

# Exploring Space Mission Design: Analogue missions simulating the exploration of space

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**Background.** Analogue missions are valuable exercises in helping to design space missions. The specific aspects of space that are simulated enables the testing, training, and refinement of various aspects of space travel and exploration. The controlled environment that is created during analogue missions provides opportunities to maximise the chance of success during space mission. Furthermore, benefits for life on Earth are simultaneously developed.

UCL Space Health Risks Research Group led the first UK analogue space mission that simulated the human exploration of another planet. A remote and uninhabited island in Scotland was used as the analogy of space, which was kept secret from the research participants (analogue astronauts). This meant that when they were brought to the island they saw it for the first time; thus, simulating an astronaut seeing another planet for the first time. During the analogue mission, a programme of research was conducted to investigate how health in space can mitigate risks to health on Earth.

This poster presents the analogue mission and proposes that future analogue missions can inform space mission designs.

**Analogue mission design.** The planet (the island – see image below) has many parallels with space. There are no services, minimal resources, and evacuation is only possible via sea or air, similar to aeromedical evacuation from space. The analogue astronauts were tasked to survey the planet to identify (1) areas of geological interest and (2) potential landing sites. Key locations on the planet are labelled in the right-hand image. Meanwhile a programme of research was conducted, including an evaluation of whether the UK could be used as an analogy of space.

The research that took place during the analogue mission included testing newly developed remote health monitoring technology, an astropharmacy study (medicines in space), and anthropology was used to explore the relationship between the land and health. Thus, implementing a programme of research within the analogue mission simulated the research that takes place during space travel and exploration.



## Analogue mission site.

- Mission control team location
- Analogue astronaut's base
- Caves, used for geological survey
- Fresh water supply
- Potential landing sites survey
- Planet (island) highest point



**Results.** A non-invasive heart rate variability device was tested to identify how physiological health can be monitored. 50% target data was collected, which informed the study re-design and proven tech can be tested during analogues.

An astropharmacy study examined pharmacological decision-making and the design of a medicines kit for human spaceflight. Version 2 is in development for testing in 2023.

The anthropological study explore the interrelations between the land and health to identify notions of 'normal health' while in the extreme environment of space. The findings suggests new perceptions of 'new normal health' are created, which inform decision-making in high-risk environments like space.

**Evaluation of UK-space analogy.** Evaluations from participants and researchers confirmed the UK can be used as an analogy of space, providing the simulation fidelity (realism) is well-defined.

**Impacts for future research.** To continue this work, Space Health Research Ltd has been founded. A programme of subsequent analogue missions have been organised in the UK from 2023. The analogue mission design can be deployed to any environment with analogies to space to enable more research and resultant benefits to life on Earth. Overall, analogue missions are an important tool in the design and preparation of space missions, providing valuable insights into the challenges and opportunities of space exploration. For more information about future missions, visit: [www.spacehealthresearch.com](http://www.spacehealthresearch.com)



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