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Implementation of the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III)

Final report of the Action Team on Public Health: the use of space technology to improve public health

Note by the Secretariat

I. Introduction

1. There are three broad areas of space technology with direct operational applications and significant potential benefits for public health: satellite communication, global positioning systems and remote sensing space technologies. The present report describes the current situation in the fields of telehealth and tele-epidemiology as an illustration of current and future applications of space technology that can improve or enhance public health services.

2. The delivery of health and public health services through satellite communication applications is often focused in areas such as e-health, telehealth and telemedicine, through which health resources and health care are provided at a distance by electronic means. Although they have certain differences in their areas of focus, e-health, telehealth and telemedicine all work to provide health-care services using information and communications technology. Communication satellites have the potential to overcome the barriers posed by distance, time and lack of resources at hand in situations where immediate on-site care is not available. Telehealth consultations are sometimes the only way for a community to have

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access to a doctor. Over the past decade, studies have found that telehealth applications are effective in a wide variety of medical specialties, as well as for capacity-building, distance education in the field of health, the creation of health profiles and surveillance and medical administrative matters. Despite positive outcomes such as the improved quality of life and improved knowledge transfer, the sustainability of telehealth programmes is still problematic due to barriers such as insufficient and unstable bandwidth access, insufficient funding and inadequate training for end-users. Standardization of technical processes and hardware poses a significant additional barrier.

3. The application of remote sensing satellite data to address public health issues is used within the disciplinary area of tele-epidemiology, and, over the past 40 years, the most significant focus of that application has been the prevention and control of infectious diseases. Despite steady advances in modern medicine, many diseases, such as malaria, cholera and epidemic influenza, still afflict millions of people worldwide each year. Many of these diseases are known to be environment-dependent, and some are transmitted by insects or animals. The growing awareness of the intrinsic interactions among humans, animals and the environment in the emergence and re-emergence of many infectious diseases of regional and international importance spurs researchers and health specialists to find ways to efficiently detect, characterize and track the sources, transmission pathways and determinants of these diseases. The discipline of tele-epidemiology (formerly referred to as “landscape epidemiology”) is a well-defined application of space technology. In short, tele-epidemiology provides consistent, large-scale and rigorous Earth observations that help in understanding, predicting and combating diseases in whose epidemiology the environment or the geographic distribution of exposure plays an important role.

4. In public health research, the application of these technologies and data have evolved considerably over the past 10 years, mainly as a consequence of the greater consideration given to geographical determinants of health in order to better understand the complex relationships of a wide range of diseases, and the rapid and notable progress in the temporal, spatial and spectral resolution and availability of various space technologies and products.

II. Background

5. The Action Team on Public Health (action team 6) was officially created in 2001 to follow up on one of the objectives relating to the use of space applications for human security, development and welfare: to focus on measures to improve public health services for telemedicine and for controlling infectious diseases. Throughout the past decade, the Action Team’s objectives have been realigned in order to support the needs and expectations expressed by Member States. From 2001 to 2006, the leadership of the Action Team was initially provided under the chairmanship of Canada, with the support of the Space Generation Advisory Council (SGAC) acting as secretariat. Initial members included Australia, Bulgaria, Cuba, France, Hungary, Iran (Islamic Republic of), Iraq, Italy, Japan, Kazakhstan, Pakistan, the Philippines, Portugal, Saudi Arabia, South Africa, the Syrian Arab Republic, Turkey and the United States of America. United Nations entities and international organizations that have participated in the Action Team

include the Economic and Social Commission for Asia and the Pacific and the World Health Organization (WHO). The initial mission statement was to improve public health services by expanding and coordinating space-based services for telemedicine. In 2004, the Action Team submitted to the Scientific and Technical Subcommittee its contribution for the report on the review of the implementation of the recommendations of the Third United Nations Conference on the Exploration and Peaceful Uses of Outer Space (UNISPACE III) (A/59/174). The preliminary report of the Action Team contained a set of recommendations for further action, including the following:

(a) The establishment of a cardiovascular disease knowledge management network;

(b) The holding of an international United Nations conference on global telemedicine;

(c) Preparation of a compilation report on the status of telemedicine worldwide.

6. Despite efforts made by Canada and Action Team members, there were some impediments to the implementation of those three recommendations. The cardiovascular disease knowledge management network, although well defined, was unable to secure the funding from Member States required to support the initiative on the basis of voluntary contributions.

