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Committee on the Peaceful Uses of Outer Space

Report on the meeting on the applications of space science and technology for public health organized by the World Health Organization and the Office for Outer Space Affairs

(Geneva, 15 and 16 June 2015)

I. Introduction

1. The World Health Organization (WHO) is the directing and coordinating authority for health within the United Nations. It is responsible for providing leadership on global health matters, shaping the health research agenda, setting norms and standards, articulating evidence-based policy options, providing technical support to countries to strengthen their health systems, assisting countries in reaching the health-related targets of the Sustainable Development Goals and monitoring and assessing health trends.

2. The Office for Outer Space Affairs of the Secretariat is the implementing organization for the United Nations Programme on Space Applications, which is mandated to provide technical advisory services on the use of space science, technology and applications as requested by Member States or any of the specialized agencies.

3. There exists a wide range of space science and technology applications that address public health issues. Earth observation satellites enable us to collect valuable local, regional and global data and information in support of public health decision-making, for example, with regard to epidemic control, disease management, planning related to well-being, and studying and monitoring vector-borne diseases.

4. Telecommunications satellites are used in tele-health and telemedicine applications for transmitting medical advice and information, in particular in rural and isolated locations that have limited access to adequate medical support. Telecommunications satellites can also assist in tracking the delivery of essential medical supplies and health commodities. Tele-health solutions aid countries in

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providing health services to hard-to-reach places, and serve as a major tool in achieving their objective of universal health coverage. Tele-health solutions can also be used for health education and training purposes. Tele-epidemiology applications are used in support of epidemic and disease management. Overall, telecommunications satellites can augment efforts related to providing quality health services.

5. Research in the space environment, which includes research conducted on-board the International Space Station (ISS), can contribute to identifying potential cures and treatments for major diseases, such as cancer. The development of space technology has also resulted in a large number of spin-off technologies for the health sector.

6. To review the role of space science and technology, and their applications for public health, WHO and the Office for Outer Space Affairs agreed to organize a meeting on the applications of space science and technology for public health on 15 and 16 June 2015 at WHO headquarters in Geneva.

7. The meeting was organized in follow-up to two previous expert meetings that had focused on technologies and applications for public health, conducted in connection with the ISS programme: the United Nations Expert Meeting on the International Space Station Benefits for Humanity, held in Vienna on 11 and 12 June 2012 (see A/AC.105/1024), and the United Nations Expert Meeting on the International Space Station Benefits for Health, held in Vienna on 19 and 20 February 2014 (see A/AC.105/1069).

8. The present report has been prepared pursuant to General Assembly resolution 69/85. It describes the background and objectives of the meeting, and summarizes the presentations, discussions and recommendations made by those who participated in the meeting.

A. Background and objectives

9. The United Nations Expert Meeting on the International Space Station Benefits for Health had recommended that WHO and the Office for Outer Space Affairs should organize a two-day planning meeting on space for health, in order to develop a plan of action for specific implementation solutions based on space technologies developed for human spaceflight-related activities (see A/AC.105/1069, para. 49).

10. In the preparatory discussions for such a meeting, it was agreed that, in addition to ISS partner agencies, other space agencies and national institutes of health should be invited to the meeting, which should also consider Earth observation, tele-health, telemedicine, tele-epidemiology and other geospatial applications in managing public health.

11. It was also agreed to link the meeting to the discussions ongoing in the expert group on space and global health, which had held its first meeting on the margins of the fifty-second session of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses for Outer Space (see A/AC.105/C.1/2015/CRP.29).

12. The meeting had the objective of bringing together WHO and health organization representatives with representatives from the space community to:

(a) Assess the status of space-technology-related contributions to addressing health issues;

(b) Identify relevant research activities, technologies and applications that are not yet being used by the health sector;

(c) Identify barriers to and potential solutions for implementing space-technology-related health solutions;

(d) Consider opportunities for aligning relevant space-related activities, including research activities on ISS and activities ongoing within the Group on Earth Observations and within other relevant frameworks, with the leadership priorities of WHO.

13. The meeting anticipated the following outcome:

(a) Meeting participants, including relevant WHO staff and representatives of space agencies, would be better informed about the potential contributions of space science, technology and its applications that are relevant to WHO-mandated activities;

(b) The meeting would identify activities, applications or technologies for follow-up projects.

14. In addition to the documents already mentioned, the meeting participants had before them the following information:

(a) The WHO Twelfth General Programme of Work and the six leadership priorities;

(b) Information about the health-related activities of the Group on Earth Observations;

(c) Information about the health-related activities of the United Nations Programme on Space Applications;

(d) Space for global health: special report of the Inter-Agency Meeting on Outer Space Activities on the use of space science and technology within the United Nations system for global health (A/AC.105/1091).

