The Integrated Medical Model – A Risk Assessment and Decision Support Tool for Space Flight Medical Systems

Eric Kerstman, MD, MPH[1], Charles Minard PhD[2], Lynn Saile, RN,MS[2], Mary Freire de Carvalho, PhD[2], Jerry Myers, PhD[3], Marlei Walton, PhD[2], Douglas Butler, MBA[2], Sriram Iyengar, PhD[4], Kathy Johnson-Throop, PhD[5], David Baumann, PhD[5]

[1]University of Texas Medical Branch, Galveston, TX; [2]Wyle, Houston, TX; [3]NASA Glenn Research Center, Cleveland, OH; [4]University of Texas Health Science Center, Houston, TX; [5]NASA Johnson Space Center, Houston, TX

Introduction

The Integrated Medical Model (IMM) is a decision support tool that is useful to mission planners and medical system designers in assessing risks and designing medical systems for space flight missions. The IMM provides an evidence–based approach for optimizing medical resources and minimizing risks within space flight operational constraints.

Methods

The mathematical relationships among mission and crew profiles, medical condition incidence data, in-flight medical resources, potential crew functional impairments, and clinical end-states are established to determine probable mission outcomes. Stochastic computational methods are used to forecast probability distributions of crew health and medical resource utilization, as well as estimates of medical evacuation and loss of crew life. The IMM has been used in support of the International Space Station (ISS) medical kit redesign, the medical component of the ISS Probabilistic Risk Assessment, and the development of the Constellation Medical Conditions List. The IMM also will be used to refine medical requirements for the Constellation program.

Discussion

The IMM outputs for ISS and Constellation design reference missions will be presented to demonstrate the potential of the IMM in assessing risks, planning missions, and designing medical systems. The implementation of the IMM verification and validation plan will be reviewed. Additional planned capabilities of the IMM, including optimization techniques and the inclusion of a mission timeline, will be discussed.

Conclusions

Given the space flight constraints of mass, volume, and crew medical training, the IMM is a valuable risk assessment and decision support tool for medical system design and mission planning.

Learning Objectives

1. The audience will learn how probabilistic risk assessment methods can be used to optimize medical systems and minimize risks within the constraints of specified space flight missions.