7. Following that report of 2004, activities of the Action Team continued at a subdued pace until the period 2006-2007, when they regained momentum. WHO accepted to co-chair the Action Team, and new members joined the Team. The Team members agreed to work on a new approach focusing on early warning of infectious diseases — a need expressed by many developing countries. The Action Team's broad new mission was defined as to foster the implementation of telehealth for developing countries and improve public health services by facilitating the application of space technologies in early warning of infectious diseases. The renewed Action Team on Public Health aimed to address the following issues, which were initially proposed by the Office for Outer Space Affairs of the Secretariat:

(a) Facilitating the development of national policies for utilizing broadband services and data in developing countries in order to support health surveillance and data acquisition for that purpose;

(b) Applying space-based data to develop an early warning mechanism capable of predicting public health threats and alerting authorities in a timely manner;

(c) Facilitating the provision of or access to capacity-building and training in the field of tele-epidemiology.

8. Action Team members also agreed that, in order to benefit from activities of the Office for Outer Space Affairs in the fields of telehealth and telemedicine, the Team would leverage activities already scheduled by scheduling the Action Team's consultations and regional activities to coincide with them. A plan for linking and maintaining communications channels between different groups has been established. Canada offered to host a web portal that would support common efforts in sharing information on initiatives, best practices and lessons learned.

From 2007 to 2010, the Action Team participated in six activities organized under the leadership of the Office for Outer Space Affairs. Reports on those activities, events and observations can be found in the sections IV and V of the present report. Due to a transition within WHO, the WHO co-chair was not able to continue his support for the Action Team on Public Health, and since 2009, co-chairmanship has been provided by Canada and India.

III. Objective of the report

9. This report provides a brief summary of the key observations, technical considerations and experiences that the Action Team on Public Health has collected during its work and consultations over the past years. It presents a summary of the key activities held in the framework of the Action Team, selected examples of activities and initiatives carried out in the areas of telehealth and tele-epidemiology, and an analysis of the current state of integration and application of those areas in public health activities. Finally, it points to a way forward for the further development of the interdisciplinary field of space technology and public health.

IV. Activities of the Action Team on Public Health, 2007-2010

10. The general approach of the Action Team on Public Health has been to identify regional needs within its mission. Since 2007, the Action Team has participated in and monitored several regional activities that were co-organized by the Office for Outer Space Affairs. A summary of those activities is provided below.

A. United Nations/Mexico/Pan American Health Organization Training Course on Satellite Technology for Telehealth

11. The United Nations/Mexico/Pan American Health Organization Training Course on Satellite Technology for Telehealth, held in Mexico City from 25 to 29 June 2007, was jointly organized in cooperation with the National Centre for Health Technology Excellence (CENETEC) of the Ministry of Health of Mexico and the Office for Outer Space Affairs and hosted by the National Autonomous University of Mexico (see A/AC.105/895). Fifteen countries were represented, as well as representatives of the Office for Outer Space Affairs, WHO, the Pan American Health Organization, the European Space Agency (ESA) and the Latin American and Caribbean Chapter of the American Telemedicine Association.

12. Participants identified three main challenges: the lack of standards for health data and communications, the lack of a training strategy in the fields of telehealth and tele-epidemiology and the reduction of the digital divide. To address those regional issues, the following recommendations were made:

(a) The harmonization and standardization of health data should be encouraged throughout Latin America. Governments should implement national, standards-based policies on health informatics, with coherent initiatives in health metrics and knowledge management, in accordance with WHO standards;

(b) A specific study should be carried out on telemedicine projects that incorporate evaluation methodologies;

(c) Even when relatively low-cost equipment and narrow bandwidth connections are used, telehealth is not sustainable for small, remote communities when it is offered as an isolated service. Therefore, the network must integrate all required applications and services, such as Internet access, tele-education, e-government and other community services. By combining the various services, costs can be shared among the largest possible user base. Community involvement is essential to the ongoing use and support of the technology.

B. Regional expert meeting on using space technology for avian influenza monitoring and early warning in Asia

13. The regional expert meeting on using space technology for avian influenza monitoring and early warning in Asia was held in Bangkok from 1 to 3 August 2007 in the framework of the activities of the Committee on the Peaceful Uses of Outer Space, the Action Team on Public Health and the Regional Space Applications Programme for Sustainable Development of the Economic and Social Commission for Asia and the Pacific. The meeting was co-sponsored by the Geo-Informatics and Space Technology Development Agency (GISTDA) of Thailand and the China National Space Administration.

