

## Working Group on Space and Global Health

### ***Questionnaire on the use of space science and technology for global health***

1. *Please describe existing or planned formal cooperative agreements and other institutional arrangements (memorandums of understanding, letters of agreement, frameworks of collaboration, etc.) between the health sector and other sectors directly involved in space activities at the national level.*

The key issues paper "Digitalization of the Health Care Industry" (2017) released by the Federal Ministry for Economic Affairs and Energy (BMW) describes that in topics such as digitalisation, telemedicine, uniform standards for telematics infrastructure applications and better use of health care data can and should be used to provide better and more humane patient care.

Although space infrastructures and technologies already offer solutions to individual problems and challenges in other sectors, there is still too little knowledge and transparency of the technological potential for the domestic industry to be able to adequately assess the competences and performance of the space sector. The use of space infrastructures and services is still underrepresented in the specialist discussions on digitisation and modernisation of the health sector and modern medicine and should be promoted on the national level in order to initiate innovation.

The Federal Ministry of Health (BMG) also emphasizes the importance of integrating new technologies and services (e.g. spaceflight, digitization and artificial intelligence) into the health care system and patient care. Currently, the healthcare system is facing decisive changes: digitization, globalization, the use of artificial intelligence and robotics, and demographic change will have a major impact on the healthcare sector and further increase the efficiency of health prevention and medical care.

A central element of the German Federal Government's space strategy "Making Germany's space sector fit for the Future" is to strengthen the links between the space industry and other sectors. This is in line with the objectives to expand strategic space expertise and develop new markets. In order to support the strategic exchange between the space and health sectors in particular, the DLR Space Administration has set a new focus on this issue through the INNOspace initiative (<https://www.dlr-innospace.de/>), which offers a platform at the national and EU level in which cross-sectoral solutions can be identified and their implementation initiated.

As part of INNOspace, the "Space2Health" network (<https://space2health.de/>) aims to ensure the sustainability of the exchange between the space and health sectors and to identify and initiate common topics for cooperation. The network has been providing a new module of the INNOspace initiative and opens a communication platform for an intensive exchange of knowledge and ideas between the space industry and health sectors. The aim of the network is to establish cross-sectoral ties and to initiate and consolidate synergies between the two sectors. In February 2020, the DLR Space Administration organized a conference on space technologies and services for the health sector in Stuttgart, Germany. The aim of the conference was to identify innovative application potentials of satellite-based Earth observation, navigation and communication as well as technology transfer potentials for the healthcare sector. The conference was attended by both space professionals and healthcare experts, such as representatives of health insurances or medical colleges.

A longstanding institutional arrangement for cooperation and exchange between the health and aerospace sectors is the DLR Institute of Aerospace Medicine (<https://www.dlr.de/me/en/desktopdefault.aspx/>). The Institute conducts interdisciplinary research into the health and performance of humans in space, in aviation and on the ground. Biological, medical and

psychological research examines the effects environmental conditions have on the basic mechanisms of human health, living conditions and human performance. The research results and technological innovations are directly implemented into psychological and biomedical applications. Within the Institute, a digital health working group is studying how modern technologies can be provided locally to patients over a spatial distance.

A practical example of space-health sector cooperation was the Myotones experiment (<https://www.dlr.de/content/en/articles/missions-projects/horizons/experimente-horizons-myotones.html>) conducted during the horizons mission of astronaut Alexander Gerst to the International Space Station (ISS) in 2018. The project aimed to analyse the basic biomechanical properties of the skeletal muscles in a non-invasive way by measuring and evaluating the changes in human resting muscle caused by the lack of gravity. The experiment was a collaborative effort between the Charité Berlin, the University of Southampton, the medical company Myoton AS, the DLR Space Administration and the European Space Agency (ESA). Insights from this experiment can be applied to optimize rehabilitation and training programmes while enabling objective evaluation of the effectiveness in clinic and practice.

Another example for advantageous cooperation between the health and space sectors is the Crew Interactive Mobile Companion (CIMON) ([https://www.dlr.de/content/en/articles/news/2018/1/20180302\\_cimon-the-intelligent-astronaut-assistant\\_26307.html](https://www.dlr.de/content/en/articles/news/2018/1/20180302_cimon-the-intelligent-astronaut-assistant_26307.html)), an autonomous astronaut assistant featuring artificial intelligence that has been deployed to the ISS twice since 2018. CIMON is a cooperative effort between the DLR Space Administration, Airbus, IBM and the Ludwig-Maximilian-University (LMU) Hospital in Munich and aims to support astronauts in increasing the efficiency of their work. Given the high exposure of astronauts to stress, LMU scientists want to study whether CIMON can act as a partner and assistant to astronauts, thereby reducing their exposure to stress. Possible applications on Earth could be the support of engineers, researchers and doctors, AI-based enquiries about medical symptoms and everyday assistance for elderly people living alone.

- Please provide recommendations regarding the establishment of a dedicated platform for effective coordination among United Nations entities, other international organizations and relevant actors on space and global health issues.*

Effective coordination among various national and international actors on global issues is desirable in principle. On the issue of health in particular, the Covid-19 pandemic has demonstrated the demand for collaboration on a global scale. Space applications have played an important role in monitoring the implications and effects of the pandemic (e.g. through Earth observation by satellite) and in adapting to life with the coronavirus (e.g. through space-enabled telemedicine). Furthermore, the Space sector creates innovations that can be used on Earth and in everyday life, including with regard to global health issues. Through information, communication and cooperation, cutting-edge space technologies and services have the potential to help solving today's health challenges.

Improving the coordination among actors on space and global health issues, and the mechanisms through which this could best be achieved, is therefore an important area for the working group to consider.

