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DEPLOYED SPACE-RESEARCH LABORATORY SET-UP IN UNCONVENTIONAL CONDITIONS: A
SYNERGISTIC EFFORT BETWEEN ITALIAN SCIENTIFIC EXCELLENCES IN LIFE SCIENCES

Abstract

As part of planning for future space exploration, understanding the impact of the space environment on human health is essential for devising personalized countermeasures against health risks. Earth-based simulations of microgravity acceleration, noise, ionizing radiations, and other space-related conditions are instrumental, but are often limited to specific human systems and constrained by the limited number of flight opportunities. Here, we provide an overview of our participation in the Virtute-1 mission operated by Virgin Galactic, which marked the first commercial suborbital spaceflight with an Italian Crew onboard Spaceship Unity. The experimental plan envisaged a complex scheme of scientific experiments, on the one hand subjecting the astronauts to biological sampling before and after the flight, and further transforming the astronauts themselves into a viable incubator for cell cultures. Our experimental plan envisaged a complex scheme of scientific experiments, including biological sampling of astronauts before and after the flight, and utilizing the astronauts as incubators for cell cultures. The core of this mission was the set-up of an advanced fully equipped cell and molecular biology laboratory for the handling and processing of cell cultures and human-derived biological samples, exported from our facilities in Italy and collocated in the hangar immediately close to the spaceship. To accomplish this task, a new synergic effort of a multidisciplinary team coming from academia, healthcare, and companies, coordinated by the Italian Air Force and the Italian Embassy in Washington, DC was carried out. This collaboration was pivotal in managing the logistic of equipment, reagent, and biological sample transportation, including exportation, importation, custom clearance, risk assessment and contingency planning. To our knowledge, this is the first report of a new operative model for sub-orbital missions wherein a hangar has been re-designed to host space vehicles and research facilities, as well as astronauts and scientists, and this may really impact the way of conducting space research, in terms of resource and result optimization. This innovative approach fostered a complex and dynamic interplay among all participants to define a novel model of work, to early collect early results from the spaceflight, enhance astronauts' performance and maximize research outcome. The ultimate aim of this mission was to improve personalized medicine on Earth, through insights gained from space flight.