14. Meeting participants unanimously agreed that to achieve effective prevention and control of avian influenza and various other infectious diseases, the way such diseases spread must be understood. Thus, information systems integrating relevant information from different sources must be established to assess risks, and tools to monitor capacity and support decision-making must be established to identify risks and possible transmission routes; early warning systems must be created in conjunction with the development of the appropriate prevention measures. Participants recognized that some space technologies (remote sensing and geographic information systems) had proven their ability in tracking environmental factors related to bird migration and the poultry industry and analysing changes in those factors, and in integrating space and in-situ information, including historical information and in determining possible migration routes and areas of high risk of avian influenza. Meeting participants also recognized that the current challenges were to transform such existing methods and technologies into workable models and to develop appropriate cooperative mechanisms for the development and operational uses of those predictive models. The work required included the following: the further examination of methodologies and data requirements and the availability of existing models; the examination of the validity and their fine-tuning of those models; the identification of national-level requirements and the identification of appropriate products and services to meet these requirements; the development of operational models and proposed operational service mechanisms. To achieve those objectives, it was critical that several countries be actively involved in providing available in-situ and historical surveillance information.

C. United Nations/Burkina Faso/World Health Organization/ European Space Agency/Centre national d'études spatiales Workshop on the Use of Space Technology in Telehealth to Benefit Africa

15. The United Nations/Burkina Faso/World Health Organization/European Space Agency/Centre national d'études spatiales Workshop on the Use of Space Technology in Telehealth to Benefit Africa was held in Ouagadougou from 5 to 9 May 2008 (see A/AC.105/915). The Workshop was attended by nearly 120 participants from 16 countries and representatives of the Office for Outer Space Affairs, WHO, ESA and the Centre national d'études spatiales (CNES) of France.

16. The Workshop produced the following recommendations for addressing issues related to tele-epidemiology:

(a) Given the costs involved and the lack of resources, participants should share resources and project results in order to save time, reduce costs and increase the overall knowledge base;

(b) Governments could set priorities for the study of diseases by consulting the WHO website, which lists the 10 most common causes of death for each country;

(c) Given that data on human health are difficult to obtain because they are confidential and that some data are unavailable for national security reasons, partnerships could be formed with a view to compiling metadata of databases;

(d) The Food and Agriculture Organization of the United Nations should be invited to contribute to the series of workshops on the use of space technology for human health, because, owing to the economic aspects of food supply, the reporting system for animal pathologies was better than that for humans, and the data of that reporting system might also be useful for human tele-epidemiology.

17. Common issues and concerns for African countries in the field of telehealth were expressed during the Workshop:

(a) Use of telecommunications infrastructure in e-learning, e-training and telemedicine and the timely collection of data on health;

(b) Telecommunications infrastructure, as well as technical knowledge of its use and maintenance in remote and rural regions of Africa, was severely lacking;

(c) The general population could not afford Internet access. Efforts should be directed towards stimulating ideas on practical implementation and sustainability and encouraging shared efforts through in-kind voluntary support provided at no cost or at a low cost.

D. United Nations/India/European Space Agency Regional Workshop on the Use of Space Technology in Tele-Epidemiology to Benefit Asia and the Pacific

18. More than 100 participants from 15 countries and international organizations including WHO and the Office for Outer Space Affairs attended the

United Nations/India/European Space Agency Regional Workshop on the Use of Space Technology in Tele-Epidemiology to Benefit Asia and the Pacific, held in Lucknow, India, from 21 to 24 October 2008 and organized in cooperation with and hosted by the Government of India.

19. Participants in the Workshop noted that the following two projects under way would produce devices to be available in the near future: the design and development of mobile satellite communications-based tele-epidemiology; and the development of a hand-held portable community health kit incorporating a satellite communications facility. Workshop participants were invited to participate in the project. Activities in capacity-building, training and education offered by the Sanjay Gandhi Postgraduate Institute of Medical Sciences were also discussed in order to identify important areas of focus: the short-term goals of raising awareness of technology and applications, understanding basic issues in day-to-day management of the programme, awareness of privacy and security issues, availability of operational research such as evaluation tools and methodologies etc.; the mid-term goals of a training programme designed for technical professionals at a lower level who are involved in day-to-day technical management of the platform and network; and the long-term goal of curriculum-based, structured programme at the graduate, postgraduate, doctoral and post-doctoral levels (to start in July 2009).

E. Workshop on applications of telehealth to service delivery in public health and environment

20. A workshop on applications of telehealth to service delivery in public health and the environment was held in Thimphu, Bhutan, from 27 to 30 July 2009. The meeting followed up on the United Nations/India/European Space Agency Regional Workshop on the Use of Space Technology in Tele-Epidemiology to Benefit Asia and the Pacific.

