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Telecommunications/information and communication technologies for e-health

Output Report on ITU-D Question 2/2

Telecommunications/ information and communication technologies for e-health

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This report was prepared in response to Question 2/2: **Telecommunications/information and communication technologies for e-health** under the overall guidance and coordination of the management team of ITU-D Study Group 2 led by Mr Ahmad Reza Sharafat (Islamic Republic of Iran), as Chairman, supported by the following Vice-Chairmen: Mr Nasser Al Marzouqi (United Arab Emirates)(resigned in 2018); Mr Abdelaziz Alzarooni (United Arab Emirates); Mr Filipe Miguel Antunes Batista (Portugal)(resigned in 2019); Ms Nora Abdalla Hassan Basher (Sudan); Ms Maria Bolshakova (Russian Federation); Ms Celina Delgado Castellón (Nicaragua); Mr Yakov Gass (Russian Federation)(resigned in 2020); Mr Ananda Raj Khanal (Republic of Nepal); Mr Roland Yaw Kudozia (Ghana); Mr Tolibjon Oltinovich Mirzakulov (Uzbekistan); Ms Alina Modan (Romania); Mr Henry Chukwudumeme Nkemadu (Nigeria); Ms Ke Wang (China); and Mr Dominique Würges (France).

The report was developed under the leadership of the Co-Rapporteurs for Question 2/2, Mr Isao Nakajima (Japan) and Mr Done-Sik Yoo (Republic of Korea), in collaboration with the following Vice-Rapporteurs: Mr Leonid Androuchko (Dominic Foundation); Mr Gregory Domond (Haiti); Ms Malina Jordanova (Bulgaria); Mr Paul Kiage (Kenya); Mr Mayank Mrinal (India); Ms Lydia Ouedraogo/Seneme (Burkina Faso); Mr John Owuor (Sweden); Ms Fatoumata Samake (Mali); Mr Babou Sarr (Senegal); and Ms Carrelle Toho Acclassato (Benin).

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Executive summary

E-health has been a key focus of attention in the ITU Telecommunication Development Sector (ITU-D) for many years. After this long period of development, e-health has come to the fore as a major means of shaping the real world with the declaration of the coronavirus pandemic. This report takes this situation fully into account, and examines some of the most topical and important issues in e-health facing countries today.

There is no doubt that *new technologies* will create new healthcare businesses, as described in **Chapter 2**. The COVID-19 pandemic has thrown a spotlight on the need to provide urgent health information to urban, rural, remote and unconnected parts of the globe. It has demonstrated the importance of information and communication technologies (ICTs) such as wireless (terrestrial and satellite), and of artificial intelligence (AI).

Artificial intelligence is experiencing its third major boom, with the adoption of new activation functions, such as rectified linear unit (ReLU), to enhance learning and cover obvious medical needs. Convolutional neural network (CNN) image-matching technology is comparable to specialists in its ability to detect coronavirus pneumonia with mild or pre-symptomatic conditions. Recurrent neural networks (RNN) can improve medical prediction.

Rural medicine with *5G technology* can transcend distance for the examination of patients; and, if installed in an ambulance, it has the capability to turn the inside of an ambulance into an emergency room. Remote robotic surgery and procedures, which are also effective for patients with complications of coronavirus infections, can be made operational via 5G with low latency. Thus, 5G is helping to create the next generation of healthcare solutions.

Blockchain can provide the answer to some of the burdensome administrative challenges encountered, such as the sheer amount of money and cumbersome paperwork involved in paying for health care, and the challenges involved in the handling of medical records. Huge amounts of administrative costs could be saved, freeing up substantial healthcare resources; and medical records could be managed and shared quickly, efficiently and with due privacy.

Chapter 3 looks at *standardization of e-health*, which is being discussed in the ITU Telecommunication Standardization Sector (ITU-T), most notably in ITU-T Study Groups 16 and 20. In view of the importance of this aspect, a vital role of ITU-D Study Group 2, through its Question 2/2, must be to carefully explain the Recommendations elaborated within ITU-T to developing countries. Standardization will support the future implementation of cross-border medical care: it is essential if, for example, African incurable diseases are to be examined by specialists in New York, and ITU is on a mission to make this possible.

Chapter 4 on *social acceptance* deals with social mechanisms pertaining to sustainable autonomous telemedicine, notably its economic acceptability. One of the assessment methods, the *contingent valuation method* (CVM), can be based for example on "willingness to pay" (WTP), which asks how much patients are willing to pay for the telemedicine services provided. It is important that the budget collected by telecom operators under the *universal service fund* (USF) to meet the demands of high-cost areas be used for e-health applications, as is well illustrated by a case report from Paraguay.

There has been much talk in the past of *human resource development* (HRD) as an important aspect of e-health, but there are few examples that describe the specifics. **Chapter 5**, therefore, includes specific details in respect of content for *training courses* for various stakeholders (e.g. medical students, healthcare workers and telemedicine researchers). It looks at some of the *underlying challenges* of e-health that need to be covered in HRD and capacity-building efforts. Finally, it describes a special MBA/DBA-level *educational programme* designed for business professionals who want to apply modern ICT for new advanced services in healthcare practice, with a focus on developing countries

Chapter 6 outlines an array of *country reports* and *best practices* describing models of telemedicine implementation around the world.

Based on the studies carried out and experiences shared in the study period, *conclusions* and *recommendations* for health policy-makers and decision-makers in developing countries are set out in **Chapter 7**.

During the study period covered by the report, in addition to meetings of the rapporteur group and the study group, three informative events were held under the auspices of Question 2/2: two *workshops* on e-health, featuring extremely valuable presentations from experts, and a *webinar* on coronavirus infections. These are summarized in **Annex 3** to this report.

Abbreviations and acronyms

5G	fifth-generation mobile communication systems
AED	automatic external defibrillator
AI	artificial intelligence
BDT	Telecommunication Development Bureau
CBA	cost-benefit analysis
CEA	cost-effectiveness analysis
CNN	convolutional neural network
CUA	cost-utility analysis
CVM	contingent valuation method
DICOM	digital imaging and communications in medicine
DNN	deep neural network
DSmT	Dezert-Smarandache theory
ECG	electrocardiogram
e-VBAB	Pan-African e-VidyaBharati and e-AarogyaBharati network project
HD	high-definition
HRD	human resource development
ICTs	information and communication technologies
ISO	International Organization for Standardization
ITU	International Telecommunication Union
ITU-D	ITU Telecommunication Development Sector
ITU-R	ITU Radiocommunication Sector
ITU-T	ITU Telecommunication Standardization Sector
MDP	Markov decision process
NGO	non-governmental organization
POMDP	partially observable Markov decision process
RCT	randomized control trial
ReLU	rectified linear unit
RNN	recurrent neural networks
SDO	standards development organization

(continued)

SDGs	Sustainable Development Goals
USF	universal service fund
WTA	willingness to accept
WTP	willingness to pay
WTDC	World Telecommunication Development Conference
WHO	World Health Organization

Chapter 1 – Introduction

Purpose of the report

This report provides details on the policy messages derived from the findings and lessons learned under the work on ITU Telecommunication Development Sector (ITU-D) Question 2/2 ("Telecommunications/information and communication technologies for e-health"). The key messages of Question 2/2 are developed for submission to all ITU members as well as to the forthcoming World Telecommunication Development Conference (WTDC). The goal is to share the outputs from Question 2/2 with all ITU members, with international, national and regional institutions and policy-makers and with all groups or individuals concerned with e-health.

History of e-health in ITU-D

Telemedicine, and subsequently e-health, have featured in the work of every WTDC since 1994.[1]

As part of its Buenos Aires Declaration, WTDC-94 (Buenos Aires, 1994) adopted a comprehensive action plan. Since then, ITU has been helping developing countries construct their communications infrastructure. Telemedicine proved to be one of the areas of the action plan that attracted most attention.

In July 1997, more than 240 people participated in a symposium on telemedicine organized by ITU in Lisbon.[2] The huge turnout helped make the 1994 plan the most popular action plan in the history of ITU-D.

When the 1994 Buenos Aires Action Plan concluded in 1997, participants at WTDC-98 (Valletta, 1998) voted in favour of a follow-up action plan. Four years later, WTDC-02 (Istanbul, 2002) adopted Resolution 41 (Istanbul, 2002), on e-health (including telehealth/telemedicine), and after three years of existence of that resolution, the World Health Organization (WHO) approved Resolution WHA58.28, on e-health.[3]

WTDC-17 (Buenos Aires, 2017) maintained e-health at the forefront of ITU-D's work, giving it a prominent place in the new 2017 Buenos Aires Action Plan and again assigning a dedicated ITU-D Question on the subject (Question 2/2) to Study Group 2.