B. Attendance

15. The meeting was attended by representatives of the Centre national d'études spatiales (CNES) of France, the Canadian Space Agency (CSA), the China National Space Administration (CNSA), the German Space Agency (DLR), the European Space Agency (ESA), the Japan Aerospace Exploration Agency (JAXA), the National Aeronautics and Space Administration (NASA) of the United States of America and the Group on Earth Observations secretariat, as well as by tele-health experts of the Public Health Agency of Canada and the University of Saskatchewan (Canada), and by representatives of the Office for Outer Space Affairs and WHO.

16. Throughout the two-day meeting, interested staff members of several WHO divisions joined the meeting to listen to the presentations and to participate in the discussions. The meeting was webcast simultaneously for WHO participants located outside Geneva.

C. Programme

17. The Office for Outer Space Affairs developed the programme of the meeting in collaboration with WHO. It comprised a welcome and opening session, and three thematic sessions addressing the health priority areas of WHO, space applications and technologies for public health, and research in the space environment for public health.

II. Summary of the meeting programme

A. Welcome and opening

18. The Assistant Director-General of the Health Systems and Innovation Cluster of WHO, after welcoming the meeting participants, noted that several WHO technical departments already had broad experience with using geographic information systems (GIS), but that space technology might have more to offer. The challenge was to identify a way to utilize the benefits of highly advanced space-based technology to support affordable health solutions. Furthermore, she affirmed that space technology had also proven its usefulness in a sectoral context, with public health being a prominent example of a sector in which the use of satellite communications and remote sensing was both a reality and a need. The Assistant Director-General concluded by stating that telecommunications technology offered appropriate and affordable tools that were needed to achieve universal health coverage, one of the six leadership priorities contained in the WHO Twelfth General Programme of Work for the period 2014-2019, especially in remote and rural areas.

19. The United Nations Expert on Space Applications welcomed meeting participants on behalf of the Office for Outer Space Affairs. He noted that the meeting was the result of previous expert meetings on the benefits of ISS for humanity and health organized under the United Nations Programme on Space Applications. The first meeting of experts had discussed ways to extend the benefits of ISS research accomplishments in the areas of Earth observation and disaster response, health and education. The second expert meeting categorized the ISS research and technologies according to the six WHO leadership priorities. He emphasized that one of the main objectives of the current meeting was to identify potential space technologies in order to initiate real collaboration projects among space agencies, WHO and the Office for Outer Space Affairs.

20. Following the adoption of the meeting agenda, the meeting objectives (see sect. I.A above) were reviewed.

21. A presentation on the health-related activities of the United Nations Programme on Space Applications that had been organized since the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III), held in 1999, concluded the session. The presentation stressed the

importance of linking the outcome of the present meeting to the 2030 Agenda for Sustainable Development and the Sustainable Development Goals, as well as the preparatory work for the fiftieth anniversary of the United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE+50), in 2018.

B. Health priority areas of the World Health Organization

22. The session began with a presentation by the director of the Office of the Assistant Director-General for Health Systems and Innovation of WHO, in order to familiarize non-WHO participants with the health priorities included in the WHO Twelfth General Programme of Work for the period 2014-2019 and the 2015-2016 programme budget.

23. The General Programme of Work sets out the leadership priorities and defines the key areas in which WHO seeks to exert its influence in global health and drive work at each level. The six leadership priorities are (a) universal health coverage; (b) the International Health Regulations (2005); (c) increasing access to medical products; (d) social, economic and environmental determinants; (e) non-communicable diseases; and (f) the health-related Millennium Development Goals (see also A/AC.105/1069, paras. 21-23). As part of a wider programmatic reform, the General Programme of Work also provides for a new organizing framework for the programme budget of WHO, into well-defined categories of work: communicable diseases; non-communicable diseases; protection of health through the life course; health systems; preparedness, surveillance and response; and corporate services and enabling functions.

24. The representative of the University of Saskatchewan made a presentation on practical experiences with health care in remote areas that had been enabled by tele-presence. He reported on the successful demonstration of tele-health applications and services in Bolivia (Plurinational State of) and Canada. The cell-phone-based remote presence application contributed to reducing medical inequality in rural and difficult-to-access areas. In the Canadian example, the tele-presence solution contributed to a substantial reduction in travel costs related to the transportation of patients. The resulting cost savings offset the cost of establishing the tele-health infrastructure within the first three months of its use.