21. Two main outcomes were achieved: the South Asian Association for Regional Cooperation (SAARC) Telemedicine Project[1] was initiated to further establish links with neighbouring countries; and the Thimphu Declaration on Telehealth of 30 July 2009 was issued with the goal of making telehealth and mobile health projects more accessible in SAARC member countries.[2]

F. Office for Outer Space Affairs symposium on the contribution to infection surveillance and health-related Millennium Development Goals

22. In the framework of the sixth European Congress on Tropical Medicine and International Health, held in Verona, Italy, from 6 to 10 September 2009, the Office for Outer Space Affairs organized a symposium on the contribution of space technology to infection surveillance and health-related Millennium Development Goals. Participants from nine countries and international organizations, including

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[1] Available from www.saarc-sec.org/areaofcooperation/detail.php?activity_id=11.

[2] Available from www.health.gov.bt/downloads/Thimphu%20Declaration%20on%20Tele-health.pdf.

ESA, attended the symposium, which was organized in cooperation with the University of Verona.

23. A total of nine presentations were delivered during the symposium. A group discussion session followed the formal presentation, which focused on opportunities for integrating space-based data and technologies and geospatial analyses into public health research and programmes.[3] All sponsored participants made presentations on various illustrations of the application of telehealth and tele-epidemiology activities to address public health or animal health issues relevant to their respective countries. Participants of this symposium were also given the opportunity to present their perspectives on the application of space technology to infection disease surveillance at a seminar activity organized by the University Hospital of Verona.

V. Summary of observations

A. Telehealth

24. Telehealth projects typically focus on the development of technologies, concepts of operations and the establishment of clinical facilities. Despite the extraordinary advances in telehealth to date, it is still only in an early stage of development. Global and regional initiatives are under way in many countries, but the capacity to maintain such programmes is often compromised. The following sections will outline global and regional initiatives in telehealth. The intent is not to report on all such initiatives but to summarize some projects that the Action Team has been aware of, given as examples of what has been done and what could be done.

1. Global initiatives

25. There are various organizations that contribute to the advances in telehealth in developing countries, for example, WHO and the Telecommunication Development Bureau of the International Telecommunication Union (ITU). WHO is the most important entity in the field of health care at the international level. It has already established some tools and networks to facilitate the implementation of health-care programmes in developing countries, using information and communications technology: the Global Observatory for eHealth, the eHealth Standardization Coordination Group, the Programme for Access to Research in Health (HINARI), the Africa Health Infoway, the Health Metrics Network and the Health Academy. The Telecommunication Standardization Sector of ITU has created a road map for telemedicine describing global issues regarding telehealth systems and security of data. The International Development Research Centre of Canada, the Swinfen Charitable Trust and national space agencies also contribute to various phases of telehealth programmes, from design to implementation.

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[3] The symposium programme and some presentations are available on the website of the Federation of European Societies for Tropical Medicine and International Health (www.festmih.eu/Page/WebObjects/PageFestE.woa/wa/displayPage?name=Wednesday+9th).

26. Cooperation between organizations and national Governments also contribute to the success of sustainable telehealth programmes. Goal 8, target 18, of the Millennium Development Goals proposes a global partnership for development, in cooperation with the private sector, to make available the benefits of new technologies, especially information and communications technology. As an example of such coalitions working to that end, the Asia-Pacific telehealth network is developing partnerships in order to help provide access to adequate medical care in developing countries. The network, including 16 countries, declared in 2007 its commitment to building e-health services in developing countries. The European Union also developed a strategic plan and the road map for the interoperability of e-health systems (RIDE), aimed at providing high-quality care and equity, as well as creating solidarity among States members of the European Union. The Aga Khan Development Network, an international network for developing nations in Asia and Africa, is involved in initiatives for social development, in areas such as telehealth and education, as well as disaster relief, economic development and preservation of cultures. Finally, the World Medical Association examines policies on telehealth.

2. Regional initiatives

27. There are numerous projects in the field of telehealth being carried out in many regions around the world. Some are research projects to study telehealth applications; others are pilot projects to set up telehealth facilities in underserved areas. Research centres, government agencies, universities and non-governmental organizations may be involved, depending on the nature of the project.

28. India is very active in telehealth development. The Apollo Telemedicine Network Foundation makes possible a great number of teleconsultations every year. The Network comprises 115 centres, including 9 overseas. Along with its projects for improving access to health care in India, it is developing various e-health programmes such as the Pan-African e-Network project, home telecare and educational courses. Among other initiatives in Asia, important projects carried out in the Philippines are the Community Health Information Tracking System, e-learning and the short message service (SMS) telehealth project. China is also involved in the development of telehealth programmes and related applications, for example, the Jin-Wei telehealth network, the China Medical Foundation telemedicine network, the Shuang-wei network and the Shanghai Medical University telehealth programme. Telehealth projects under way in the Pacific Islands are often carried out in conjunction with other Asian countries. Governmental and non-governmental organizations are getting involved in programmes such as the Pacific Open Learning Health Network, the Pacific Basin Telehealth Initiative and the Pacific Public Health Surveillance Network.

