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Dealing with a physically disabled crew member: Lessons learned by the crew of the ICAres-1 mission

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Abstract

The standard for designing manned missions today is to assume that a crew flying to the Moon or to Mars is healthy and physically fit – and remains healthy and fit during the duration of the mission. However, common sense predicts that it is just a matter of time until the first accidents occur during planetary surface missions, accidents that may handicap crew members temporarily or even permanently.

For this reason, the former Laboratory of Extreme Medicine at the University of Medical Sciences in Poznan has conducted the first ever analog mission with one physically disabled crew member. This mission with the name ICAres-1 (short for Innovative Concepts Ares) took place at the Polish LUNARES habitat in the October of 2017 and initially comprised a tri-national 6-person crew, 3 males and 3 females, which was reduced to 5 crew members a few days into the mission due to circumstances unrelated to the mission.

One crew member, an engineer by training, had lost eyesight and the greater part of their two hands about 10 years prior to the mission. Consequently, unlike most missions which simulate first arrival on Mars, ICAres-1 is set long after the first arrival, up to perhaps 10 years, which shifts the mission scenario to a near-permanent settlement.

Members of the crew will present here the lessons they learned during the 2-week simulation. In particular, we will discuss the necessarily made adjustments to schedules provided by mission support, the influence of a physically disabled crew member on group dynamics, and ways in which architectures of surface habitats can be improved to accommodate injured or disabled astronauts.

1. Introduction

ICAres-1 is the first analog mission in which one crew member is physically disabled. The name ICAres derives from Innovative Concepts Ares, and the overarching goal of ICAres-1 is to study the effects of "everything that can go wrong on Mars". Beside the disability of one of the ICAres-1 crew members, the mission included a number of experiments aimed at enabling a crew on Mars to reacting to various worst-case scenarios.

The crew was subjected to various simulated incidents, but also experienced several unforeseen events. In the case of these off-nominal occurrences, ICAres-1 aimed to find and understand good reaction strategies by both the crew and mission control.

2. Mission Details

ICAres-1 took place form October 8th to 22nd, 2017. Initially, the crew comprised 6 crew members, of which one was forced to leave on mission day 4 due to reasons beyond the control of the ICAres-1 team. The remaining crew consisted of three females (D,F,PL) and two males (both PL).

In particular, one of the Polish crew members had suffered an accident 10 years prior to the simulation in which he had lost eyesight and both his hands except for the thumb and index of his right hand.

While it is questionable that a base on Mars would have the capacity to treat the injuries from that accident similarly as they were treated on Earth, we believe that the type of accident and following incapacitation should be within the scope of risk management for Mars, especially for near-permanent missions.

Due to the long-term nature of this mission scenario, the size of mission control was kept to a minimum, with the team only comprising a Flight Director and Flight Surgeon, plus the team of researchers leading varies experiments conducted by the crew.

As is customary with most Mars simulations, the crew was allowed to leave the habitat only when wearing a simulated spacesuit, and then only into the hangar. During the mission, the crew received two cargo drops that had to be transferred to the habitat with an EVA.

Communication with the outside world was limited to e-mail, and internet access was restricted. Contact with Mission Control was to take place via the specially designed HabitatOS, which also enforced a 20-minute delay in messaging in each direction. A similar limitation for internet access and normal email communication had been planned, but was not implemented until the end of the mission. Resources such as food and water were limited, but with a comfortable margin.

Mission control and the crew managed life and work with a physically disabled crew member, which lead to significant adjustments in the crew schedule and many activities. Additionally, the crew learned many lessons for the architecture of a Mars base and how to improve its usability for the event of an incapacitating accident of one of the crew members.

Moreover, the crew dealt with the loss of one crew member (including the subsequent “funeral”), communication difficulties, a simulated food shortage and a number of equipment failures.

On the plus side, the crew tested various stress relief and crew bonding methods, including exercising and spending leisure time together and organizing EVAs together – with the limitations of the disabled crew member.

3. Summary

We will present the outcomes of the ICAres-1 mission, the first mission with a physically disabled crew member, with a special focus on the lessons learned by the crew to help future missions to prepare better for and react to disastrous events.

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