25. Tele-epidemiology uses space technology to study human and animal diseases transmitted by water, air or vectors. Such diseases are closely linked to climate and the environment. Tele-epidemiology applications supported by CNES were presented, using as examples the monitoring of Rift Valley fever and urban-zone malaria in Senegal and of dengue fever in Martinique. The conceptual approach for tele-epidemiology applied by CNES is a multidisciplinary one that is based on the study of key mechanisms that favour the emergence and propagation of infectious diseases, linking various disciplines, for example, the social sciences, entomology microbiology, veterinary medicine and the study of climate and the environment. It has been patented by CNES. The various projects are conducted in close cooperation with the Committee on Earth Observation Satellites and the Group on Earth Observations.

C. Space applications and technologies for public health

26. The session began with a series of presentations on WHO programmes and their priorities and the ongoing use of space applications by WHO.

27. In the field of e-health, WHO is providing strategic guidance to countries with regard to strategy development; standardization and interoperability; capacity-building; health promotion and education; and legal, ethical and governance matters. It was noted that there were still many barriers to the wider use of e-health. In general, the element that was holding back the implementation of e-health initiatives was not the technology, but rather the lack of supporting policies, an enabling environment, availability of an adequate workforce and critical infrastructure.

28. A particular GIS application that WHO is aiming to develop is a global health facilities locator database. The database would be supplemented by country-specific geo-datasets. Satellite-derived data, such as GPS location, remote sensing imagery, thermal maps, weather data and GIS shape files, could provide additional useful information. When completed, the global health facilities locator database would provide much-needed tools for member States to maintain and manage data on health facilities by linking to GPS location, remote sensing imagery, thermal maps and weather data. In addition, the effort would also provide an advance visualization tool for tele-epidemiology, tele-health and health emergency response, linking health workforce data and health commodities data, along with existing public safety and other public health and emergency management entities. Potential users of the database would be federal and state ministries of health, local governments authorized bodies, intergovernmental and non-governmental organizations, the United Nations system and affected communities at large.

29. The capabilities of geographic information systems were used by WHO in its Ebola response and its global polio eradication initiative, including for Ebola-response mapping, Ebola infrastructure mapping (laboratories and treatment centres) and drive-time mapping. Based on the positive experience with using GIS, WHO is preparing white papers and standard operating procedures to open the GIS infrastructure established in response to the Ebola threat for general WHO use and to strengthen the GIS capacity of WHO. The Organization is also interested in establishing partnerships with relevant agencies.

30. The final presentation by WHO discussed a project undertaken in cooperation with the United Nations Environment Programme and the United Nations Human Settlements Programme on integrating remote sensing data in monitoring the water-health sector in support of the post-2015 development agenda. Earth observation data can contribute to the monitoring of Sustainable Development Goal 6, Target 6.3, on wastewater indicators. WHO is also working with the Group on Earth Observations under the societal benefit area on health. A representative of the Group on Earth Observations secretariat gave an overview of the work of the Group under its six societal benefit areas.

31. The session concluded with a presentation by the chair of the Scientific and Technical Subcommittee expert group on space and global health, entitled “Space for global health: from concept to action”. The speaker stated that the world continued to face major global risks which had an impact on health. Science and

technology were essential for addressing those risks. That included applications in the fields of telemedicine, tele-health, health sciences, tele-epidemiology and disaster management, enabled by space-related technologies and activities in telecommunications, global navigation satellite systems, remote sensing of the Earth and atmosphere, GIS applications, space life sciences and technology development (see A/AC.105/C.1/2015/CRP.29, appendix 1). The presentation recalled the developments that had taken place since UNISPACE III that had led to the establishment of the expert group on space and global health and which were aimed at promoting space benefits for global health by proposing relevant high-level actions.

D. Research in the space environment and public health

32. During the session, space agency representatives presented information on space life science research activities conducted on suborbital and orbital platforms and at ground-based facilities, as well as technologies developed for these purposes that could be applied to public health issues. Several space agency representatives also provided updated information on the projects and technologies discussed during the United Nations Expert Meeting on the International Space Station Benefits for Health.

33. CSA had been using ISS since 2001. Canada had in particular specialized in the field of space robotics, which had resulted in various spin-off technologies, such as NeuroArm, a surgical robot. Remote patient monitoring capabilities had been explored with the advanced, fully integrated, crew medical system, which could also be adapted for terrestrial use. The Space Health and Aging Research for Exploration (SHARE) project could be applicable to many of the problems of an ageing society. CSA was cooperating with the Gerontological Society of America within the framework of the World Explores Space Health and Aging Research (WE-SHARE) project by bringing together space experts with experts on ageing from academia, industry and clinics, as well as caregivers.

