

HUMAN FACTORS AND ISS MEDICAL SYSTEMS: HIGHLIGHTS OF PROCEDURES AND EQUIPMENT FINDINGS

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As part of the Space Human Factors Engineering Critical Questions Roadmap, a three-year Technology Development Project (TDP) was funded by NASA Headquarters to examine emergency medical procedures on ISS. The overall aim of the emergency medical procedures project was to determine the human factors issues in the procedures, training, communications and equipment, and to recommend solutions that will improve the survival rate of crewmembers in the event of a medical emergency. Currently, each ISS crew remains on-orbit for six-month intervals. As there is not standing requirement for a physician crewmember, during such time, the maintenance of crew health is dependant on individual crewmembers. Further, in the event of an emergency, crew will need to provide prolonged maintenance care, as well as emergency treatment, to an injured crewmember while awaiting transport to Earth. In addition to the isolation of the crew, medical procedures must be carried out within the further limitations imposed by the physical environment of the space station. For example, in order to administer care on ISS without the benefit of gravity, the Crew Medical Officers (CMOs) must restrain the equipment required to perform the task, restrain the injured crewmember, and finally, restrain themselves. Both the physical environment and the physical space available further limit the technology that can be used onboard. Equipment must be compact, yet able to withstand high levels of radiation and function without gravity. The focus here is to highlight the human factors impacts from our three year project involving the procedures and equipment areas that have been investigated and provided valuable to ISS and provide groundwork for human factors requirements for medical applications for exploration missions.

PROCEDURES STUDIES: Simplified, easy-to-identify procedures have proved to be effective in identifying the medical issue and the completion of a procedure in a timely manner. Such efforts will improve crew efficiency and health care, as well as reduce costs for training and risks to mission safety and success.

- *Non-emergency and emergency paper-based procedures studies* – These studies compared the layout of paper-based procedures and resulted in recommendations for the reorganization the layout of the materials with minimal impact to the content of medical procedures. Reorganizing to an Anatomical layout provided a more intuitive means of locating the appropriate diagnosis in the paper procedures.
- *Respiratory Support Pack cue card development and study* – Developed Respiratory Support Pack (RSP) Cue Card redesigns based on human factors principles, and evaluated them against the original in terms of completion time and errors. Average time to complete a procedure with the redesigned cue cards was improved by almost 3 minutes.
- *Medical Human Computer Interfaces* – Interfaces currently under development received Human Factors inputs at a very early stage of development. For example, The Health Maintenance System Inventory Tracker Tool (HMS; HITT) will be a tool to support different user populations.

EQUIPMENT ASSESSMENTS: Given limited crew medical training, a review of the current ISS medical packs was performed to assess the organization and ease of use of the equipment within the packs.

- *Ambulatory Medical Pack and Advanced Life Support Pack* – Assessments of the organization of these packs were performed and a number of recommendations for labeling, location of items, error prevention, and stowage were provided.
- *Respiratory Support Pack* – While performing cue card redesign, issues and recommendations for hardware organization and ease of use were documented.

This project has also generated ongoing collaborations across NASA Johnson Space Center (JSC) organizations. Efforts to make programmatic changes have demonstrated the medical community's acceptance of the recommendations put forth in this project and the desire to integrate human factors personnel into the medical domain. Where any mission-critical human function is performed, human factors is required for effective human-system integration and mission success. In order to accomplish NASA's Vision for Exploration, while assuring crew productivity and safety, human performance issues must be well integrated into system design from mission conception.