In this regard, it should be especially investigated how existing space-related coordination mechanisms can also allow for effective coordination on space and global health issues. The Inter-Agency Meeting on Outer Space Activities (UN-Space) has a proven track record of bringing together UN entities and discussing matters related to the use of space technologies in their activities. In 2015, the UN Office for Outer Space Affairs (UNOOSA), the World Health Organization (WHO) and other entities prepared an excellent special UN-Space report on the many ways in which UN entities were already using space science and technology for public health (A/AC.105/1091). Based on this positive experience, UN-Space could explore further ways to enhance coordination on space and global health within the UN system, e.g. through closer cooperation

and coordination between UNOOSA and the WHO. Another mechanism could be the designation of WHO Collaboration Centres, where national institutions focused on space science and technology can carry out activities in support of the WHO's programmes.

Another avenue to explore could be a concept of regional support offices and network infrastructures similar to those established in relation to the United Nations Platform for Space-based Information for Disaster Management and Emergency Response (UN-SPIDER) with the aim of connecting the space and disaster management communities. Experiences from the aforementioned "Space2Health" network in bringing together the space and health communities could be provided.

3. *Please describe existing or planned policy-enabled environmental and governance mechanisms for removing barriers to the effective use of space-based technologies in support of global health.*

An important aspect of space-enabled technologies in support of global health is the trustworthiness of information. The Covid-19 pandemic has demonstrated how dependent an effective epidemiological response is on the collaboration of the society as a whole. In order to improve access to and use of space-based applications, users need to be able to rely on information provided to them. One mechanism to explore is the use of digital signatures in space-enabled health applications to validate that information provided come from a trusted source, such as international or national health agencies, and have not been altered. Adding information to spatial public health analysis through another entity for decision support can also be digitally signed. Public-private-key methods can further be used to append a digital signature to any encrypted or non-encrypted digital spatial information from the health or space domain.

4. *Please describe existing or planned policies on open data-sharing and participatory approaches to developing and improving access to geospatial information relevant to global health.*

Further information may be provided at a later stage.

5. *Please describe existing or planned efforts related to the geotagging of all assets relevant to health systems, including health information systems.*

Further information may be provided at a later stage.

6. *Please describe existing or planned intersectoral coordination and cooperation for effective international, regional, national and subnational capacity-building activities relevant to the application of space science and technology in the field of global health.*

Further information may be provided at a later stage.

7. *Please describe existing or planned mechanisms to engage educational institutions and other capacity-building mechanisms in motivating young health professionals to acquire skills and abilities required to efficiently use advantages provided by space technology, science and applications at an early stage in their careers.*

The medical research facility :envihab of the DLR Institute of Aerospace Medicine is studying human spaceflight problems whose answers might also yield beneficial applications for problems of life on Earth, such as ageing, bedriddenness, immobilisation or isolation. Through a wide range of research opportunities, it allows young scientists to explore future challenges of human spaceflight as well as problems related to life on Earth.

Additional information on further mechanism may be provided at a later stage.

8. *Please describe existing or planned mechanisms to better integrate space-derived data and information into decision-making processes related to global health, and to harmonize and share such data.*

Further information may be provided at a later stage.

9. *Please describe how space technology and applications are integrated into health-related emergency planning and management and disaster management plans.*

Further information may be provided at a later stage.

10. *Please describe key activities, reference documents and plans relevant to the topic "Space for global health".*

The key principle of the space strategy of the German Federal Government is to use space for the benefit of the Earth and to assess space activities according to their contribution towards solving societal challenges. The strategy notes that significant potential lies in applications and services markets which are only made possible through space-based infrastructures. It considers space activities to constitute an enabling technology that can provide an infrastructure for new value chains in other economic sectors, especially in downstream value-added services. The space sector creates innovations that can be used for everyday life. Through information, communication and collaboration, new space-enabled applications can reach other sectors of the economy and act as a promoter of innovation (e.g. Smart Cities). Such applications can be used in the service of modernizing the health sector.

The key issues paper "Digitisation of the Health Care Industry" (*"Digitalisierung der Gesundheitswirtschaft"*) by the Federal Ministry for Economic Affairs and Energy (BMWi) describes that topics such as digitisation, telemedicine, uniform standards for telematics infrastructure applications and better use of health care data can and should be used to provide better and more humane patient care. The Federal Ministry of Health (BMG) also emphasises the importance of integrating new technologies and services (e.g. space applications, digitisation and artificial intelligence) into the health care system and patient care. Currently, the healthcare system is facing decisive changes: digitisation, globalisation, the use of artificial intelligence, robotics and demographic change will have a major impact on the healthcare sector and have the potential to further increase the efficiency of health prevention and medical care. The high-tech strategy of the German Federal Government furthermore states that particular attention will be paid to research into providing healthcare services more effectively to hard-to-reach population groups, an effort where telemedicine will prove beneficial.

The DLR Space Administration has initiated and supported initiatives to promote innovation, cross-sectoral technology transfer and commercialisation. The INNOspace initiative was founded on behalf of the BMWi in 2013. INNOspace creates incentives and platforms for transfer of technology, services and knowledge between the space industry and other sectors of the economy (spin-offs and spin-ins). The emphasis of the INNOspace initiative is also focused on supporting the New Space economy and commercialisation of space technologies. INNOspace is aimed at companies, colleges, universities, research institutions, ministries and public authorities, industry associations and clusters as well as policy makers and multipliers.

11. Please provide an overview of existing and planned practices and initiatives in the current uses of space (technology, applications, practices and initiatives) in support of global health and identify gaps, if any, in the following areas:

- a. Telemedicine and tele-health;
- b. Tele-epidemiology and environmental health;
- c. Space life sciences;
- d. Disaster and health emergency management;
- e. Other.

Please refer to the previous answers for specific practices and initiatives.