

EARLY SYSTEMS INTEGRATION STRENGTHENS ORION MEDICAL CAPABILITIES

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INTRODUCTION: The Orion spacecraft has significant mass and volume constraints, which limits resources that can be provided for medical use. Sharing of resources between vehicle systems is therefore required to meet design requirements. This presentation will illustrate resource sharing within the Orion vehicle using oxygen as a case study.

METHODS: Oxygen is stored aft of the crew compartment in the Orion Service Module and can be delivered on-demand through an oxygen port in the Orion Command Module (CM). The use of oxygen for medical purposes must be balanced against the pressure and flammability limits of the Orion Command Module. Meeting requirements for use of oxygen for medical purposes during the Orion mission relies on collaboration between multiple vehicle system stakeholders.

RESULTS: A requirement for medical use of the oxygen port was included early in the development of the Human-Systems Integration Requirements (HSIR). Several questions still needed to be answered on how the oxygen port could be used while still staying within the environmental control requirements for total cabin pressure and flammability limits. Provision of oxygen to a crew member also required an analysis of the mass/volume constraints of the medical kit and what devices were best suited for use in the Orion CM. In addition, a determination was necessary on whether the time of available oxygen use for medical purposes would be effective in addressing conditions deemed as having sufficient risk during a mission. As part of this process, alternative methods of oxygen delivery were also discussed such as use of the Orion Crew Survival Systems (OCCS) suit as another potential delivery method.

DISCUSSION: A traditional development flow often designs vehicles first, then introduces human systems integration later in the cycle, putting medical systems at a disadvantage. Early connections between crew health stakeholders and other development teams have reduced costs and schedule overruns, while providing the best medical capabilities possible. Logistics planning for austere environment missions should include medical stakeholders from the beginning so that the best medical capability can be provided.

Objective: Understand the interplay between different systems and stakeholders to optimize medical capabilities in an austere vehicle environment.

MOC Questions:

- 1) True or False: the duration of time allowed for the provision of oxygen to a crew member in the Orion Command Module is dependent on both the total cabin pressure and flammability limits.

Answer: True.

- 2) The following considerations were important to provide oxygen for use aboard the Orion spacecraft...
 - a. Flammability of different types of oxygen tubing
 - b. Downregulation of pressure from the vehicle oxygen port
 - c. Purification of oxygen to medical grade levels
 - d. a and b
 - e. all of the above

Answer: D. Flammability of the oxygen tubing and a method for decreasing pressure for the port needed to be considered. Oxygen supplied by the service module already has a purity above that of "medical grade" oxygen and thus required no additional purification.