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Surface Habitation Considerations

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Surface Habitation

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- **Surface Habitation is more than just what is inside the habitat**
  - Entire surface infrastructure is the crew's "neighborhood" for ~300-600 days
- **Crew (and robotic assistants) impacted by**
  - Walking paths between elements (distance, hills, traction, lighting, shadows, etc.)
- **Habitat placement should consider**
  - View outside element windows
  - Direct sunlight on windows (including hatch windows)
- **Look for options for local terrain to assist with radiation shielding (hills, cliffs, etc.)**
  - Includes shielding for habitat/elements and EVA activity near habitat
  - Especially important for long duration missions, sustained ops

Internal Habitable Volume

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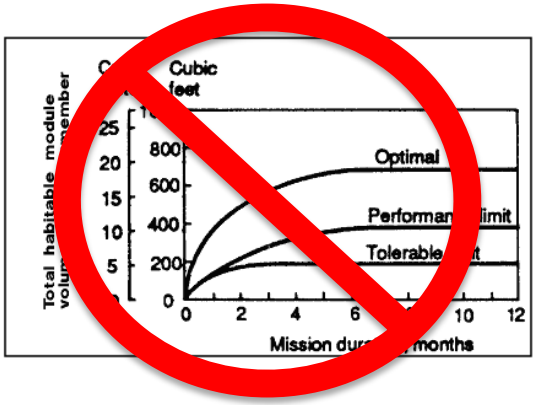
- **Must provide enough habitable volume (whether modular or monolithic)**
  - Heavy dependency on crew tasks (which themselves may be undefined, especially early in studies)
    - What's good for short duration may not be good for long duration
  - Translation and ingress/egress paths
  - Window and hatch accommodation
  - Stowage, trash, and waste accommodation
  - Crew size and duration are factors, but may not be primary volume drivers
  - Not based on the old NASA-STD-3000 volume vs. duration charts



Internal Architecture

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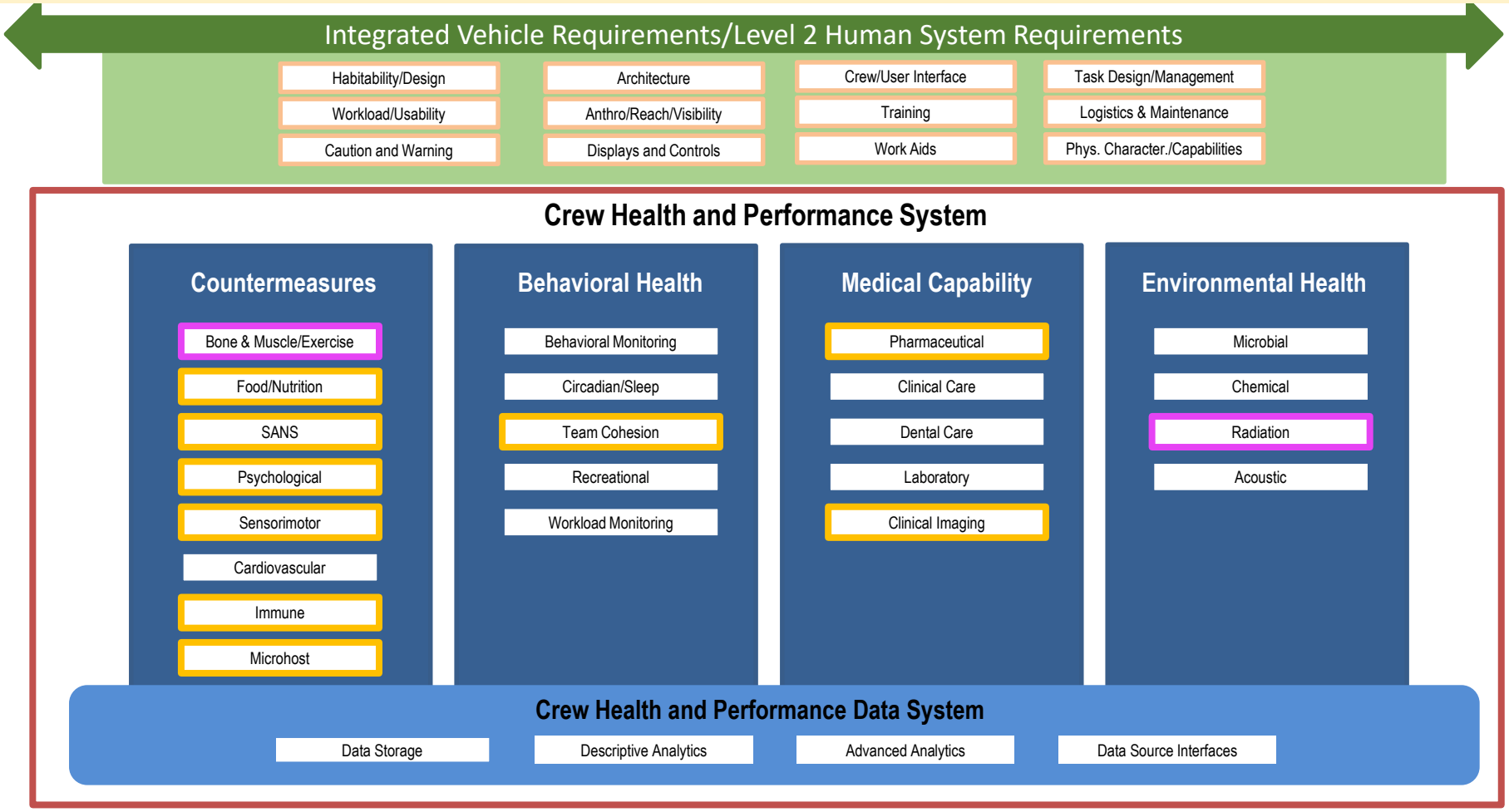
- **Identify tasks and performance levels before designing interior**
  - Not just “provide maintenance,” but provide what kinds of maintenance
  - The crew is ALL ALONE…what do they really need to survive and thrive?
- **General design guidelines**
  - Separate potentially conflicting volumes
  - Co-locate sequential functional volumes
  - Only share volumes with caution
  - Separate clean and dirty areas, public and private areas
  - Ensure subsystem access for serviceability
  - Even a “short duration” surface stay is not a short mission
- **Apply virtual and physical human-in-the-loop testing iteratively to down select concepts and refine design**

Crew Health and Performance System (Gateway Example)



Contingency Responsiveness

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- **Shuttle and ISS responses to contingency less viable on Mars (or even lunar) surface**
  - Shuttle/ISS crews could/can evacuate and be on the ground in hours or less
  - ISS logistics chain enables on-orbit replacement
  - Mars preparation creates increasing demand to recover from contingencies and continue rather than abort and abandon
  - Less important in a short initial surface mission, but becomes more significant for sustained operations
- **Habitat maintenance capability responsible for all surface assets**
  - Habitat, rovers, robots, lander (when on surface), ISRU, spacesuits, etc.
- **Medical contingencies may happen anywhere**
  - Rover excursions, local EVA, distant EVA, lander, habitat, etc.
  - Do the pressurized rovers need ambulance capability?
  - Is rehabilitation necessary before moving to next phase of mission (e.g. return to orbit)?

Questions?

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