Focus of the ITU-D Question on e-health

E-health has a crucial role to play in healthcare delivery in developing countries, where the acute shortage of doctors, nurses and paramedics is directly proportional to the enormous unsatisfied demand for health services. At the same time, the extremely rapid expansion of the mobile telecommunication network opens up opportunities for the implementation of e-health activities. E-health has a long history in ITU-D, dating back nearly 30 years, and has been a consistent research subject since its inception.

1 ITU-D. World telecommunication development conferences
2 ITU. First World Telemedicine Symposium for developing countries. Cascais, Portugal, 30 June - 4 July 1997.
3 WHO. 58th World Health Assembly. Resolution WHA58.28, on e-health.

In responding to Question 2/2, Study Group 2 was to focus, *inter alia*, on issues in the following four areas:

- Awareness-raising among high-level decision-makers on the role of ICTs in improving healthcare delivery
- Fostering collaboration between ICT stakeholders and the health sector
- Collection and review of best practice on the use of e-health in developing countries, including in regard to legal and financial issues
- Providing suitable guidelines on collecting and managing big data for public health crises and introducing and disseminating ITU-T standards related to e-health for developing countries.

A set of guidelines is to be developed for the telecommunication/ICT aspects of e-health master plans. Collaboration with ITU-T Study Groups 16 and 20 is sought in order to accelerate the elaboration of technical standards for e-health applications.

Linkage with the United Nations Sustainable Development Goals

The Sustainable Development Goals (SGDs), the successor to the Millennium Development Goals (MDGs), were adopted at United Nations headquarters in 2015. The 2030 Agenda for Sustainable Development comprises 17 goals and 169 targets, constituting a shared blueprint for peace and prosperity for people and the planet.[4]

E-health and telemedicine are essential ICT tools for achieving SDG 3 (Good health and well-being). In addition, it goes without saying that promoting e-health will indirectly contribute to:

- SDG 1 (No poverty): Millions of people fall below the poverty line due to the need to cover health expenses.
- SDG 4 (Quality education): There is a need for tele-education and lifelong education of professionals and citizens.
- SDG 8 (Decent work and economic growth): There can be no economic growth without health care.
- SDG 11 (Sustainable cities and communities): E-health is a component of safe cities.

ITU, as an international organization under the umbrella of the United Nations, has been and will continue to be committed to supporting developing countries through studies on e-health.

[4] United Nations. Department of Economic and Social Affairs. Sustainable Development. The 17 goals.

Chapter 2 – New technologies for e-health

2.1 Artificial intelligence for new e-health business

Currently, artificial intelligence (AI) is in its third phase of development – perfection, following the first phase – genesis, in the 1950s, and the second phase – growth, in the 1980s. The first and second phases of technological development injected a boost of about a decade, but not enough to bring about major reforms in society.

More than 10 years have already passed since the advent of deep-learning technology, which symbolizes the current tertiary period of technological perfection. This third boom is qualitatively different from the previous two, and is likely to be more than a one-time event, with a high probability that it will become the foundation for social reform. In particular, the post-coronavirus society is expected to develop around AI.

There are two major factors behind the practical application of AI. The first (machine learning) is that computers can now process data on a scale that could not previously be achieved efficiently by humans (hereinafter referred to as "big data"), automating the tasks that used to be handled manually by sorting and organizing data and entering them into computers. The second (deep learning) is that computers are now able to discover and learn the elements for data classification themselves based on big data, whereas in machine learning it was necessary for humans to provide them.

Thus, the elemental technologies of AI – machine learning, deep learning and big data – are closely related to each other, and in order to understand AI it is necessary to think of them as a set.

In this section, we will discuss the legal challenges posed by AI in relation to e-health and the AI technologies recently used in health care.

2.1.1 Legal issues surrounding medical records

There is still no international standard for the handling of medical big data. The socialist principle is that "what goes back to the earth belongs to the State". However, for a healthcare business, this dividing line does not give companies much freedom, or motivate them to get involved.

Owing to the caution surrounding medical data – whereby no mistakes can be tolerated from the outset, because it is the life of the patient that is at stake – and the fact that information has been distributed across multiple hospitals, it has not been easy to handle medical data in a unified manner. Ownership of a patient's personal health record essentially lies with the individual patient; but this individual control of their data means that the information in question cannot be kept alive for the next generation. Infrastructure technologies such as big data, AI and communication networks make the data of the past useful for the next generation of health care.

So the challenge for the future may be summed up as follows: Who manages medical big data? Who processes medical big data? And who can provide medical big data as a medical service?

Anonymity

Anonymity, which means that patient information is handled in such a way that the patient's name cannot be identified, has already been agreed upon and put into practice by the medical industry and by organizations that handle medical statistics. In other words, privacy laws can be circumvented by anonymization.

Personal health records

Personal health records collect, manage and record data on individuals' health and medical care from birth to death on a consistent and large scale. A key feature of medical big data is the collection of data on each individual's timeline. Health and medical data of 1 000 people on a timeline from birth to death is more important than medical data on 1 million people in one second.

Medical big data across borders

With the globalization of corporate business activities and the distribution of large amounts of data across borders, there is a movement to regulate cross-border data distribution for the purposes of:

- protecting privacy;
- protecting domestic industry;
- ensuring security;
- law enforcement and criminal investigations.

This is governed by so-called "data localization" laws. Enactment and enforcement of the corresponding system is being considered.

Data localization is based on the idea that, for example, with respect to services on the Internet, the physical server that runs the service must be operated in the country where the service is provided, i.e. all the data necessary to provide the service must exist in the country. Regulation and standardization in this domain have lagged a step behind, due to the various constraints on treating personal medical information as digital data in a unified manner. However, mechanisms to make use of the vast amount of medical big data originally held by the medical industry have begun to advance rapidly from both the legal and technical standpoints, and there is increasing activity at the level of discussions, research and development and dissemination of information on the introduction and use of AI in the medical industry.

Standardization efforts in ITU in this regard have not yet begun to take shape.

2.1.2 Recent trends in artificial intelligence[5]

2.1.2.1 Reinforcement learning in the service of diagnosis

Process of diagnosis

Doctors' medical practice, especially in the realm of diagnosis that identifies a disease, becomes more accurate when based on past medical experience, the literature and raw data relating to the patient.

Chronic diseases that progress over time require long-term monitoring and management of the patient's condition. The diagnosis becomes more accurate through continuous interaction between doctor and patient. The doctor assesses the patient's uncertain condition, taking into account a variety of available information, and makes decisions that evolve with time. This is the process of diagnosis.

Markov decision process

Modelling the process of doctor-patient interaction with a probabilistic model includes decision-making processes such as the Markov decision process (MDP) and the partially observable Markov decision process (POMDP). Finding the best strategy for accumulated reward is one way to support physician decisions in order to improve and maintain the patient's condition.

As an application of reinforcement learning, medical data, especially time-series data, are improved by modelling the medical treatment process through MDP or POMDP. Two case reports (from early research, but internationally recognized) of methods aiming to improve data for better medical decision-making may be introduced.[6]

Living-donor liver transplantation

MDP has been used as a tool for sequential decision-making to model the evolution of the status of patients undergoing living-donor liver transplantation and to determine the optimal timing of receipt of the transplant.[7,8]

Therapeutic model of ischemic heart disease

POMDP has been used to model the course of treatment for ischemic heart disease (IHD) and calculate the optimal treatment strategy for expected reward. It is shown how the POMDP framework can be used to solve the problem of managing patients with IHD, demonstrating the modelling advantages of the framework over standard decision formalisms.[9]

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5 ITU-D SG2 Document SG2RGQ/149 from Tokai University (Japan)
6 Ibid., §3.2.1.3
7 Oguzhan Alagoz et al. The optimal timing of living-donor liver transplantation. Management Science, 50(10), pp. 1420 1430. 1 October 2004.
8 Oguzhan Alagoz et al. Markov decision processes: A tool for sequential decision making under uncertainty. *Medical Decision Making*, 30(4), pp. 474-483. 31 December 2009.
9 Milos Hauskrecht and Hamish Fraser. Planning treatment of ischemic heart disease with partially observable Markov decision processes. *Artificial Intelligence in Medicine*, 18(3), pp. 221-244. 3 March 2000.

2.1.2.2 Convolutional neural networks for medical image analysis

A convolutional neural network (CNN) is a deep neural network characterized by a convoluted structure that combines information in a certain range with reference to human visual signal processing.