34. The representative of CNSA provided examples of research and applications of spatial information technology for the health sector in China. The country had begun to use GIS-based methods for health applications in the 1990s to analyse the spatial distribution of infectious *Oncomelania* snail populations and plague-affected areas. In 2003-2004, further advances had been made in the application of GIS during the severe acute respiratory syndrome (SARS) crisis. A large number of national scientific research institutions, colleges and universities had contributed to developing and using spatial information technology in the health field. To improve existing GIS applications, further developments would be necessary to improve the technology, as well as the availability and accessibility of data and the education of interdisciplinary personnel with skills in both the GIS and health fields.

35. CNES had been active in human spaceflight activities for several decades. The CADMOS centre for the development of microgravity applications and space operations, located in Toulouse, France, was conducting ISS experiments related to cardiovascular research, neuroscience, nutrition and physiology. In addition, health-related research was also taking place during parabolic flight campaigns and in

bedrest and dry-immersion studies. The majority of those activities were performed in cooperation with international partners.

36. The Deutsches Zentrum für Luft- und Raumfahrt (DLR) was using earth observation data for the global monitoring of air pollution; the development of "health risk indices"; the monitoring of megacities, slums and refugee camps; decision support for humanitarian relief; satellite-based analysis for mitigating vector-borne diseases; and satellite-based crisis information for natural disaster management. Telemedicine applications included the Advanced System for Teleguided Ultrasound Diagnosis. The "envihab" project of DLR was a terrestrial life sciences analogue for research on ISS and for future human exploration. The Combined Regenerative Organic-food Production system was an environmentally closed food production system with terrestrial applications.

37. JAXA was using satellite technology for public health and undertook a wide range of biomedical research activities related to ISS. Health and mental care for people living in space could also benefit people living on Earth. In the Asia-Pacific region, JAXA was contributing to the monitoring of air quality, including dust, and to the creation of risk maps for polio eradication and tropical malaria. In some of those activities, JAXA was already cooperating with WHO.

38. NASA had developed numerous technologies and applications under the ISS programme. Examples included the technologies developed for the Exploration Medical System Demonstration, water processing assemblies and commercial water filtration appliances, and family communications solutions as a way of addressing isolation and confinement.

39. ESA was implementing the European Programme for Life and Physical Sciences, which was making use of a wide range of ground- and space-based research platforms. Activities included biological and physiological research, as well as research linked to the immune system and to the health issues typically seen in a sedentary and ageing population. In addition, several ESA programmes were supporting activities related to telemedicine, e-Health and health-related technology development.

III. Summary of the discussions

40. Following the individual presentations, the discussions centred around four issues: (a) updating the table mapping ISS health research activities and technologies to WHO leadership priorities; (b) utilizing space technology for areas related to the activities of WHO; (c) drafting a World Health Assembly resolution to raise awareness about the role of space science, technology and applications for public health; and (d) issuing a dedicated call for proposals regarding health-related research on ISS linked to WHO leadership priorities.

A. Updating the table mapping International Space Station health research activities and technologies to the leadership priorities of the World Health Organization

41. One of the main objectives of the United Nations Expert Meeting on the International Space Station Benefits for Health held in Vienna on 19 and 20 February 2014 was to map ISS health research activities and technologies to the leadership priorities of WHO (see A/AC.105/1069, sect. III). At that meeting, it was decided that WHO would prioritize the potential space technology solutions contained in the table mapping ISS health research activities and technologies to WHO leadership priorities, and identify WHO technical staff who would work with space agency representatives towards implementing promising technologies. WHO has undertaken internal discussions across the three levels of its organization and will prepare a document for internal use to identify research activities and space-based technologies that are of interest to WHO.

42. Many of the technologies included in the table are spin-offs from existing terrestrial applications that have been adapted for use on orbital stations. Some of the technologies are readily available from commercial vendors.

43. It was noted that WHO would not be the direct beneficiary of research activity results or of spin-off technologies; instead, the member States of WHO and non-State actors would be the ones to benefit. It was noted that many of the space agencies had dedicated technology-transfer departments and programmes which maintained catalogues of spin-off technologies, including for the health sector, that could be consulted by interested health-service providers.

44. It was suggested that to make the table more useful it would need to be updated and complemented with further information, such as links to project and technology websites and information on points of contact. In addition, during the presentations made by space agency representatives, several new research activities and technologies had been identified that should also be included in the table.

45. It was noted that WHO had a unit that focused on innovations relating to technology transfers and patent issues. The cost effectiveness of new technologies in relation to their benefits was the primary criterion used by WHO to assess such technologies. A way forward might be to bring the updated table to the attention of the WHO innovation unit.

