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DEVICES FOR CARDIOVASCULAR CONTROL: WHEN SPACE AND EARTH TACKLE COMMON  
CHALLENGES

**Abstract**

The connection between biomedical science and space technology has historically been very strong and often lead to significant scientific/technological evolutions. The ISS has been for years the perfect environment to study and test many biomedical applications, such as crew personal dosimeters, effects of microgravity, innovative detectors, blood flows measuring devices, just to mention a few. The arising need emerging from long duration space travels has increased the necessity of developing reliable, portable and miniaturised medical support systems. In addition, in the past years there has been an increase also in the number of space start-ups/spin-offs specifically dedicated to health, with the aim of commercialising the results of research. For example, the use of CNT to treat brain tumours, fibre optic probes to detect cataracts, or development of wearable devices for clinical and leisure use. In our study, we would like to review the devices for cardiovascular control and how space scientific and technological experiments contributed to the evolution of terrestrial applications and vice-versa. In order to propose a systematic approach, we combined the standardised taxonomy of ESA Technology Tree – which provides a classification of all technological expertise available for space activities - with the Italian National Classification of Medical Devices (CND). In particular, we focused on the technologies related to Life Physical Science and to Environmental Control Life Support (ECLS) and In-Situ Resource Utilisation (ISRU). The CND taxonomy is also aligned with the existing classifications in the sector at International level, such as the Global Medical Device Nomenclature (GMDN). By using specific sectoral keywords, our review takes into consideration both patent and scientific literature data (2010-2020) on cardiovascular control devices for space applications as well as space developments that may have contributed to the improvement of terrestrial activities. We analysed the global trends, the International Patent Classifications (IPC), the country distributions, top assignees and funding sponsors, etc. As a result, we identified that both scientific literature and patents have witnessed a general increase for the period under examination. China and United States maintain the highest positions in both scientific literature and patenting publications. Similarly, Europe (particularly Germany, Italy, Spain and France) and Great Britain are very active. The most recurring technological protected domains include diagnosis, surgery, measurement and pharmaceuticals technologies. Therefore, patent and literature indicators, integrated with market information, provide a clear evaluation of the related technology trends and readiness levels.