CNN in drug discovery

Atomwise, which started its business in California, United States, discovered two new candidate drugs for reducing the infectivity of Ebola virus through two deep-learning systems. Interaction of up to 7 000 existing drugs as well as the "claw" model (i.e. 3D chemical molecular structure provided by a private company) that viruses use as they enter cells were analysed. It is reported that this analysis, which usually takes several months to a year, can be shortened to within one day by deep learning.

CNN in medical imaging

CNN demonstrates its power in pattern matching of medical images. The structure of CNN is a neural network in which convolutional layers and pooling layers are alternately connected. Near the output, all nodes between adjacent layers are fully connected. The basic structure is a forward propagation neural network, and each node of a layer adds bias to the weighted sum of the inputs from the nodes of the immediately preceding layer connected to it. The variable that is input to the activation function defines the output of the node that propagates to the next layer. The rectified linear unit activation function (ReLU) is often used. Learning improves the accuracy of this network. The main purpose of the convolution layer is to detect edges, lines and other visual elements such as characteristic local motifs in image recognition.

In one example,[10] a dataset of breast cancer histopathology images acquired on 82 patients was taken. The images were of two different classes: benign and malignant. The image patches were extracted to train the network. Subsequently, the image was given as an input for classification. Performance with CNN compared favourably with other reported results on MNSIT dataset using other algorithms for classifying an image.

2.1.2.3 Recurrent neural networks for medical prediction

Time-series data in medical care

Time-series data are a series of data that are observed at regular intervals in chronological order, and for which statistical dependence between them is recognized. For example, time-series data could consist of a patient's temperature, electrocardiogram (ECG), liver function data, and number of influenza patients. In medical care, visualization of time-series data makes it easy for doctors to grasp the current patient's (or population's) status on the basis of the past. Recurrent neural networks (RNN) make it possible, in addition, to predict near-future movements.

10 Kundan Kumar and Annavarapu Chandra Sekhara Rao. Breast cancer classification of image using convolutional neural network. *4th International Conference on Recent Advances in Information Technology (RAIT)*, Dhanbad, 15-17 March 2018, pp. 1-6. IEEE Xplore.

Why do we need to communicate?

It is difficult to collect data for events that occur only rarely. For example, if liver dysfunction due to drug allergy only occurs in 1 in 10 000 users, data collected are meaningless if each individual manages data independently. There is thus a need to collect data as a group of people in the same environment, or belonging to the same race or region, and share rare event logs globally. Managing data on the cloud is important for data to be accessed relatively easily by healthcare professionals. It is necessary for ITU to have a common understanding of the extremely important role this plays in terms of communications as an international public policy.

Forecasting influenza infection trends using RNN

An example of the use of RNN is data-driven machine-learning methods that are capable of making real-time influenza forecasts which integrate the impacts of climatic factors and geographical proximity so as to achieve better forecasting performance.[11] The key contributions of the approach are both the application of deep-learning methods and the incorporation of environmental and spatio-temporal factors to improve the performance of the influenza forecasting models. They method is evaluated on influenza-like illness (ILI) counts and climatic data, both publicly available datasets. The proposed method outperforms existing known influenza forecasting methods in terms of their mean absolute percentage error (MAPE) and root mean square error (RMSE). The key advantages of the proposed data-driven methods are as follows: (1) The deep-learning model was able to effectively capture the temporal dynamics of flu spread in different geographical regions; (2) The extensions to the deep-learning model capture the influence of external variables, including geographical proximity, and climatic variables, such as humidity, temperature, precipitation and sun exposure, in future stages; (3) The model consistently performs well for both the city scale and the regional scale on the Google Flu Trends (GFT) and Centre for Disease Control (CDC) flu counts. The results offer a promising direction in terms of both data-driven forecasting methods and capturing the influence of spatio-temporal and environmental factors for influenza forecasting methods.

Advanced detection of arrhythmia using RNN for ambulatory application

When a deep neural network (DNN) was tested to classify 12 rhythm classes using ECGs from patients who used a single-lead ambulatory ECG monitoring device,[12] the findings demonstrated that an end-to-end deep-learning approach can classify a broad range of distinct arrhythmias from single-lead ECGs with high diagnostic performance similar to that of cardiologists. If confirmed in clinical settings, this approach could reduce the rate of misdiagnosed computerized ECG interpretations and improve the efficiency of expert human ECG interpretation by accurately triaging or prioritizing the most urgent conditions.

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11 Siva Venna et al. A novel data-driven model for real-time influenza forecasting. bioRxiv, 19 April 2018.

12 Awni Hannun et al. Cardiologist-level arrhythmia detection and classification in ambulatory electrocardiograms using a deep neural network. *Nature Medicine*, 25, pp. 65–69. 7 January 2019.

2.2 Blockchain and cryptoassets[13]

2.2.1 Introduction

With the continuous development of ICT, a large volume of high-density, high-value data has been gradually accumulated around the world. Most data, especially medical data, are in the hands of government departments or State-owned hospitals and medical institutions. How to mine and use these data more effectively, share them and exploit them is a hot topic in the field of digital health. Only by combining certain application requirements and scenarios and by using appropriate scientific methods to utilize and develop them can the full value of the data be realized. One of the most important methods is blockchain, which has the potential to boost the development of the entire digital health industry.

There are two main types of blockchain: "public", where anyone can participate, and "private", where only authorized persons can participate. Since virtual currency uses public blockchains, problems such as making money through mining occur. However, with a managed private blockchain, it is possible to construct a system in which the range of information sharing is limited, and safety is dramatically increased. The healthcare applications introduced here are based on the private type of blockchain, restricted to patients, medical providers, payment funds and government. Based on a recent study,[14] some suggestions have been made for governments to develop blockchain technology in the field of digital health.

Why blockchain in developing countries?

It is said that financial institutions in developed countries should use credit cards instead of bitcoins. In these countries, there are financial institutions such as banks, and there is a well-established system in which credit cards can easily be used. Credit cards are also secured by the fact that banknotes are on the market, so they can be immediately exchanged for banknotes.

In the developing world, on the other hand, there are countries where the national currency is not stable and the inflation rate can be as high as 46 000 per cent per year. In such cases, there are few areas where ATMs are operational, and there is no way for individuals to buy foreign currency in banks and save it as an asset.

In such an environment, even if people who were hitherto unable to hold assets have the possibility to buy a blockchain virtual currency (cryptocurrency), they will only be able to possess a small amount.

Healthcare reimbursement

In countries around the world, health care is not run on market principles, but as a managed economy. With the blockchain system, payments to medical institutions can be completed without actually exchanging cash, which greatly reduces the administrative expenses on the payment fund side. Since users do not have to pay cash at the hospital, this can alleviate some of the stress for low-income people visiting medical institutions. Moreover, blockchain addresses

[13] ITU-D SG2 Document SG2RGQ/168 from Tokai University (Japan)
[14] ITU-D SG2 Document 2/51 from the China International Telecommunication Construction Corporation (CITCC) (China)

the problem of unnecessary additional expenses stemming from miscalculations in receipt documents requested by medical institutions.

If blockchain is used, therefore, management costs can be significantly reduced.

Blockchain has what is called a timestamp function, which proves that the electronic data requested were reliable at a certain time and have not been changed since. In addition, the traceability function that tracks past history is extremely rigorous, so users can track where mistakes such as calculation errors occur. As medical expenses are refunded, they can take full advantage of these functions.

Link with medical data

Medical data that must be kept confidential, such as patient DNA data, can be managed by linking them to the blockchain. If anonymization can be employed to ensure transparency and specific researchers are able use the data for academic work and research as big data on the blockchain, this will be valuable for the development of new drugs and the diagnosis of rare diseases.

2.2.2 Digital e-health in China[15]

Blockchain drives the decentralization of medical services and helps to realize interconnection of information and data

In "The Creative Destruction of Medicine: How the Digital Revolution will Create Better Health Care",[16] it is stated that the future will be patient-centric. On the basis of current trends, the medical-centric system is being constantly disrupted. Blockchain is accelerating the decentralization of the traditional medical system. It allows the patient's data to be carried at all times, and ownership of the data is permanently attributed to the patient. Medical health records based on blockchain technology are recorded on the time axis, and can be updated and transmitted in real time. Blockchain technology enables medical data to be truly returned to patients themselves, empowering patients with more autonomy, allowing them to access medical records across institutions, view their complete records and optionally share their personal health data, so as to promote the development of medical research programmes and other related projects. Blockchain facilitates individual access to medical data and active participation in medical management. This is of great value and significance for effectively reducing medical costs, and for disease prediction and prevention.

The use of electronic medical records based on blockchain technology will solve the data-sharing problem in the development of digital medicine. With its introduction, all common and previous cases will be clearly documented. Thus, when a doctor designs a treatment plan for a patient, he/she will have effective and continuous medical records for reference, which will improve the efficiency of treatment. For example, when a patient goes to a new hospital to see a doctor, the doctor needs to know which drugs the patient is allergic to; but the patient may not remember clearly or may even simply not know. In the past, this kind of situation has often meant re-doing various tests in order to determine the next step. If personal medical records

[15] Ibid.

