This Directed Acyclic Graph and write-up is an excerpt from a larger NASA document.
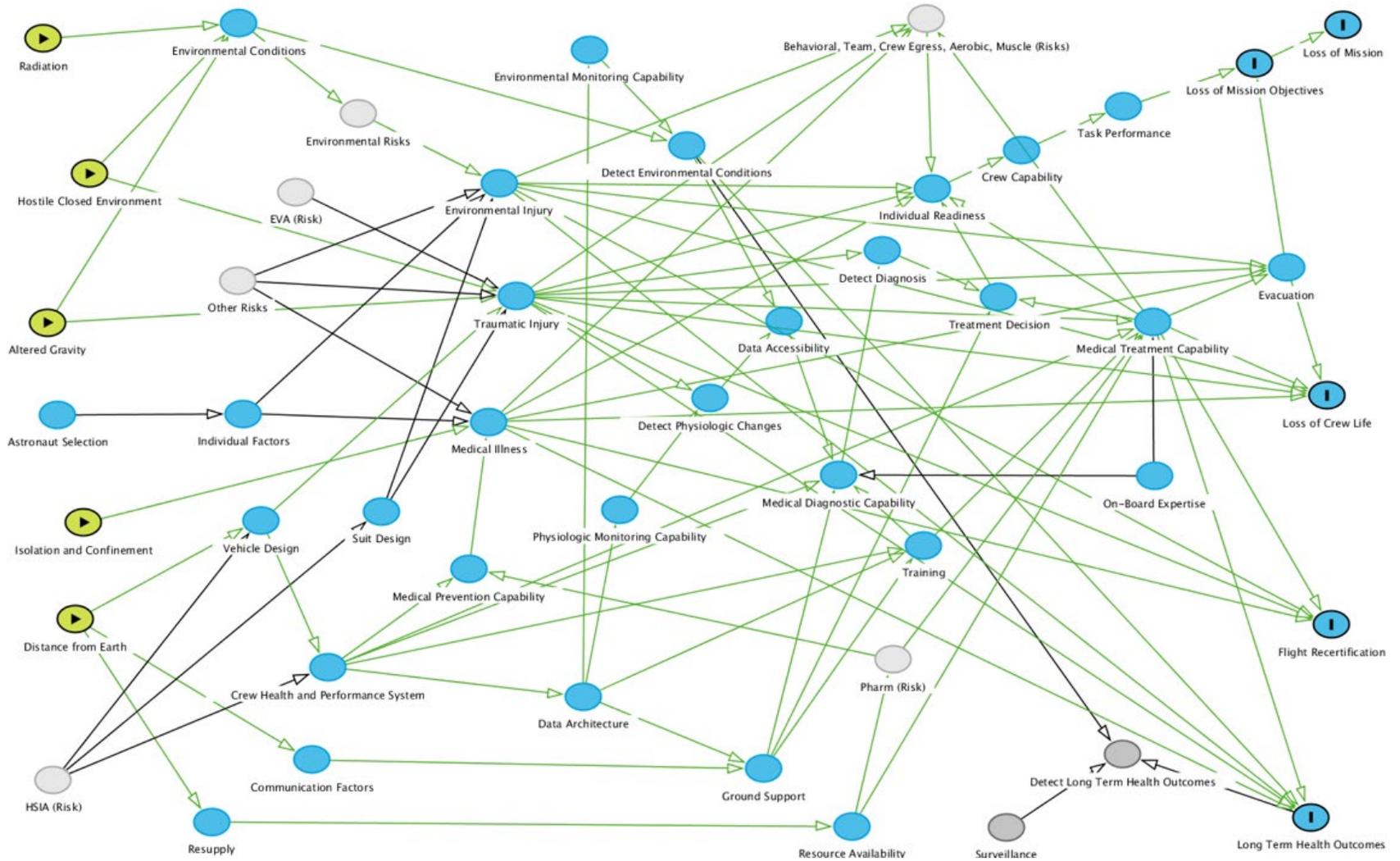
NASA/TP-20220015709

Directed Acyclic Graphs: A Tool for Understanding the NASA Spaceflight Human System Risks

Human System Risk Board

October 2022

Risk of Adverse Health Outcomes and Decrements in Performance Due to Medical Conditions that occur in Mission, as well as Long Term Health Outcomes Due to Mission Exposures (Medical Risk)

Medical Risk DAG Narrative

The Medical Risk boils down to two parts – First, what medical conditions/events are going to happen in a given mission. Second, what can be done to decrease the likelihood (prevention) or the consequence (treatment) of those events.

- For the first part: Total Medical Events are made up of three categories – Environmental Injuries, Traumatic Injuries, and Medical Illnesses.

  - **Environmental Injury** likelihood is affected by Environmental Conditions (and other Environmental Risks), EVAs, and **Vehicle** and **Suit Designs**. **Individual Factors** inform the bio-variability in response to environmental insults.

  - Traumatic Injury likelihood is affected by EVAs, Vehicle and Suit Designs, and other risks (Bone fracture, Dynamic Loads, Crew Egress, Muscle and Aerobic (Risks)).

  - **Medical Illness** likelihood is affected by other risks and **Individual Factors**.

Each of these categories can affect mission level outcomes, especially if not planned for. This is why there is a second part – What can we do about it?

- For the second part: The **Crew Health and Performance System** provides for a variety of capabilities intended to mitigate medical risk. These include **Medical Prevention Capabilities** (designed to decrease likelihood of conditions) and **Medical Treatment Capabilities** (designed to decrease the consequence of conditions that have occurred). Deciding on what treatment to provide is an information dependent process that requires **Physiologic** and **Environmental Monitoring Capabilities** and **Diagnostic Capabilities**. These are closely linked to a **Data Architecture** and depend on **Data Accessibility** to inform the correct **Treatment Decision**. If an incorrect **Treatment Decision** is reached, risk is not mitigated, and it may be increased. **Diagnostic** and **Treatment Capabilities** are dependent on the **On-Board Expertise**, **Ground Support**, **Training**, **Resource Availability**, and **Data Architecture** provided by the **Crew Health and Performance System**.

- **Resource Availability** is dependent on **Resupply**. **Ground Support** is dependent on **Communication Factors** including communications delay. Both of these are dependent on **Distance from Earth**.