29. States members of the European Union can leverage their global e-health initiative, which is expected to improve the development of and access to telehealth. Partnerships between the European Commission, ESA and ITU are good examples of strategic alliances to improve the interoperability of e-health programmes. Meanwhile, European countries are developing their own facilities and programmes at the governmental and regional levels. Western European countries and Russia are also investigating telehealth applications. The WHO Regional Office for the Eastern Mediterranean contributes to telehealth initiatives through its Virtual Health

Sciences Library, the HINARI programme and other activities related to policy, education, training, planning and development of infrastructure.

30. Partnerships among African subregions are also being developed to expand their telehealth activities. For example, the WHO Regional Office for Africa is involved with several institutions, such as the e-Africa Commission of the New Partnership for Africa's Development, to accelerate the development of telehealth in Africa. As an example of a project in Africa, the Réseau en Afrique francophone pour la télémédicine (RAFT), a telehealth network for French-speaking Africa established in 2001, has the mandate of providing telehealth infrastructure to developing countries in Africa. This network has improved access to physicians in remote and underserved African areas.

31. In the Americas, countries are also developing telehealth applications for a variety of purposes (such as home care and rural care), as well as implementing networks for facilitating the exchange of knowledge. At the Sixth Space Conference of the Americas, held in Pachuca, Mexico from 15 to 19 November 2010, the Conference's committee on space and health (including the fields of tele-epidemiology, telehealth and telemedicine) agreed on a number of proposals, methods and means to better serve the needs of public health. The Committee identified the fostering of synergy and new initiatives as being of key importance. A number of past initiatives have created a strong foundation on which to build. For example, the Institute for Connectivity in the Americas was established in 2001 to provide strategic network capabilities to facilitate innovation in the field of telehealth in the Americas, in particular Latin America and the Caribbean. Since 2007, the Institute has been supported by the Canadian International Development Agency to promote the use of information and communications technology for health care. The United States and Canada are very active in the development of technology and procedures for telehealth applications for rural communities, as well as tele-home care. South American countries are also improving their knowledge and infrastructure in the field of telehealth through various pilot projects carried out by universities and research centres. For example, 43 telehealth projects were identified in Colombia in 2010.[4]

B. Tele-epidemiology

32. Public health authorities worldwide have had to respond to the emergence and spread of various infectious diseases at the regional and global levels. Most such diseases arise from the interaction of humans with animals and their environment, and considerable attention is now given to global factors (i.e. climate change, population migration and the intensification of agriculture production) affecting their incidence and transmission. The scope of tele-epidemiology goes far beyond the simple use of space technology, as it encompasses the disciplinary convergence of epidemiology, ecology, environmental sciences and space applications. Tele-epidemiology not only provides new and improved means of measuring environmental characteristics, but does so within the framework of a rich scientific

[4] C. Rey-Moreno and others, "A systematic review of telemedicine projects in Colombia", *Journal of Telemedicine and Telecare*, vol. 16, No. 3 (2010), pp. 114-119.

paradigm capable of collecting new types of knowledge about the relationship of populations with their environment.

33. Tele-epidemiology provides a unique opportunity for governmental agencies, research centres and non-governmental organizations to work together by sharing information, resources and a quick response system in case of emergency situations. The majority of the projects recently conducted in this field are international or regional efforts directed towards a common goal. By regrouping various data originating from satellites, predictive models can be constructed to forecast and control epidemics.

1. Global initiatives

34. As in the field of telehealth, various organizations are contributing to the field of tele-epidemiology by conducting research and pilot projects and encouraging new collaborations. WHO is a key player at the multilateral level, initiating and collaborating on many projects. WHO provided a workplan on the global burden of disease that evaluates the relevance of the Global Earth Observation System of Systems (GEOSS) and potential applications of remote sensing. WHO also provides support to the science of tele-epidemiology by stressing the potential of modelling the empirical relationship between the climate and various health-related factors. In addition, symposiums, workshops and meetings contribute to the exchange of information in the field of tele-epidemiology and encourage the development of new initiatives. The Office for Outer Space Affairs has contributed to two workshops on tele-epidemiology, one during the 12th Symposium of the Latin American Society for Remote Sensing and Space Information Systems (SELPER), held in Colombia in September 2006, and the second on the occasion of the 13th Symposium of SELPER, held in Havana from 22 to 26 September 2008.

2. Regional initiatives

35. As the former chairman of the Committee on the Peaceful Uses of Outer Space, Ciro Arévalo Yepes, noted, the use of satellite remote sensing, global navigation satellite systems and geographic information systems are facilitating the integration of ecological, environmental and other data to predict the spread of approximately 1,400 infectious diseases worldwide.