[16] Eric Topol (2011). The Creative Destruction of Medicine: How the Digital Revolution will Create Better Health Care. Basic Books. EBOOK / ISBN-13: 9780465029341.

are stored with a blockchain system, however, then the problem would effectively be solved. All the doctor will need to do is retrieve the patient's medical history data from the blockchain system, thus obviating the need to repeat checks or tests and achieving the targets of data sharing, improved efficiency and saving resources. The application of blockchain will achieve the interconnection of medical data in practice.

Blockchain creates a new trust mechanism and makes medical data more reliable

Once blockchain has solved the problem of sharing medical data, people may start to consider whether the data are genuine and accurate. Currently, the medical industry is experiencing mass data-quality problems. Most of these problems are caused by mistakes made by doctors, attacks and tampering by hackers, or failure to update electronic medical records in a timely manner. If the medical history data are inaccurate, this will have a significant impact on the efficacy of medical treatment. In a word, current medical records have not yet shown themselves to be perfect enough for people to fully trust them.

In this context, deploying a blockchain that can record all clinical trial results will greatly increase people’s trust in medical data. In 2015, the illustrious magazine “The Economist” published a leader entitled “The trust machine”, referring to blockchain.[17] Blockchain’s timestamp feature makes medical data impossible to tamper with, and the technology uses consistency algorithms to ensure the accuracy of recorded medical data. For example, if a patient's blood type happens to be entered as B in a medical record, but the same patient's blood type is recorded as A in other medical institutions, then the conflicting information will not be recorded in the blockchain and the system will prompt a message flagging the information mismatch.

In this way, the accuracy of patient records can be guaranteed. Blockchain can maintain transparency of all data. Misdiagnosis information will be considered as noise and be excluded from the medical records, thereby preventing any attempt to selectively report the effect of a treatment. Since blockchain-based electronic medical records are not kept in the hands of doctors, hospitals or any third party, and all participants in the blockchain will work together to maintain the security of information, this approach provides a unique and real data source for medical treatment.

In conclusion, blockchain can to some extent avoid the problems of misdiagnosis in the medical industry or of malicious data-tampering activities. Given the high reliability of blockchain data, the quality of the medical information will be extremely high, resulting in a reduction of data-collection and data-cleaning costs in the process of data mining and analysis performed by a hospital or research institution. It is also a great contribution to accurate medicine.

Blockchain protects information security and improves data privacy

Blockchain enhances people's trust in medical data and, by protecting against infringement of personal privacy, also provides solutions for data sharing. Blockchain guarantees the data producer's ownership of the data. For the data producer, blockchain can record and save their valuable data assets, which will be recognized in the Internet, making the data source and ownership transparent and traceable across the entire network.

[17] The Economist. The promise of the blockchain - The trust machine. 31 October 2015.

The key to the electronic medical records in blockchain is in the hands of the corresponding patient, and it cannot be viewed by anyone else. This improves the confidentiality of medical data. Blockchain can use multi-signed private keys, encryption technologies and secure multi-party computing technologies to ensure that only authorized persons can access the data, and the original data cannot be accessed in the process of data analysis. Patients can selectively disclose relevant data without having to trust any institution or individual. Since the information stored in blockchain is uniquely identified by a private key, personal medical data can be provided to and shared with research institutions and doctors worldwide. It can be anonymized, which will greatly improve the privacy of data and provider.

Shared data provided to research institutions can be desensitized with blockchain-based technologies (data desensitization technology processes the data with cryptographic algorithms such as hashing, but it does not access the original data). In this way, it is entirely possible not to encroach on the patient's privacy in the process of scientific research. Even if a hospital or a scientific institution leaks the patient's medical data, as long as the patient's private key is not available, no one can dig into the specific data content, and the patient's privacy is securely protected. Blockchain will greatly increase individuals' readiness to share their own medical data, and effectively promote the comprehensive development of medical research.

Suggestions on the development and application of blockchain in digital health sector

As already indicated in the introduction to this section, with the continuous development of ICT, a large volume of high-density, high-value data has been gradually accumulated around the world, and it is only by combining certain application requirements and scenarios and by using appropriate scientific methods to utilize and develop them that the full value of these data can be realized.

One of the most important methods is blockchain, which has the potential to boost the development of the entire digital health industry. Nevertheless, its application is still at an early stage, and not yet mature. There is still a lot of work for governments and relevant organizations to do if they wish to promote the development and application of blockchain in the field of digital health:

1) Appropriate regulations for the sharing, development and use of medical data need to be introduced. Major hospitals should continuously renovate legacy systems and invest in existing electronic health records, establish an electronic medical record system based on blockchain, and set consistent standards for data interoperability so as to lay a solid foundation for the sharing of blockchain information.
2) It is recommended that hospitals establish a "health cloud" based on blockchain, and use integrated technologies to create a medical blockchain ecology at the medical record level. At the initial stage of the development of blockchain, centralized servers will still play an important role in key services, and a large volume of medical record information will still need to be stored in the central servers of major hospitals. As the technical foundation of blockchain is the patient's private key, blockchain technology will provide patients with a high level of protection ensuring their data privacy.
3) Depending on the different levels of openness desired, blockchains can be divided into public chains, alliance chains and private chains. The public chain is open to all, and anyone can participate; the alliance chain is open to specific groups of organizations;

the private chain is only open to certain organizations or persons. In order to achieve the interconnection of medical data, and to improve medical efficiency and the effect of treatment, major hospitals that are well-equipped in ICT are encouraged to develop blockchain systems, build medical alliance chains (which can be considered as "partial decentralization"), and attract other medical institutions to join.

The numerous technical advantages of blockchain make it ideally suited to the medical process, which involves multiple participants, multiple processes and multiple links. It can help the government to improve information sharing, reshape trust mechanisms, protect privacy and improve medical efficiency in the development of digital health. In a word, blockchain has great potential, and stands to make an increasing contribution to the development of digital health in many countries in the future.

2.3 Fifth-generation mobile (5G) / International Mobile Telecommunications-2020 (IMT-2020) and satellite systems

2.3.1 Introduction

The newest wireless technologies, including both terrestrial and satellite systems, have arrived just in time to ensure that no spot on the globe need ever again suffer through a pandemic without sufficient health information, training and even the ability for remote self-care. E-health services such as video-based health-worker training have been and continue to be supported by videoconferencing systems, often carried by cellular-mobile or satellite, that allow medical services to be extended into rural and remote areas.[18] As procedures become more complex and technology advances, high-definition (HD) video, such as 4K or 8K, can make it easier to communicate while referring to images with a sense of reality. It also enables a doctor intervening from a remote location to grasp the state and condition of the patient. Since a relatively large-capacity communication line is required to simultaneously transmit the HD diagnostic images/videos and camera/videoconference video to a remote location, it has generally been assumed that fixed (wired) communication networks will be used for remote medical care. However, with the advent of fifth-generation mobile communication systems (5G), which are capable of supporting ultra-high-speed/high-capacity, ultra-reliable/low-delay communication, and more importantly operate on a mobile (wireless) communication network, it is possible to expand the range of locations and cases where telemedicine services can be provided or used.[19] In addition, Internet of Things (IoT) and also satellite, especially in remote locations, can play a very crucial role in e-healthcare and in assistance to older persons.

