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PRELIMINARY CONCEPT OF AN ORBITAL MEDICAL CENTRE TO SUPPORT SPACE
EXPLORATION

Abstract

In the frame of the Third International Master SEEDS Project Work focused on a permanent habitable space station located in the Earth-Moon Lagrangian Point 1 (EML1), a concept of a Medical Center featuring a quarantine facility has been developed.

The starting point of the work was to establish boundaries and assumption for the definition of a long term exploration scenario. The resulting scenario pictures: the presence of a permanent base on the surface of the Moon with In-Situ Resources Utilization (ISRU) capabilities; the availability of new launchers with heavy lifting capabilities (cargo and man-rated launchers); a long term exploration program (human/robotic) towards the Moon, Mars and beyond.

Sitting on the edge of the Earth-Moon gravity well, the envisaged station would act as the local space transportation hub and provide key capabilities not only in terms of assembly and maintenance of exploration vehicles, but also in terms of crew health care. The main objectives identified for the Medical Center are: managing crew medical issues; providing forward and backward quarantine for Mars mission crew members; improving space biomedical knowledge to help human permanence in space.

In order to define the diagnostic and therapeutic capabilities to be embedded in the Medical Center, a number of different operative scenarios were analysed to develop the appropriate procedures and identify the required equipment. Nominal and contingency scenarios were investigated in details by means of functional analysis techniques.

International planetary protection policy states that, in order to prevent backward and forward contamination, any potentially threatening mission should undergo appropriate preventive actions. For this reason, the designed Medical Center provides quarantine capabilities through a specific insulation facility, which can accommodate 6 astronauts for up to 30 days.

Despite continuous progress in the space biomedical field, present knowledge must be greatly enhanced to enable safe human exploration of the solar system. A Medical Center in the Cis-Lunar environment represents the evolutionary step of the research performed in space until now. The study deals also with countermeasures for microgravity induced problems, through the preliminary evaluation of the issues related to the design and the operation of a centrifuge device for the crew.

Preliminary design of a 0-G operating theatre, with identification of related technological criticalities, was performed. Telemedicine capabilities have been embedded in the system through the preliminary design of a remote Health Monitoring system based on Wearable Biometric Sensors.