36. Accordingly, projects and studies in the field of tele-epidemiology are conducted in Africa to prevent infectious diseases such as Rift Valley fever malaria and dengue. Those projects help national Governments and regional authorities in their allocation of resources and provide support for their contingency plans. The WHO Regional Office for Africa, together with organizations for climate research based in Southern Africa, developed risk maps for malaria for each country of the region, using tools such as weather forecast data. In Senegal, the use of satellite data for monitoring the risk of the emergence of zoonotic diseases, supported by vector control actions and vaccination campaigns, will lead to the eventual development of an early warning system for Rift Valley fever (see A/AC.105/915, paras. 24-34). Other projects assess the possible use of geographic information, remote sensing and geographic information system capacities to study epidemics and to identify the environmental factors that contribute to the spread of vector-borne diseases. As an illustration of these activities, a project to develop a potential malaria vector distribution map has been undertaken in Zimbabwe. The UNITAR Operational

Satellite Applications Programme develops and disseminates satellite-based services and products for humanitarian relief and disaster prevention. Over the past two years, the Programme provided support for emergencies in several African countries such as Algeria, Angola, Côte d'Ivoire, Ghana, Kenya and Zambia (see A/AC.105/941, para. 59).

37. Collaborative efforts and projects are being developed throughout the Americas to support and enhance the use of space technology to prevent and control epidemics. The Latin American Group on Tele-epidemiology was established in 2005 as part of the outcome of the United Nations/Argentina/European Space Agency Workshop on the Use of Space Technology for Human Health, held in Cordoba, Argentina, from 19 to 23 September 2005. The main objective of the Group is to establish a regional alliance to facilitate the development and exchange of space technology applications in the public health sector, for the benefit of the countries of Latin America and the Caribbean. Among other initiatives in Latin America, the National Commission on Space Activities (CONAE) of Argentina elaborated risk maps for the monitoring and control of infectious diseases such as malaria, dengue fever, Chagas disease, leishmaniasis, Hantavirus pulmonary syndrome and viral hemorrhagic fever. Projects developed so far include a map of malaria risk prepared using data from satellite-based synthetic aperture radar, satellite-based radiometer measurements of lead contamination, a study of the evolution of the spread of dengue fever and a study of Chagas disease (see A/AC.105/895, paras. 81-83).

38. Among the conferences on tele-epidemiology organized recently in Asia, the United Nations/India/European Space Agency Regional Workshop on the Use of Space Technology in Tele-Epidemiology to Benefit Asia and the Pacific, held in Lucknow, India, from 21 to 24 October 2008 encouraged the use of space technology for public health surveillance and tropical diseases health care. Participants also discussed future projects addressing various issues such as mobile health systems, capacity-building, training and education, and data-sharing and data collection and repositories. Participants in the 2009 GEOSS Workshop XXVIII on health and the environment, held in Geneva from 7 to 9 July 2009, discussed projects undertaken in their respective regions. For instance, participants from Thailand described the development of national malaria distribution patterns based on risk maps created using remote sensing data, while participants from India described the expansion if the national approach to early warning systems.

39. European organizations, research centres and non-governmental organizations are making great efforts to further the use of tele-epidemiology and its applications. The Satellites for Epidemiology and Health Early Warning (SAFE) project, co-founded by ESA, has the goal of providing a better assessment of epidemiological risks based on real-time objective data by developing a European outbreak early warning system. Another successful model of regional collaboration is the creation in 2007 of the Re-emergent Diseases Global Environment Monitoring from Space (REDGEMS) information system, which promotes a tele-epidemiology approach and encourages participants to share knowledge. The multidisciplinary information system highlights dynamic links between climate and environment variability and re-emerging and new diseases. National organizations are also particularly active. CNES has invested considerable efforts in the study, validation and demonstration procedures for new satellite services, while participating in several projects in many

areas of the world such as the Emercase network in Senegal, Argentinean Monitoring in Tele-Epidemiology (MATE), the BIBO project in China and Europe and VIBRIO.[5] The French Institute for Space Medicine and Physiology (MEDES), a consortium of French governmental and non-governmental organizations, has initiated and participated in different multilateral projects in Europe and Africa in the space surveillance of epidemics by designing prediction models for epidemic risk.

