Human Factors Assessments of the International Space Station Emergency Medical System

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The aim of the Emergency Medical Care Project was to identify human factors issues within the International Space Station medical care system and to recommend solutions that will improve the usability of the system, as well as the survival rate of crewmembers in the event of a medical emergency. There is no standing requirement for a physician crewmember onboard the Space Station; during the mission the maintenance of crew health is dependent on individual crewmembers. Further, in the event of an emergency, the crew will need to provide prolonged maintenance care, as well as emergency treatment, to an injured crewmember while awaiting transport to Earth. Given these facts and the limitations and challenges inherent in a microgravity environment, it is crucial that medical procedures and equipment be easy to understand and easy to use. This report highlights the human factors impacts from this three-year project, with particular focus on the procedures and equipment evaluations that have provided the immediate benefit to the Space Station medical community. Results from this project have established the groundwork for human factors requirements for medical applications for exploration missions.

Well-designed procedures will improve crew efficiency and health care, as well as reduce costs for training and risks to mission safety and success. Two examples of procedures-related studies are described below.

- Non-emergency and emergency paper-based procedures studies – These studies compared various methods of procedure organization for the paper-based Space Station medical checklist: original (anatomical/alphabetical mix); anatomical only; and alphabetical only. The results indicated that revising the original 1000+ page Space Station medical checklist to use an anatomical organization provided a more intuitive means of locating the appropriate diagnosis and treatment procedure.
- Respiratory support pack (RSP) cue card study – Several RSP cue card redesigns were created based on human factors principles. The new design alternatives were evaluated against the original format in a scenario-based task where procedure completion time and errors were evaluated. The best cue card redesign yielded an average completion time improvement of over three minutes.

Given the limited amount of Space Station medical training provided for crewmembers, it is critical to have equipment that is well organized and easy to use. We conducted a review of current Space Station medical packs to assess the organization and ease of use of the equipment within the packs.

- Ambulatory Medical Pack and Advanced Life Support Pack – We performed human factors assessments of the organization of these packs, and a number of recommendations for labeling, location of items, error prevention, and stowage were provided. The feasibility of using an eye tracker to measure medical pack layout efficiency was also assessed.

Ambulatory Medical Pack.

- Respiratory Support Pack – While performing cue card redesign, issues and recommendations for hardware organization and ease of use were documented.

This project has demonstrated the benefits of including human factors within the NASA medical domain. Efforts to implement programmatic changes based on results from these human factors activities have provided a quantitative means of measuring the efficiency of the system. In addition, this collaborative effort with medical operations and informatics personnel demonstrated how human factors could be integrated throughout the life cycle of medical systems. Where any mission-critical human function is performed, human factors are required for effective human-system integration and mission success. In the case of space medicine, this need is especially pronounced; without an attention to human performance capabilities, the best medical protocols will have little chance of success. 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.