Exploration Medical System Technical Development

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The needs identified by this work will drive future ExMC research
Review - Systems Engineering “V”

“Problem space” or “What”

“Solution space” or “How”
Review-Con Ops Scenario Tree

- In-flight Medical System Scenarios
  - Planned
    - Self-Care
    - Directed Care
    - Medical System Maintenance
    - Performance Support
  - Unplanned
    - Self-Care
    - Directed Care
    - Medical System Maintenance
    - Performance Support
    - Emergent Care

- Headache
Scenario: 03. Transit – IVA – Unplanned – Self-Care – Autonomous from Ground
Context: Headache

Assumption:
1) The “resource” in this scenario is a medication
Identify Needed Functions

Assess contraindications

Assess resource availability
Identify Interactions

Accept treatment plan input from patient

Dispense medical resource to patient
Build Functional Decomposition

- Begin defining problem space

- Provide medical system implementation functions

- Understand crew health and system status

- Guide decisions on crew health actions

- Support crew health action execution

- Sense crew health and system status
Build Functional Decomposition Cont.

- Assess resource availability
- Assess resources for personalized medicine
- Create flags of potential issues using info from sensors
- Understand crew health and system status
- Log medically relevant encounters
- Interpret info gathered during crew activity
Now begin bridging to "Solution Space"
Example Traceability to Requirements

Operational concepts ➔ System functional needs ➔ System requirements ➔ Allocations ➔ Subsystem requirements

All content is in draft form!

Headache scenario

Operational concepts
- Accept treatment plan inputs
- Assess resource availability
- Assess resources for personalized medicine
- Dispense medical resources

System functional needs
- The Medical System shall accept treatment plan inputs from a crewmember.
- The Medical System shall track and assess medical resource availability.
- The Medical System shall assess medical resource appropriateness for individual crewmembers.
- The Medical System shall provide medical resources to a crewmember.

System requirements
- In-flight Medical Resources shall...
- In-flight Health Data System shall...

Allocations
- In-flight Medical Resources shall...
- In-flight Health Data System shall...

Subsystem requirements
- In-flight Medical Resources shall...
- In-flight Health Data System shall...
Systems Engineering Process “V” Example

Traceability supports system negotiation

Informs V&V planning
Summary

• “What” not “How” initially
  – ConOps → Functions → Requirements

• Structured approach
  – Envisioning and guiding the development of an exploration medical system is a big job
  – This approach gives an organized path

• Traceability
  – When negotiations are necessary regarding capabilities to include (hardware and/or software), we are able to trace to impacted requirements and system functions
  – Identify orphans – then why do we have this capability?
  – Identify parents with no implementation – function and capability are lacking
    → RESEARCH NEED
Conclusion

• Next steps
  – Top Down – continue:
    • Activities and interactions
    • Functional decomposition
    • System architecture
    • Traceability
  – Bottom Up – begin reconciling existing subsystem level content
  – Draft system functional requirements 2017

• Cross-disciplinary, cross-Center team has made huge strides in only a few months
Thank you