VI. Analysis

A. Telehealth

40. Telehealth programmes are becoming key elements in the provision of medical care to populations living in remote and rural areas as well as communities facing a scarcity of resources. These programmes and infrastructures have, over the years, become ideal solutions to overcome the barriers of distance, time and resources when access to immediate on-site care is not possible. Lessons learned from telehealth projects have demonstrated that it is hard to make such programmes for access to health care sustainable. The lack of homogeneity among the projects, the problems associated with diffusion of knowledge and the absence of standardization could limit the development of global telehealth programmes. In addition, the sustainability of telehealth programmes is compromised due to the difficulty of gaining access to a sufficient and stable satellite link. Bandwidth access is expensive, and interruptions of service can be frequent. There are also legal, clinical and ethical issues, as well as the problem of insufficient funding. A significant gap remains between demonstration and implementation. In addition to those issues affecting the sustainability of programmes, policymakers do not have at their disposition sufficient literature incorporating globally accepted methodologies to provide support for decisions relating to the cost and feasibility of certain telehealth practices.

41. Despite the difficulties encountered, successful action by various organizations, such as the Swinfen Charitable Trust and other global and regional initiatives has led to satisfactory local outcomes and could act as source of inspiration to continue to work for the provision of standardized health care for all. For example, telehealth projects can have many benefits: improved quality of life and reduced use of medical transfer through the use of teleconsultations; improved skills of health-care workers through the use of tele-education; and access to expertise by means of e-mail consultation. As stated by Wootton and others in their article entitled "*Telehealth in the Developing World*", the use of information and communications technology for telehealth programmes in developing countries could be useful in terms of providing care, as well as capacity-building and remote education of health-care providers.[6] The authors of the article stress that telehealth might not solve all public health issues and is not a magical tool that simply requires

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[5] F. Marechal and others, "Satellite imaging and vector-borne diseases: the approach of the French National Space Agency (CNES)", *Geospatial Health*, vol. 3, No. 1 (2008), pp. 1-5.

[6] Richard Wootton and others, eds., *Telehealth in the Developing World* (London, Royal Society of Medicine Press, 2009).

implementation: concrete development with the local authorities, international agreements on standards, collaboration, policy regulations and other efforts are required.

42. A platform for knowledge transfer and the creation of frameworks could aid the development of telehealth in countries without an adequate health-care delivery system or that cannot offer universal access to care throughout their territory. The provision of adequate bandwidth and support in of the areas of project design and implementation, training and technology utilization are required to ensure that telehealth programmes take an integrated approach and are sustainable. All stakeholders, such as Governments (ministry of health and space agencies), non-profit organizations (such as Médecins Sans Frontières), international organizations (such as WHO and ITU) and industry (telecommunications providers and medical device providers) would benefit from global strategies to overcome the barriers to providing access to care.

B. Tele-epidemiology

43. A few key factors may significantly contribute to the renewed interest of national and international authorities in such tele-epidemiology and its integration into core public health functions. First, there is a growing need to explicitly place regional issues in the global context. The recent spread of pandemic strains of avian influenza and influenza A (H1N1), issues relating to microbial hazards in drinking water, climate change and emerging and re-emerging vector borne diseases have demonstrated the need to study and take action on multi-scale phenomena, including very large-scale determinants such as climate, economy and population migrations. The second factor driving the renewed interest in such technologies is the recognition by authorities of the highly complex nature of the transmission of and exposure to important pathogens, leading to a clearer desire to make use of transdisciplinarity to gain new knowledge and formulate sustainable proposals for interventions and policies. A compelling illustration of that force is the traction gained recently by the “One World, One Health” vision initially proposed by the Wildlife Conservation Society, which explicitly embraces the notion of the interdependence of human, animal and environmental health. Finally, the possibility of observing Earth features at any location and at almost any time has created a sustained interest in the ability to gain knowledge of health phenomena in remote locations and the ability to promptly react to emergencies following large-scale disasters.

44. Parallel to that public health vision, one must recognize the ever-growing role of medical, analytical and information technologies in tackling large and complex, multi-scale public health issues. By providing consistent, rigorous and large-scale data on Earth features and activities, remote sensing constitutes a significant technological advance that can supplement current land-based information, which may be obsolete, incomplete or biased due to rapid changes in population dynamics or events occurring in remote locations or distributed over large geographical areas. Over the past 10 years, there has been a marked increase in the number of activities documenting the application of remote sensing technologies for epidemiological and public health purposes. However, most of that effort has been linked to demonstrating conceptual aspects or gaining focal knowledge on a specific disease.

Surveillance, as one of the key functions of public heath, is usually framed as a long-term, ongoing and pragmatic activity aimed at action (field intervention, preventive measures, policy direction etc.).

