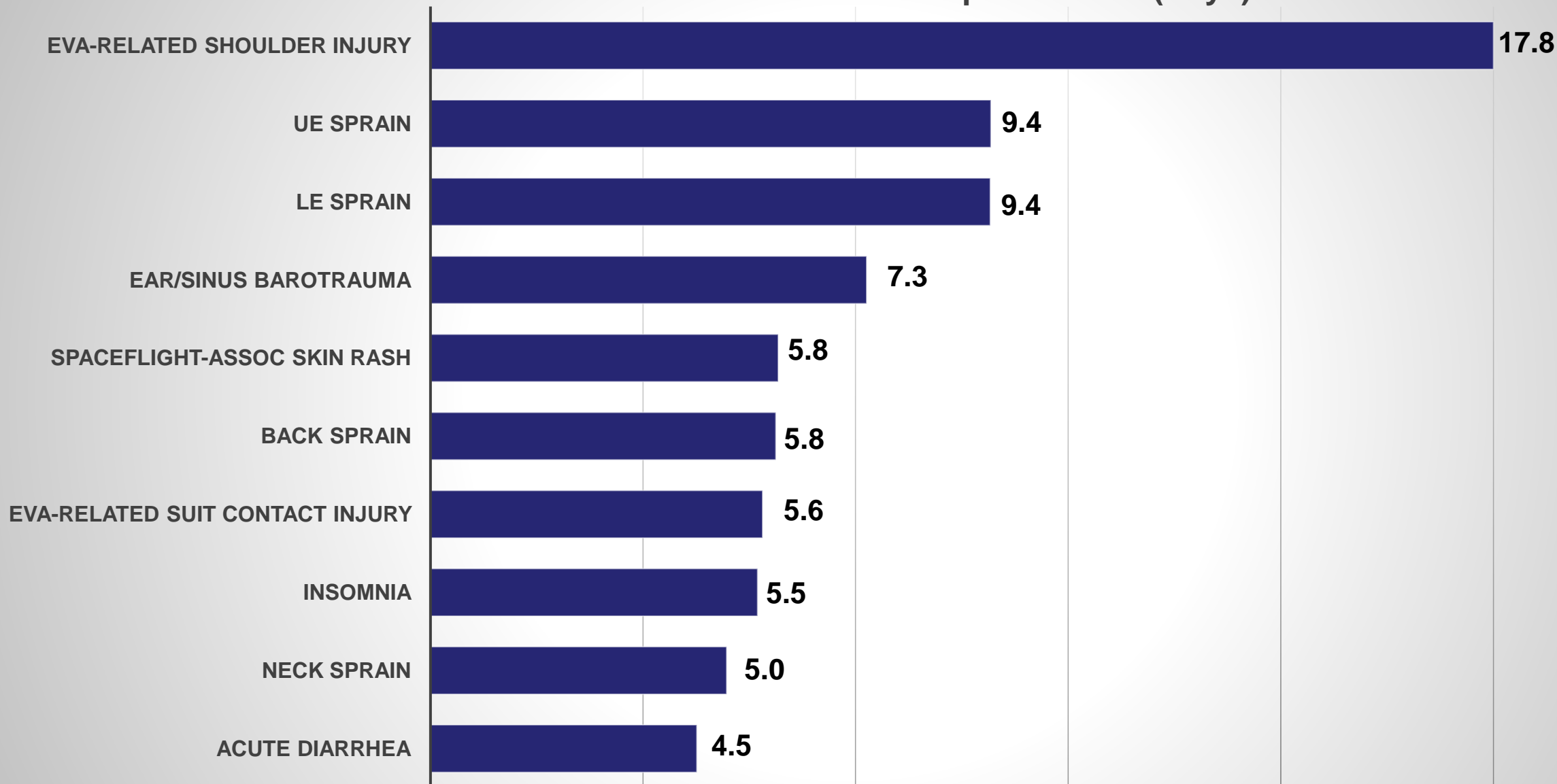


Events per Mission



TTL – Days per Mission

Total Task Time Lost per Mission (Days)



- Future Updates
 - Modeling more complex mission profiles
 - Separate initial medical system from re-supply
 - Adapting model to specifications of mission planners



IMPACT provides a quantitative method to estimate medical risk for exploration missions



Sophisticated ability to define a medical system's capabilities by trading medical risk against system resources



Progressive updates to increase fidelity with increasing complexity of missions, update evidence or tailor to co-morbidities.



NASA will begin using IMPACT for medical risk modelling this year

Questions?

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