DESIGN OF AUTONOMOUS MEDICAL RESPONSE AGENT (AMRA) AGGREGATE INFORMATION DASHBOARD (AID)

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PROJECT DESCRIPTION

Nahlia's autonomous medical response assistant (AMRA) is envisioned to help astronauts interpret their symptoms and guide self-treatment until healthy is restored. Major challenges for astronauts in deep space missions will be that crewmembers are not expected to be medical professionals, may be under high workload, high stress, are facing physiological challenges caused by spaceflight, and have limited voice communications with Earth. This proposal focuses on the creation of a prototype that:

1) provides an optimal work flow of actionable recommendations for self-care of the crew while, 2) building trust between Mission Control Center (MCC) flight surgeons and astronauts on long-duration exploration missions (LDEM) with limited voice communication.



Nahlia's autonomous medical response agent (AMRA) is envisioned as a technology interface to capture and record information from planned and unplanned medical incidents in future long-duration exploration missions while making actionable recommendations to crew when real-time communication with ground would not be possible. AMRA's algorithm develops a differential diagnosis for high-risk medical conditions and based on the perceived risk makes recommendations to the crew and/or guides the crew through appropriate testing and treatment protocols. Through AMRA AID, the flight surgeon also has the opportunity to comment and respond to medical incidents.

PROJECT AIMS



PERSONAS

In our research we have identified three key stakeholders and defined the user needs, pain points, and design requirements for each. To validate our assumptions, we have interviewed and received feedback on our design approach with: 5 Former NASA Flight Surgeons, 2 Current Flight Surgeons, 2 Emergency medicine specialists, and 2 Former Astronauts.



Crew Member with Limited Medical Expertise

Future crewmembers on long-duration exploration missions may or may not have emergency medical training. The AMRA interface must therefore be designed for use by both medical specialists and non-specialists alike. AMRA will integrate protocols relevant to the development of a differential diagnosis through a touch-screen and a conversational user interface.



Crew Medical Officer

The CMO will have received specialized training specific from other crewmembers. AMRA will typically prioritize the CMO's participation when scheduling diagnostic tests and treatments with other crewmembers. The CMO will require quick & straightforward access to emergency procedure protocols, reference materials and possibly training.



Fight Surgeon on Ground

The flight surgeon will require the capability to comment, respond, and make additional recommendations to the crew and in response to AMRA's diagnosis & treatment course following planned & unplanned incidents. The flight surgeon will require data relevant to routine and unplanned medical incidents to be captured and sent to ground routinely.

USER SCENARIOS

Two user scenarios have been conceived to demonstrate the efficacy of AMRA AID in the event of 1) a routine and/or chronic medical incident, and 2) an emergency or unplanned medical incident. The interactions and communication requirements for all stakeholders have been considered within the context of a future long-duration exploration mission, where time delays and limited bandwidth would prevent real-time communications between the crew and ground.

SCENARIO 1: HEADACHE



Crew #1 finds and takes Tylenol

Crew #1 answers more detailed questions and medical history

3. Guided Test + Measure Results Report + document headache Provide input of current conditions Become aware of diagnosis Provide responses to AMRA's ranked Questions Fills out incident report Crew 1 has headache that its not extreme USER INPUT Determine level of condition and next steps Receive headache information Run diagnosis question Receives biometric vitals and crew input Ask questions to determine diagnosis Determined its not Provides option of extreme Tylenol treatment PROTOCOL PROTOCOL Crew 2 (care giver) Becomes aware of current state Receive information to keep informe Become aware of headache Opportunity to communicate with crew Receives answers of Crew 1's input that headache is happening on Tylenol being the next step USER INPU Reflect change

SCENARIO 2: DIFFICULTY BREATHING / PNEUMOTHORAX

Crew #2 listens to Crew #1 lungs



Crew #1 can't breathe and Crew #3 and #4 get

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|---------------------------------|--|--|---|--|---|----|
| Crew 1 (patient) | 1. Chief Complaint Report pain Crew mentions chest pain and difficulty breathing | | 2. Evaluate / Asked Ranked Receives needle decompression | Questions | 3. Guided Participate in procedure | F |
| AMRA | Receive breathing condition information Provide C1 vitals | Provides needle decompression procedure | Run questions and detect severity Receives that procedure has been completed | Provide guidance for Heimlich Valve | Guide through procedure Receive and schedule ultrasound into | 29 |
| Crew 2 (care giver) | Notify and report Pulls up C1 vitals from AMRA growth on C1 | Pulls up needle decompression procedure | Receive and scale information Pulls up needle decompression procedure done | Follow steps for Heimlich Valve | Perform ultrasound | F |
| Flight Surgeon (on ground) | Become aware of condition | Receives into on vitals and procedure accessed | Receive information on procedure | Receives results decompression and valve placement | Identify follow up Identifies and suggests ultrasound as follow up | |
| Other Crew | | | Become aware of conditions | Made aware of medical event is happening | | |
| Crew Schedule | | | | Displays changes in C1 and C2 schedule | Reflect procedure happening | |
| Vehicle State | Show environmental confitions Display environmental conditions | | | Display change in inventory | Display situational info | |

Crew #2 conducts a neurological exam





Crew #2 conducts point of care ultrasound



PROCESS DESCRIPTION

The sequence flows are used to derive "static states" for the user interface, which show how missioncritical information can be interrelated without assuming a causal relationship. The comprehensive view enables efficient information access for both crew & ground support, and enables ground support to make critical analytical decisions based on crew and vehicle health.



CURRENT PROTOTYPE

The current prototype is comprised of 5 screens. While the Flight Surgeon interface is specifically intended for ground, the remaining screens capture the information captured and communicated between the crew, AMRA, and the flight surgeon in the event of a planned and/or unplanned medical incident.







On-board Crew Medical Information

NEXT STEPS

CHALLENGES

- planned or unplanned medical incident.



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Crew Schedule

Vehicle Health / Information

• Our next prototype is anticipated for completion in late February and we will continue performing user tests with flight surgeons, astronauts, emergency medical experts and other subject matter experts.