2.3.2 5G e-health applications in Japan[20]

5G telemedicine to enhance community medical clinics

In Japan today, the regional disparity between rural and urban areas is growing, owing to a declining population compounded by depopulation in rural areas nationwide. Measures to address the shortage, or uneven distribution, of medical institutions and doctors are also

[18] ITU-D SG2 Document SG2RGQ/236 from the EMEA Satellite Operators Association (ESOA/GMC)

[19] Background information on the global status of 5G and its importance for the developing countries can be found in ITU-D SG2 Document SG2RGQ/250(Rev.1) from Intel Corporation (United States)

[20] ITU-D SG2 Document 2/294 from Japan

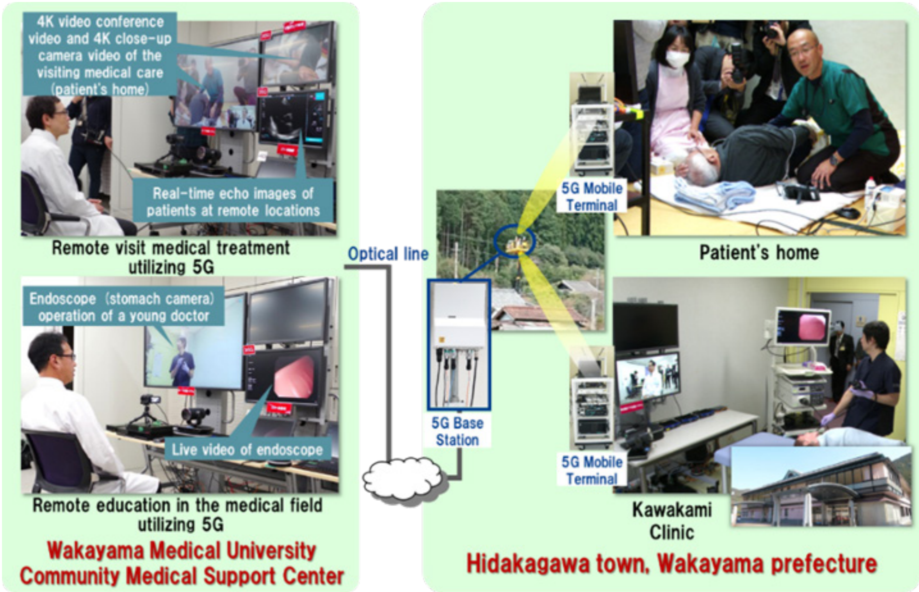
being stepped up. This has indeed become a challenge. In order to contribute to solving this problem, NTT Docomo, Inc., in cooperation with Wakayama Prefecture and Wakayama Medical University, are examining and carrying out verification testing for a telemedicine service utilizing 5G to enhance regional medical care. They have been conducting a field test, as part of the Comprehensive 5G Verification Trials being undertaken by the Japanese Ministry of Internal Affairs and Communications (MIC). The service will use 5G to provide advanced telemedicine services, expand the service area, and provide the same advanced medical care in mountainous and depopulated areas as in general hospitals in urban areas. The goal is to upgrade regional medical care. Verification tests to confirm the effectiveness of the solution were conducted from 2017 to 2019, with the aim of enhancing community medicine.

In a verification test conducted from February to March 2018, a remote medical treatment system using 5G was built between the Wakayama Prefectural Community Medical Support Centre in the Medical University and the National Health Insurance Kawakami Clinic in Hidakagawa-cho, situated within the same prefecture. Verification tests for telemedicine in three medical departments (dermatology, orthopaedic surgery and cardiology) took place, whereby doctors and specialists at the Prefectural Medical University Hospital shared HD diagnostic images and communicated seamlessly with each other via videoconference. In the verification test, the specialist and the patient could be treated as if they were in the same examination room, even though they were about 40 km apart. As a result, the effectiveness of telemedicine using 5G was confirmed.

Two cases of cardiology and one case each of psychiatry and nutritional guidance were handled by remote visit in a verification test conducted in January 2019. In the cardiology case, a clinician visited the home of a patient with a history of heart disease and asked a cardiologist at the Prefectural University of Medicine to view the echocardiogram images, via the 4K close-up camera and a 4K videoconference. In this remote medical intervention, particularly when using echograph, a specialist can instruct a clinician in real time how to apply the requisite sensor probe, etc., while the 5G HD echogram images, with colour Doppler, are transmitted from the patient's home. The doctors were able to make a quick and accurate diagnosis (**Figure 1**, upper).

As a further example of application of the 5G telemedicine system, a verification test for distance education for medical staff also took place: specifically, a scenario in which a young doctor in a clinic is trained to operate an endoscope (stomach camera) on a training model (humanoid model for training) while receiving advice from an internal medical instructor at the Prefectural Medical University. As with conventional telemedicine, the two doctors can simultaneously transmit a 4K videoconference picture, which functions as a video for monitoring the status of the doctor in training, and by using 5G they were able to perform the training without feeling any effect due to distance (**Figure 1**, lower).

Figure 1: Remote visit for medical treatment and remote education to enhance regional medical care



5G telemedicine for advanced emergency care

In the field of emergency medical care in Japan, issues are emerging in relation to increasing numbers of patients with cardiovascular and cerebrovascular diseases due to ageing. Furthermore, measures to address a doctor shortage in local communities are proving problematic. To help resolve this situation, NTT Docomo, Inc. has worked together with Maebashi City, Gunma Prefecture (Information Policy Division and Fire Bureau), the Japanese Red Cross Maebashi Hospital Advanced Emergency Medical Service Centre, the Maebashi Institute of Technology and the ICT Community Development and Common Platform Promotion Organization to study emergency transport services utilizing 5G. A verification test was performed between 2018 and 2019, as part of the MIC's Comprehensive 5G Verification Trials, in which a wireless communication line using 5G was established between three designated emergency hospitals, ambulances and "doctor cars"[21] which enables the transmission and sharing of HD video for diagnostics.

In the 2018 verification test, depicted in **Figure 2**, an emergency transport support system to confirm patient information using the My Number Card (personal ID card) was tested to enable accurate and prompt treatment for patients who require emergency attention. A teleconference system for real-time communication between the three sites was developed, which uses video and audio. This allowed the transmission of HD images of patients and diagnostic images from multiple medical devices from an ambulance and a doctor car to hospital. A complex data-transmission system was also built and used. The doctors' room in the advanced emergency medical service centre that simulates the communication instruction room was set up in Maebashi City Hall, and a 5G base station using Ka-band was installed. Under the supervision of the advanced emergency medical service centre and the fire bureau, an ambulance and a doctor car were equipped with a mobile terminal and placed on patrol or parked at the city hall parking lot. In the 2019 test, medical information was shared among four locations, adding a local primary care doctor to the configuration of the 2018 test with three locations.

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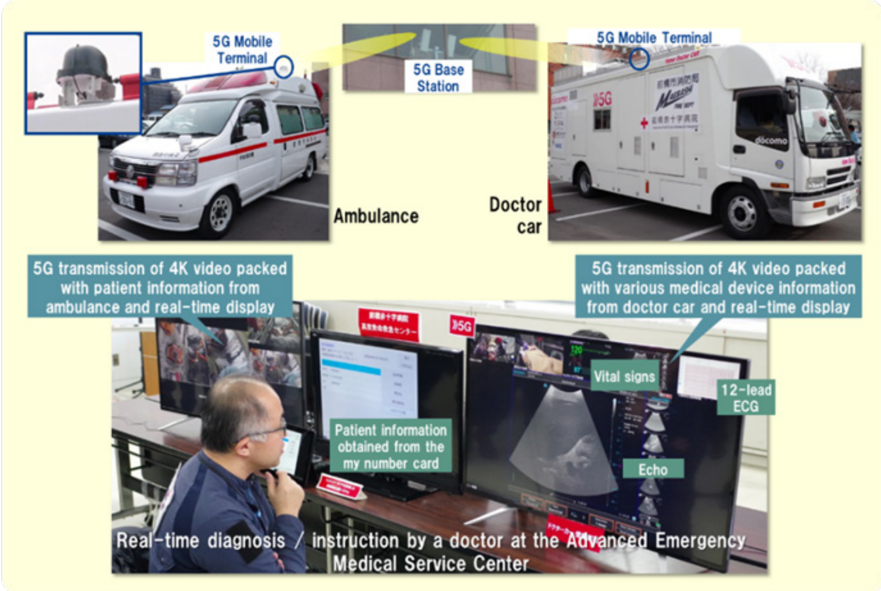
[21] For the "doctor car" rapid response system in Japan, see: https://www.ashikaga.jrc.or.jp/publics/index/215/

Figure 2: Verification test for advanced emergency medical care



Infected patient care system in the form of a 5G networked care unit[22]