B. Utilization of space technology for areas related to the activities of the World Health Organization

46. WHO is specifically interested in developing a global health facilities locator database. The goal of this activity is to obtain validated health facilities data from ministries of health, and for that data to be used at the country level. The details of the architecture are being developed through a consultative process.

47. The database could be complemented with remote sensing data on regions of particular interest, for example Earth observation imagery collected during crisis situations. It was noted that data from several Earth observation satellites were

freely accessible and available, including data from the Landsat series of satellites and data from the Sentinel satellites of the Copernicus programme of ESA.

48. It was also noted that the Group on Earth Observations, the Committee on Earth Observation Satellites and the existing United Nations coordination mechanisms for the use of geospatial data — the United Nations Geographic Information Working Group and the Committee of Experts on Global Geospatial Information Management — were conducting activities that could also contribute to the development of a global health facilities locator database.

49. It was decided that WHO would provide further details on its proposal for the database and share them with space agencies and other relevant actors for their input.

C. Resolution to raise awareness about the role of space science, technology and applications for public health

50. During the discussions, it was proposed to consider drafting a World Health Assembly resolution in support of raising awareness about the role of space science, technology and applications for public health. The resolution should be linked to the Sustainable Development Goals and the 2030 Agenda for Sustainable Development, as well as to the ongoing activities in preparation for UNISPACE+50. A particular example that could be followed was the World Health Assembly resolution on e-health (WHA58.28).

51. The draft resolution could be prepared in cooperation with the Scientific and Technical Subcommittee expert group on space and global health, and introduced during one of the forthcoming sessions of the World Health Assembly by the delegation of a WHO member State.

D. Dedicated call for proposals for health-related research on-board the International Space Station

52. It was noted that ISS partner agencies were presently planning to use ISS until the 2020-2024 time period. Owing to the complexity of an orbital station, its utilization had to be planned and scheduled many years in advance. Planning for research to be conducted on-board ISS during the 2017-2020 time period was already taking place. Proposals for research to be conducted during the 2020-2024 time period were expected to be solicited in 2018.

53. It was proposed that ISS partner agencies should consider issuing a dedicated call for proposals for experiments and research linked to the WHO leadership priorities. Such a call for proposals could mobilize the existing space life science community to refocus their activities on the health priorities identified by WHO, and would allow for relevant research activities to be conducted on-board ISS before it had reached the end of its lifetime.

54. Calls for proposals relating to international life science are coordinated by the International Space Life Sciences Working Group, which considers issues relating to international development and the use of spaceflight and special ground research facilities. The Working Group meets every six months and would need to consider

the possibility of issuing such a future call for proposals, which, issued in cooperation between the ISS partner agencies and WHO, would also be a highly visible opportunity to promote the benefits of human spaceflight activities for public health.

IV. Identification of collaborative projects

55. Meeting participants agreed to follow up on the following proposed collaborative projects:

(a) Collaborative project 1 (geo-dataset and global health facilities locator database): WHO will prepare a concept note for space agencies to review and identify possible opportunities for cooperation. WHO will organize a follow-up meeting to move the project forward. A meeting date will be proposed by WHO;

(b) Collaborative project 2 (sensors, portable diagnostic equipment): WHO will prepare a concept note for space agencies to review and identify possible opportunities for cooperation;

(c) Collaborative project 3 (access to safe water and use of water purification technologies): WHO will prepare a concept note for space agencies to review and identify possible opportunities for cooperation;

(d) Collaborative project 4 (drafting of a resolution on collaboration between member States, space agencies and other relevant entities for advancing universal health coverage and raising awareness about the role of space science, technology and applications for public health): The text of a draft resolution could be circulated to member States via the expert group on space and global health;

(e) Collaborative project 5 (identifying opportunities for collaboration, including a dedicated call for proposals for research related to WHO leadership priorities and other areas of mutual interest, on-board ISS and at ground-based facilities and through associated programmes): The Office for Outer Space Affairs and WHO will further assess the viability of this collaborative project with relevant space agencies and the International Space Life Sciences Working Group;

(f) Collaborative project 6 (updating the table mapping ISS health research activities and technologies to WHO leadership priorities): Space agencies will provide their inputs for updating the table.

V. Conclusions

56. The collaborative projects listed above will be followed up by WHO and by the Office for Outer Space Affairs in the framework of the United Nations Programme on Space Applications under its thematic priority on global health.

57. In doing so, WHO and the Office for Outer Space Affairs will closely cooperate with the relevant space agencies and with the expert group on space and global health.