

## Development of Requirements Analysis Tool for Medical Autonomy in Long-Duration Space Exploration Missions

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**Abstract :** Improving resources for medical autonomy of astronauts in prolonged space missions, such as a Mars mission, requires not only technology development, but also decision-making support systems. The Advanced Crew Medical System - Medical Condition Requirements study, funded by the Canadian Space Agency, aimed to create knowledge content and a scenario-based query capability to support medical autonomy of astronauts. The key objective of this study was to create a prototype tool for identifying medical infrastructure requirements in terms of medical knowledge, skills and materials. A multicriteria decision-making method was used to prioritize the highest risk medical events anticipated in a long-term space mission. Starting with those medical conditions, event sequence diagrams (ESDs) were created in the form of decision trees where the entry point is the diagnosis and the end points are the predicted outcomes (full recovery, partial recovery, or death/severe incapacitation). The ESD formalism was adapted to characterize and compare possible outcomes of medical conditions as a function of available medical knowledge, skills, and supplies in a given mission scenario. An extensive literature review was performed and summarized in a medical condition database. A PostgreSQL relational database was created to allow query-based evaluation of health outcome metrics with different medical infrastructure scenarios. Critical decision points, skill and medical supply requirements, and probable health outcomes were compared across chosen scenarios. The three medical conditions with the highest risk rank were acute coronary syndrome, sepsis, and stroke. Our efforts demonstrate the utility of this approach and provide insight into the effort required to develop appropriate content for the range of medical conditions that may arise.

**Keywords :** decision support system, event-sequence diagram, exploration mission, medical autonomy, scenario-based queries, space medicine

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