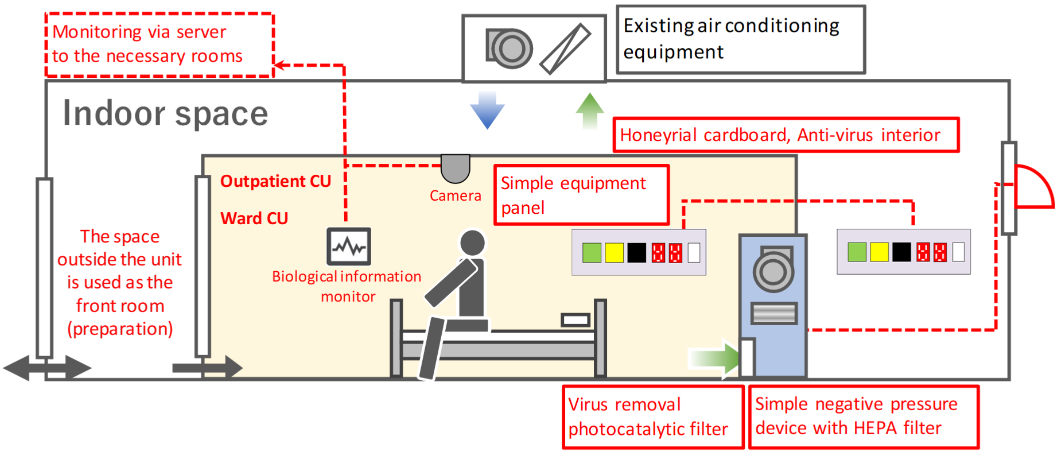
An infected patient care unit is being developed that will incorporate antiviral functions and air-conditioning equipment necessary for the treatment of infectious disease in a basic unit that is inexpensive, lightweight and easy to set up locally, with a structure made of Honeyrial cardboard. Furthermore, the system will be designed so as to support remote monitoring of medical information transmitted from a biological information monitor or medical equipment such as a respirator. Two types of infected patient care units are foreseen: a care unit installed in the outpatient department of a hospital, and a care unit installed in a ward. **Figure 3** shows a configuration of the common unit. As shown in the figure, the infected patient care unit simply constructs an isolated space in the indoor space in the hospital, and the room has various antiviral functions (yellow part in the figure). With an infected patient care unit of this type, medical staff can manage patients remotely without having to enter the room. This is expected to contribute to preventing the spread of patient infections, reducing the infection rate and the burden on medical staff in terms of wearing protective clothing, and preventing nosocomial infections.

Honeyrial cardboard is a corrugated cardboard with a honeycomb structure, and is characterized by its light weight and high strength. The medical unit using Honeyrial cardboard consists of multiple cardboard panels which can be joined together without the need for any tools such as a screwdriver, so it is quick and easy to assemble.

By transmitting a variety of biological information captured in the outpatient care unit via a communication network, it is possible to manage the patient remotely, from a base away from the care unit. In addition to the VPN communication conventionally used in the outpatient care unit, the system uses 5G, supporting high-speed, low-latency communication, together with its network cloud, to provide the necessary connection environment between the outpatient care unit and the remote patient management base. As a result, it is possible to carry out appropriate management of a patient with an infectious disease from a remote location.

22 ITU-D SG2 Document SG2RGQ/TD/26+Annex from Japan

Figure 3: Remotely monitored infected patient care unit



2.3.3 Satellite communications for e-health

Satellite broadband increases access to reliable, cost-effective, high-speed broadband services that are fundamental to the delivery of broadband-enabled healthcare solutions all over the world. Telehealth and telemedicine services are vital to the healthcare system. With a growing and ageing population globally, the demand for medical services is increasing, putting a strain on existing healthcare frameworks. Satellite allows these services to reach remote parts of a country and provide quality health care to those in need, thus avoiding the need for patients to relocate to main cities. The COVID-19 crisis has demonstrated the essential role of connectivity worldwide and the importance of having telecommunications and ICTs in place to plan and respond to eventualities as and when they occur.

Extending e-health services into off-grid communities (Nigeria)[23]

A study by InStrat Global Health Solutions (InStrat) on the penetration of 3G wireless services found that that approximately 47 per cent of Nigeria's population of 193 million is not covered by any 3G network. As a result, InStrat partnered with satellite operator Inmarsat to deliver sustainable mobile healthcare applications in order to improve disease-surveillance capabilities, providing an early-warning system for disease outbreaks. With the support of the Nigerian state health ministries, 75 medical centres in Kano and Ondo states and the Federal Capital Territory have been supplied with broadband global access network (BGAN) satellite terminals.

19Labs – mobile healthcare platform powered by satellite[24] (United Sates, Mexico, Guatemala)[25]

The smart healthcare platform provider 19Labs has partnered with Viasat to deploy mobile healthcare units containing a tablet computer, a digital camera and digital medical tools. A total of 175 deployments have been made in schools to help provide local healthcare points for the state government of Utah, United States. Units have been deployed in Baja California, Mexico, and a further 20 in the states of Oaxaca and Tabasco. Rural pharmacies in Guatemala also rely on the kits and satellite connectivity to provide e-health services to local residents.

23 Inmarsat. Digital frontiers: Nigeria – Satellite connectivity saving lives. July 2018.
24 19Labs: https://www.19labs.com
25 Utah Education Network (UEN). News article. UETN provides telehealth kits to rural schools.

Bringing e-health to rural areas (Bangladesh and Sierra Leone)[26]

The Luxembourg Government's platform[27] helps non-governmental organizations (NGOs) make a difference for healthcare professionals by giving them access to a dedicated e-health software connected via satellite. The platform enables healthcare workers on Friendship floating hospitals to connect to doctors and gain access to medical knowledge from around the world, provide medical counselling to marginalized communities through telemedicine and provide e-learning services.[28] The platform has been utilized by the Serabu Hospital in Sierra Leone, which is supported by the NGO German Doctors e.V. Drawing on its experience of fighting Ebola, the hospital expanded the existing triage system and set up information exchange with the dedicated government COVID-19 centres.[29]

Coronavirus channel and Ebola channel (Africa, Europe and Asia-Pacific)[30]

SES is transmitting a free-to-air TV channel dedicated to delivering reliable, informative content about COVID-19. The channel broadcasts content that is aimed at providing underserved and rural communities with critical information about how to limit the spread of the virus. The content is provided by organizations such as the United Nations Children's Fund (UNICEF) and *Agence France Presse* as well as global EdTech social enterprise Potential.com.[31] SES had earlier launched an Ebola-focused education channel to be broadcast via satellite in West Africa.[32]

SOS Children's Villages (Benin)[33]

In 2014, a telemedicine initiative tested remote health care for the benefit of 1 346 children and their families in Benin, West Africa. The charity SOS Children's Villages worked with clinics in two rural locations in the Abomey and Dassa-Zoumé regions to monitor, diagnose and treat adults and children, utilizing the telemedicine application to gather the patients' medical information on smart tablets and send it in real time via a satellite broadband link to a secure server so urban hospital doctors could monitor and evaluate the villagers' health. Following the successful pilot, the project is still in operation today.[34]

Improving treatment of infectious tropical disease (Benin)[35]

SES deployed an e-health platform at the *Centre de Dépistage et de traitement de l'Ulcère de Buruli* (Buruli ulcer detection and treatment centre) in Allada. The satellite-based platform is used by *Fondation Follereau Luxembourg* to improve communication between patients and

26 ITU-D SG2 Document SG2RGQ/236 from ESOA/GSC
27 SATMED: https://satmed.com/
28 SES Techcom Services. Press release. SES donates VSAT antenna to Friendship NGO to deliver connectivity in rural Bangladesh. 14 April 2016.
29 SES Techcom Services. News blog. Fighting COVID-19 through satellite-based telemedicine networks.
30 ITU-D SG2 Document SG2RGQ/236 from ESOA/GSC
31 SES Techcom Services. Press release. SES launches free-to-air satellite channel to fight spread of COVID-19. 14 July 2020.
32 SES Techcom Services. Press release. SES joins the fight against Ebola. 10 November 2014.
33 ITU-D SG2 Document SG2RGQ/236 from ESOA/GSC
34 SOS Children's Villages international. Press release. ICT4D 'Telemedicine' project brings needed medical expertise to remote Benin. 31 March 2015.
35 ITU-D SG2 Document SG2RGQ/236 from ESOA/GSC

medical staff, raising further awareness of tropical disease analysis; access online training tools; and establish facilities such as videoconferencing, data collection and analysis.[36]

Mobile laboratory "B-LiFE" (Guinea and Italy)[37]

SES has partnered with B-LiFE to bring rapid disease identification for a fast response to sanitary crises such as the 2014 Ebola or 2020 COVID pandemics. B-LiFE is a mobile laboratory that can be deployed rapidly to perform quick diagnostic tests of patients. The effectiveness of the response depends on real-time communication provided by satellite, in this case via an "emergency.lu" rapid deployment kit of the Directorate for Development Cooperation and Humanitarian Affairs of the Luxembourg Ministry of Foreign and European Affairs.[38,39]

2.4 Robotic remote surgery and trial in the Islamic Republic of Iran[40]

Tarbiat Modares University (Islamic Republic of Iran) is carrying out research on the design and implementation of a prototype for robotic remote surgery.

2.4.1 Introduction

The surgical robot consists of two independent arms, each with three degrees of freedom with Cartesian structure. The fourth degree of freedom is the rotary movement in the end effectors. The head is tightly fixed during the operation, and surgical devices can easily slide across the scalp's outer surface due to the curvature of the scalp. In the solid Cartesian structure, three-dimensional movements are independent; and small vibrations and sudden movements on any axis do not affect the other axes. In the robot, one arm keeps the drilling tools, and the other keeps the cutting tools. The details of the robot are shown in **Figure 4** (left image), together with the details of the movement of the robot's arm (centre image), and details of the arm, line lasers, location of the surgery tool and end effector touchpoints (right image).

