There is ample evidence to suggest that space flight leads to immune system dysregulation. This may be a result of microgravity, confinement, physiological stress, radiation, environment or other mission-associated factors. The clinical risk (if any) from prolonged immune dysregulation during exploration-class space flight has not yet been determined, but may include increased incidence of infection, allergy, hypersensitivity, hematological malignancy or altered wound healing. To date, precious little in-flight immune data has been generated to assess this phenomenon. Considering the technical and programmatic difficulties related to implementing a flight study, it is attractive to utilize ground-based spaceflight analogs as appropriate. Analogs may be utilized to investigate some aspect of flight that may be replicated in a terrestrial setting, for assay development or for validation of countermeasures. Importantly, it is relatively straightforward to generate “in-flight” data while using a ground based analog. Selection of an appropriate analog with respect to the physiological system of interest is particularly important. For spaceflight-associated immune dysregulation (SAID), the authors believe the most appropriate analogs are NEEMO (Shuttle analog), Antarctic winter-over (ISS analog) and the Haughton Mars Project (intermediate duration analog). Each of these analogs replicate isolation, mission-associated stress, disrupted circadian rhythms, and other aspects of flight thought to contribute to SAID.

To validate NEEMO as a flight analog with respect to SAID, a pilot study was conducted during the NEEMO-12 and 13 missions during 2007. Assays were performed that assessed immune status, physiological stress and latent viral reactivation. Blood and saliva samples were collected at pre-, mid-, and post-mission timepoints. The data revealed minimal changes in peripheral leukocyte subsets, as would be expected from healthy subjects in an adverse environment in the absence of actual illness. There were however, dramatic alterations in T cell function. Intracellular cytokine profiles within T cell subsets were altered, and generalized T cell function was diminished during the missions, in a similar fashion to that observed post-flight in ISS crewmembers. Serological evidence of EBV reactivation was observed in 50% of the subjects. As evidence of latent VZV reactivation, salivary VZV DNA was detected in 2 of the 4 NEEMO-12 subjects. Plasma cortisol was elevated in some of the NEEMO subjects. Salivary cortisol increased during the mission compared to pre- and post-mission values. Taken together, the pilot study data seem to validate the NEEMO analog as being appropriate to replicate some aspects of SAID observed during short duration Shuttle flights. In addition, the ease of utility and high-fidelity of the analog make it attractive for rapid investigations. However, to investigate SAID associated with prolonged missions (a key element to determining clinical risk for exploration class missions) another analog would be required.