C. Conclusion

45. There seems to be a notable gap in the operational integration of space technology within public health organizations in most parts of the world. This is in contrast with the significant increase in activities carried out over the past 10 years by a wide array of scientists to specifically address public health and epidemiological issues linked with environmental determinants. This reflects not only the sizeable challenge of transdisciplinary collaboration among scientists and organizations with different mandates, but also speaks directly to the need to explicitly integrate space technologies into recognized public health surveillance functions and in synergy with other fast-developing medical diagnostic technologies (i.e. genomics, nanotechnology), analytical technologies (i.e. geographic information systems and modelling) and information technologies (i.e. Internet-based data capture and alert systems). After nearly 40 years of documenting the possible contributions of these technologies to enhancing public health research and health surveillance, a sustained effort must now be made to demonstrate the added value of functional, cost-effective and operational solutions with measurable effects on public health functions and outcomes.

VII. The way forward

46. The present section is a proposal for a way forward in the continued development, promotion and implementation of telehealth and tele-epidemiology initiatives, in the light of the increasing interest, broad applications and direct pertinence that these cross-disciplinary fields are expected to play in the delivery of core public health programmes, both for developed and developing nations over the next decade. Three main steps are proposed.

47. *Step 1: Recognizing drivers and promoting strategic development*. Although space safety and sustainability constitute important issues for many countries, the international community should vigorously pursue solutions provided by space applications to address practical and operational social needs worldwide. With that in mind, Member States should recognize that the following drivers constitute an important foundation for the strategic development of the integration of space technologies used for public health:

(a) Global environmental changes are directly and indirectly affecting the health of all populations, and there is therefore a strong connection between the state of the environment and the health of humans, animals and the ecosystems;

(b) Addressing public health needs requires the interdependent contribution of policy, science and technology, knowledge and capacity-building through enhanced coordination mechanisms;

(c) Space technology plays a significant role in supporting operational needs specific to public health practice, including in areas such as early warning systems

for infectious diseases, health surveillance programmes and emergency preparedness and field response. Therefore, linking space technology to public health functions is a necessary component of a global and sustainable strategy to explore and support social and economic benefits for humankind;

(d) We have witnessed a great number of initiatives, programmes and activities at the global, regional and national levels. It is now time to foster more synergy and to create new integrated platforms to promote the convergence of common interests and needs. The international community should benefit from these initiatives and the lessons learned shared in existing forums.

48. *Step 2: Promoting coordination and engagement*. Promoting coordination and engagement comprises the following areas:

(a) *Coordination of inter-organizational and multidisciplinary actions should be initiated at the national level*. The objective is to bring technical experts together with policymakers working in all fields, including human, animal and environmental health, as well as other key stakeholders involved in the development of space initiatives including space science, space technology and space applications;

(b) *Promoting and supporting active engagement of international organizations*. As stated above, a number of United Nations entities and international organizations are already very active in undertaking initiatives and programmes to address needs in telehealth and tele-epidemiology. International leadership should be supported to foster further engagement and synergy with close links to countries in order to build the knowledge base and the capacity for action in this area;

(c) The three areas of development — namely (a) capacity building and training; (b) the provision, and integration of space-based, health and environmental data; and (c) the development of strategic frameworks including policies, infrastructure and leadership — should be framed within national and regional implementation plans.

49. *Step 3: Implementing practical recommendations*. The following proposed actions are to be taken at various levels:

National level

(a) In their international cooperation, States should consider the need to share information on initiatives being implemented at the regional and national levels, share infrastructure and data whenever possible and share knowledge in order to seek common solutions;

(b) Within a country, intersectoral agreements should be encouraged to engage the health community (e.g. the Ministry of Health), the telecommunications community (e.g. the Ministry of Information and Technology) and the space community (e.g. the national space agency);

(c) States should carry out long-term efforts in cross-disciplinary capacity-building in the areas of telehealth and tele-epidemiology;

International and regional levels

(d) States should consider hosting technical conferences, workshops and symposiums on tele-epidemiology in the context of global warming;

(e) States should encourage the creation of regional platforms that can address cross-cutting issues pertaining the use of space technologies for telehealth and tele-epidemiology (e.g. avian flu in Asia and the Pacific);

Within the United Nations

(f) United Nations bodies undertaking or interested in telehealth and tele-epidemiology activities should be linked in a horizontal effort to disseminate information and promote initiatives in these areas throughout the United Nations system;

(g) The Scientific and Technical Subcommittee should consider placing on its agenda a new item entitled “Telehealth and tele-epidemiology capacity”, with a multi-year workplan. Deliberations under this agenda item should benefit from the expertise of WHO as an active contributor;

(h) The Scientific and Technical Subcommittee should consider inviting the Group on Earth secretariat to provide, on a regular basis, briefings on GEOSS initiatives in telehealth and tele-epidemiology.