All the necessary tools for controlling the robot, including the drivers, power supplies, PCs and the required connections are placed inside the console. The actual console is shown in **Figure 5**. As can be seen, two PCs are used in the console, one for each arm of the robot.

Surgery is performed remotely from the surgery console. As shown in **Figure 6**, three monitors are placed in the surgery console to for the three sagittal, coronal and axial cameras on the robot. The surgeon's commands are issued by using the precise proportional-movement joystick located on the surgery console. Our constructed joystick is shown in **Figure 7**.

36 SES Techcom Services. Press release. SES deploys Satmed e-health platform in Benin to improve treatment of infectious tropical disease. 8 June 2016.
37 ITU-D SG2 Document SG2RGQ/236 from ESOA/GSC
38 SES Techcom Services. Press release. SES partners in the fight against Ebola in Guinea through deployment of mobile laboratory "B-LiFE". 22 December 2014.
39 SES Techcom Services. Press release. B-LiFE, SES and GovSat deploy mobile COVID-19 testing Laboratory to Italy. 24 June 2020.
40 ITU-D SG2 Document SG2RGQ/138 from Tarbiat Modares University (Islamic Republic of Iran)

Figure 4: Details of the craniotomy surgical robot

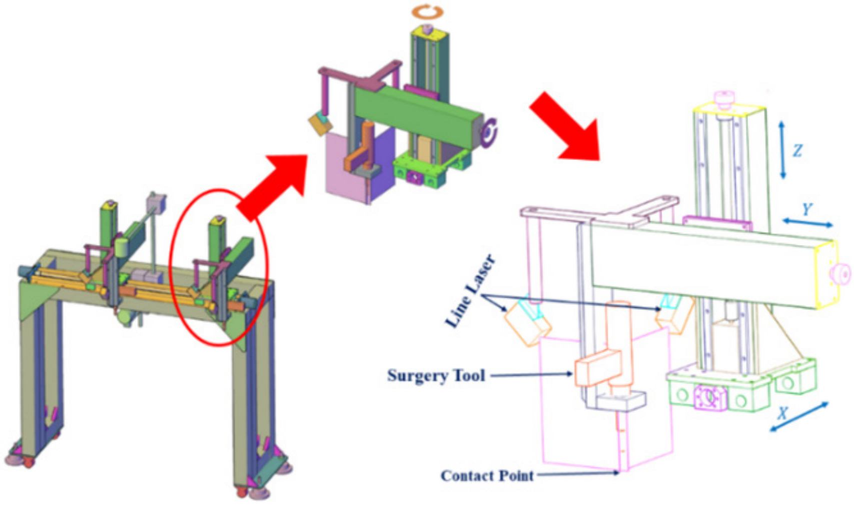


Figure 5: Control console of the robot

Figure 6: Surgery console

Figure 7: Joystick of the robot

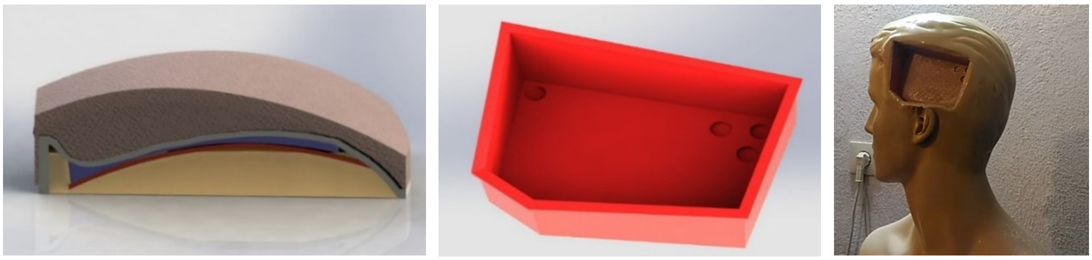
2.4.2 Communication system

The maximum end-to-end delay for tele-surgery systems should remain under 300ms. To provide proper visual monitoring to the remote surgeon, a minimum of 25 frames per second with 720p resolution is needed. An H.265 encoder was used, requiring at least four consecutive frames to encode, resulting in 160ms delay in the encoding process. Hence, either 5G (ultra-reliable, low-latency) or dedicated point-to-point links should be employed. In the absence of an operational 5G network, two dedicated point-to-point links were used: one as the command and control link from the surgeon to tele-robot, and one as the video link from the cameras in the robot to the displays in the surgeon's console. A VHF UART link was used for the command link and a point-to-point 5-6 GHz link for the video.

2.4.3 Human head phantom

To evaluate the precision and functionality of the robotic tele-surgery machine, a 3D-printed phantom of the human head was designed and implemented. In order to make the surgery more real, a standard moulage is used as the total body of a human. The phantom needed for testing does not exist in the moulage standard form factor. To make the phantom similar to the human body, silicon rubber (which is widely used in biomedical engineering) was used instead of flexible PLA. The phantom has six layers as shown in **Figure 8(a)**. All layers follow the anatomy of the human brain and include skin of scalp, bone of skull, dura mater, sensing layer and brain tissue. The phantom includes a holder box as shown in **Figure 8(b)**, which is constructed from hard polylactic acid (PLA) material, and is packed with a 3D print process. The dimensions and the shape of the box are based on the mannequin's head. The mannequin's head is cut and the phantom box is placed in the cut part. Glue was used to fix the box and fill the cut-off region, followed by painting and sanding. Also, acrylic putty was used to make the final surface of the mannequin's head look more real, as shown in **Figure 8(c)**.

Figure 8: Phantom layers (a), phantom box (b), phantom location (c)



(a) (b) (c)

2.4.4 Safety measures

The system is capable of protecting the patient against accidents as well as hardware and communication failures. Specifically, there is a pre-set limit for the drilling depth to protect the patient against errors by the surgeon, and also against latency prolongations that may otherwise cause the drill to continue even though a stop command has been issued by the surgeon. As stated, actual use of unsupervised remote robotic craniotomy in practice requires either dedicated point-to-point links or a functional 5G network.

2.4.5 Conclusion

Robotic remote surgery is an ICT-based system that can save lives when life-threatening accidents that require immediate surgery occur and qualified surgeons are not present at the site. The system for robotic remote surgery includes a precision robot and its accompanying fixture at the patient's location, a set of command and control consoles and systems at both the surgeon and patient locations, as well as an ultra-reliable low-latency wireless link between the patient and surgeon to perform surgery remotely and monitor the patient. Laboratory experiments are encouraging, and indicate that for the safe operation of unsupervised remote robotic craniotomy, either a high-speed dedicated link between the patient location and remote surgeon or a functional 5G network is needed to avoid disruptive prolongations of network latency.

Chapter 3 – E-health standardization[41]

3.1 Overview of e-health standardization

In spite of the huge amount of money and manpower invested in implementing e-health standards, the result is rather poor, particularly for developing countries. On account of the condition of their network infrastructure, the developing countries require special attention in order to meet their needs. A host of ICT solutions for health and e-health services have been developed. However, they are often geared to small-scale applications that are unable to communicate with other health systems and/or share information across geographies and technologies.

Barriers to scaling up small systems in developing countries prevent supporting a larger patient and care-provider base. Decision-makers are not always able to assess the actual health situation, which in turn inhibits comprehensive planning, response and policy formulation.

The ITU Telecommunication Standardization Sector (ITU-T) coordinates the technical standardization of multimedia systems and capabilities for e-health applications. ITU-T has released a Technology Watch report that looks to the future of e-health.[42] The report observes that e-health development will require more universal e-health interoperability standards, and strategies to overcome technical infrastructure barriers and address privacy, security and other legal requirements. There are many generic standards used in e-health applications for video coding, security, multimedia transmission and languages, for instance. And many of those have been developed in ITU-T. These and other issues are being addressed by experts in ITU-T Study Groups 15, 16 and 17 as well as in other external standardization bodies. International standards for e-health need to be based on existing "mature and stable technologies" already in place, and not solely on future advanced technologies.

