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SPACE HOSPITAL: HOW FUTURE SPACE-BASED MEDICAL INFRASTRUCTURES COULD REVOLUTIONIZE TOMORROW'S HEALTH CARE SYSTEM

Abstract

After the first paying passengers on-board the International Space Station (ISS) between 2001 and 2009, a considerable number of space tourism mission concepts has risen, aiming at a large multiplicity of platforms, typically from already existing small size suborbital spaceplanes to future large-scale touristic space stations. On the other hand, many years of space-based research on biological systems has demonstrated how the space environment, and in particular micro-gravity, can introduce beneficial effects on humans for what concerns, as an example, cardiovascular and neoplastic pathologies. When considering the treatments for such diseases, microgravity and exposure of patients to the space environment could represent a visionary healthcare provision in the future space era where affordable, low-risk launch and space transportation systems will be granted and available to everyone. The healthcare space-based infrastructure would benefit from the advancements in space systems introduced by the touristic and commercial space outposts, but by specializing their mission for providing medical treatment to "patient astronauts". In a far future scenario of an homogeneous, wide access to manned space infrastructures for the large majority of humanity, the patients could benefit from considering microgravity a treatment and a part of an international public medical infrastructure. As an example of the potential diseases to be addressed, microgravity can induce beneficial effects to patients experiencing cardiovascular diseases, such as heart failure, contributing with a pressure drop and a heart contractility improvement, while the microgravity-driven induction of a lower heart frequency can help patients suffering from atrial and ventricular fibrillation. In addition to cardiac diseases, neoplastic pathologies such as melanoma could benefit from being treated in microgravity, leading to a reduction of the neoplasm aggressivity and with a consequent increase of a therapeutic efficacy. Besides the user-end systems, represented by the space hospital station ECLSS (Environmental Control and Life Support Systems) for long-term permanence in space and by the systems devoted to actually treating patients, huge improvements in all fields of space engineering and manned space explorations shall be introduced. This paper presents a concept for a medical treatment "hospital" space station. After a description of the current trends for commercial and touristic large-scale spaceborne infrastructures concepts, the potential beneficiaries of microgravity treatments are outlined with the disease to be treated. Then, an outline of the space station subsystems and architecture is presented with a roadmap of the key technologies to be dramatically improved for the introduction of similar infrastructures.