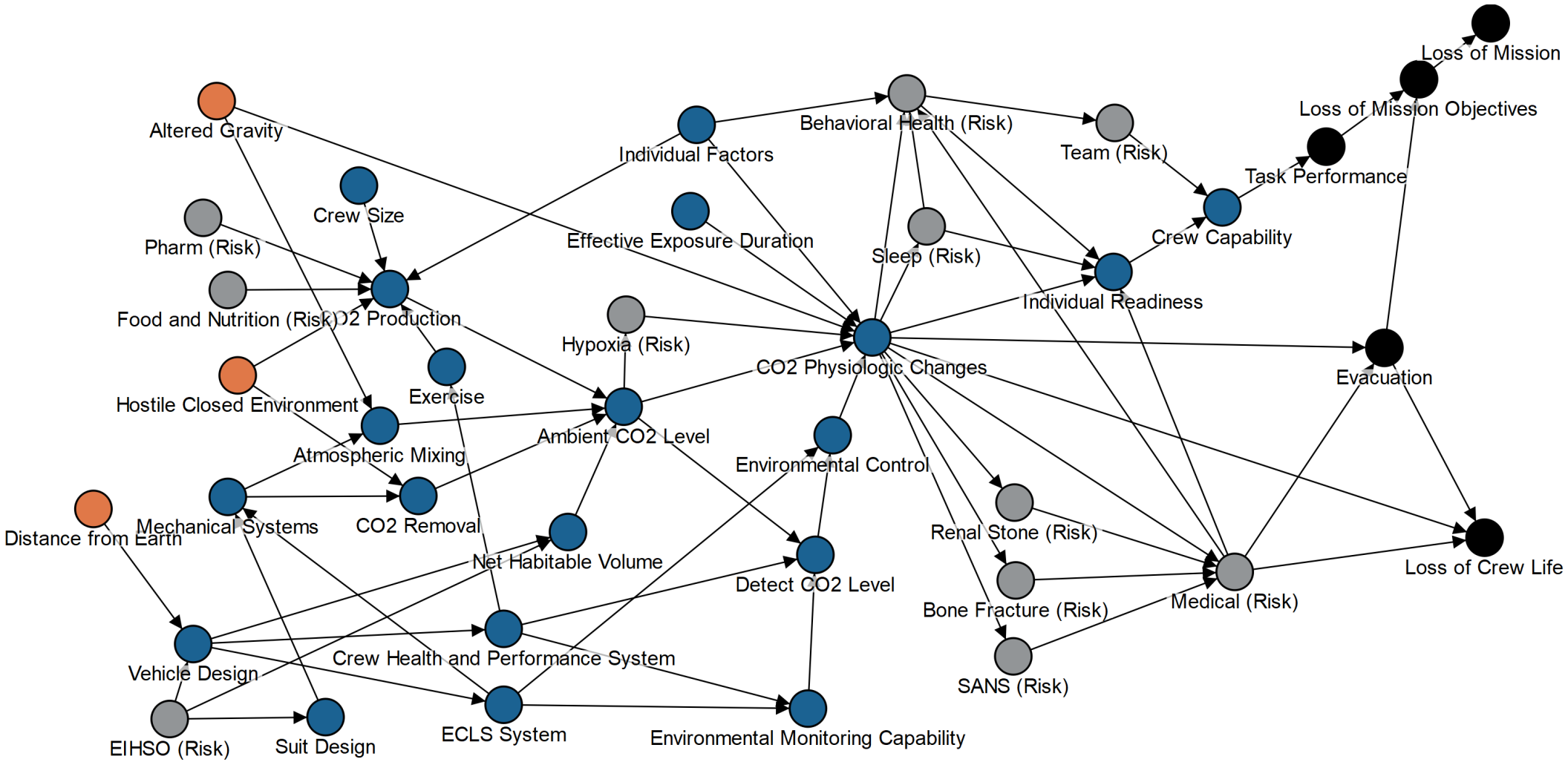
This Directed Acyclic Graph and write-up is an excerpt from a larger NASA document.

NASA/TP-20220015709

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

Human System Risk Board

March 2025


Loss of Mission
Loss of Mission Objectives
Behavioral Health (Risk)
Team (Risk)
Task Performance
Altered Gravity
Individual Factors
Crew Size
Effective Exposure Duration
Sleep (Risk)
Crew Capability
Pharm (Risk)
Food and Nutrition (Risk)
CO2 Production
Individual Readiness
Hypoxia (Risk)
CO2 Physiologic Changes
Evacuation
Hostile Closed Environment
Exercise
Ambient CO2 Level
Atmospheric Mixing
Environmental Control
Distance from Earth
Mechanical Systems
CO2 Removal
Renal Stone (Risk)
Loss of Crew Life
Net Habitable Volume
Detect CO2 Level
Bone Fracture (Risk)
Medical (Risk)
Vehicle Design
Crew Health and Performance System
SANS (Risk)
EIHSO (Risk)
Suit Design
ECLS System
Environmental Monitoring Capability

CO_2 Risk DAG Narrative

- The CO_2 concentration in the closed spacecraft environment is a balance between production (primarily crew) and Environmental Control and Life Support (ECLS) scrubbing.
- When the balance is impacted by vehicle capability (limited ECLS mass/power, for example) or production influences (exercise, for example), the CO_2 concentration will increase and may result in several different physiological changes.
- Monitoring is essential to understand the levels and possible outcomes.
  - Ambient cabin level averaging is currently relied upon almost exclusively.
  - Ambient local/area monitoring also possible via the carbon dioxide monitor (CDM) and personal CO_2 monitors (pCO_2m).
  - Periodic individual monitoring (inspired CO_2 or other, for example) is not currently available.
- Levels that are elevated significantly and/or chronically may lead to adverse mission outcomes, including loss of mission objectives or loss of mission (evacuation). Unexpectedly high acute levels may lead to loss of crew life, but the likelihood of this event is very low.