The ITU Plenipotentiary Conference (Busan, 2014) adopted a revised Resolution 183 (Rev. Busan, 2014), on telecommunication/ICT applications for e-health, calling on ITU "to give priority consideration to the expansion of telecommunication/ICT initiatives for e-health and to coordinate e-health-related activities between the ITU Radiocommunication Sector (ITU-R), ITU-T and ITU-D and other relevant organizations" and "in particular to promote awareness, mainstreaming and capacity building in the creation of telecommunication/ICT e-health standards, reporting findings to the Council as appropriate". In the strategic plan for the Union for 2020-2023, adopted by the Plenipotentiary Conference (Dubai, 2018), one of the strategic objectives for ITU-T is "Bridging the standards gap: Promote the active participation of the membership, in particular developing countries, in the definition and adoption of non-discriminatory international standards (ITU-T recommendations) with a view to bridging the standardization gap". One of the specific concerns in this regard must be the development of e-health standards that are appropriate for existing networks in developing countries.[43]

41 ITU-D SG2 Document SG2RGQ/267 from the Republic of Korea
42 ITU-T. Technology Watch report. E-health standards and interoperability. April 2012.
43 ITU. Collection of the basic texts adopted by the Plenipotentiary Conference. 2019.

The World Telecommunication Development Conference (WTDC) approved Resolution 54 (Rev. Dubai, 2014), on ICT applications, in which the ITU Telecommunication Development Bureau (BDT) was invited "… to continue to promote the development of telecommunication standards for e-health network solutions and interconnection with medical devices in the developing-country environment, in conjunction with ITU-T and ITU-R in particular".[44,45]

3.2 International standards for e-health

Enormous national and international efforts are being directed at regulating or guiding the growth of the healthcare ICT ecosystem. These efforts are fuelled by the compelling need for the standardization of processes by which healthcare information is represented and transmitted from system to system. For any developing country proposing to embark on standards for e-health and hospital management information systems (HMIS), it is essential to study the existing international status in regard to e-health standards, the work of established organizations active in that field, and the current adoption of the standards issued and their acceptance and use by different nations. Many standards development organizations (SDOs) and special interest groups (SIGs) are engaged in the standardization process in relation to the issues of sharing of health data, data structure, access management, standardizing clinical and business processes in health care, and security and privacy.

Standards for e-health, especially telemedicine, have been developed since the 1990s in the International Organization for Standardization (ISO) (ISO Technical Committee 215)[46]. In the early 2000s, standards for personal health devices (PHD) started to be developed in the Institute of Electrical and Electronics Engineers (IEEE) (IEEE-11073: Working Group on PHD).[47]

Standards for e-health services have started to be actively developed in ITU-T in recent years. The groups engaged in developing these service standards are Questions 24 and 28 of ITU-T Study Group 16.[48] The published ITU-T standards are in listed in **Table 1A** in **Annex 1** to this report.

E-health standards in the field of medical information and medical data exchange systems have been established in ISO. The published ISO standards are listed in **Table 2A** in **Annex 1**.

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44 ITU-D World telecommunication development conferences.

45 Note: Resolution 54 (Rev. Dubai, 2014) of WTDC is the successor resolution to Resolution 65 (Hyderabad, 2010) of WTDC, on improving access to healthcare services by using ICTs. It was subsequently subsumed into Resolution 37 (Rev. Buenos Aires, 2017), on bridging the digital divide, adopted by WTDC-17.

46 ISO. Technical committees. ISO/TC 215. Health informatics.

47 IEEE. IEEE 11073-00103-2012 - Health informatics - Personal health device communication Part 00103: Overview.

48 ITU-T. Study Group 16 at a glance

Chapter 4 – Social acceptance

4.1 Study on economic aspects of digital health

In regard to the economic aspects of digital health, this section explores the applicability of the contingent valuation method (CVM) for economic assessment of an e-health system. It focuses on the notions of willingness to pay (WTP) and willingness to accept (WTA), and demonstrates their importance in the economic evaluation of e-health.[49]

4.1.1 Background

Field surveys have been conducted to date on e-health-system projects in Japan, the United States and the United Kingdom. The results obtained in terms of the effects of e-health systems were that they: (a) stabilize the condition of diseases; (b) raise health consciousness; (c) decrease anxiety towards health; and (d) reduce medical expenditure.

In all the projects surveyed, health-related data are regularly sent to the medical institution, and by examining the medical data each day medical staff are able to recognize changes in health condition and give advice to users. On reading their data records, users will seek to improve their data; thus, they pay more attention to their own health. Users can communicate with medical staff via the system, and the realization that they are connected to the medical staff 24 hours a day decreases their feelings of anxiety. In addition, their medical costs go down as well.

To quantify this impact of e-health in economic terms, there is a real need for more precise and accurate methods based on rigorous scientific foundations. For the purpose of assessing new medical services and technology, the available tools in the field of health economics include cost-effectiveness analysis (CEA), cost-utility analysis (CUA) and cost-benefit analysis (CBA).

Although CEA and CBA are simple methods that compare costs and effects such as rate of cure, the effects must be compared with the same unit of measurement. On the other hand, CUA evaluates benefits in terms of health-related quality of life (HRQOL), which is the patient's ability to enjoy a normal life and activities, having regard to life expectancy, cause of death and other factors exerting an impact on health status. One of the issues with this measurement is that the utility is not expressed as a specific unit, and therefore not tractable for measuring the effects of e-health, since it influences the rate of cure and life expectancy by only an infinitesimal amount. From long-run research on the evaluation of e-health, it can be concluded that more accurate and concrete benefits are obtained by enquiring about such effects with the users themselves. This leads us to the contingent valuation method (CVM).

4.1.2 Contingent valuation method

The contingent valuation method (CVM) measures the benefits of a service in terms of willingness to pay (WTP) and willingness to accept (WTA): the former is the monetary amount which users are willing to pay for receiving the service, whereas the latter is the amount which users are willing to receive as compensation for forgoing it. By ascertaining each user's WTP, it is then possible to

49 ITU-D SG2 Documents SG2RGQ/169 and SG2RGQ/302 from Tokai University (Japan)

construct the surrogate demand function for the e-health system. As already mentioned, users of e-health perceive all kinds of benefits. The notion of WTP and WTA encompasses all the benefits users may envisage, and in this sense they are considered as the broadest measures.

CVM has clear theoretical foundations, as well as accumulated research results not only in health economics but also in the fields of public economics, environmental economics and experimental economics, as a method used to evaluate in monetary terms services and projects which are not traded on the market by asking the exact value people are willing to pay for them. Although CVM has a strong theoretical basis, it tends to be subject to a response bias because it asks for concrete valuation and choice under fictitious circumstances. In respect of its methodology, therefore, efforts have been made in the field of environmental economics, for example, to (i) clarify the type of bias to which it is subject and (ii) eliminate that bias.

4.1.3 Questionnaire

The typical survey questions put to respondents in relation to WTP and WTA addressed the following: (a) WTP; (b) effectiveness; (c) frequency of usage; and (d) user properties such as age, gender, income, education and health condition. The questions in categories (b) to (d) are designed to examine correlations with respondents' WTPs. Various methods of extracting respondents' WTP have been built up, including dichotomous choice, payment card, bidding game, and so forth. To avoid response bias in revealing the true value for respondents, it is commonly believed that the dichotomous choice method is the most adequate, insofar as it quotes one particular monetary amount and asks whether the respondent agrees to pay that amount for the use of e-health or not. It is difficult for a respondent to come up with an exact amount payable for the use of e-health, but it is somewhat easier when the only possible answers are "yes" or "no" to a particular amount. Questioning related to WTP works as follows. The survey begins by asking the respondent whether they would be willing to pay monthly charges of, say, USD 100. If their answer is "yes," it then asks whether they would be willing to pay USD 150. If they reply "yes" again to USD 150, their WTP is USD 100. If the answer is "no", then the amount is lowered to USD 75. If they reply "yes" to USD 75, then that is their WTP. If their answer is again "no," the amount is lowered further to USD 50. Three-stage dichotomous choice is considered to be better for practical purposes. WTA is obtained by a similar process.

4.1.4 Estimation of WTP and WTA

Each respondent's WTP and WTA are obtained as above from the survey questionnaire, and the WTP and WTA values for the e-health system are calculated by estimating the logistic curves which show the relationship between WTP and WTA and the percentages of respondents who can pay (receive) this amount. The area below the curve is equivalent to WTP and WTA.

4.1.5 Avoiding biases

Although CVM and WTP have a strong theoretical basis, as mentioned above CVM tends to be subject to a bias because it asks for concrete valuation and choice under fictitious circumstances. Care should be taken to clarify, and eliminate, any such bias.

To avoid bias, the traditional method of evaluating clinical intervention is the randomized control trial (RCT), in which subjects are randomly selected and categorized into a treatment group and a control group, and the effect is compared between the two groups. The most serious problem of RCTs is avoiding bias between the two groups, which is referred to as sample selection bias. One of the methods of overcoming selection bias is propensity score matching (PSM), which enables the inclusion of as many criteria as necessary. A propensity score related to biased characteristics is first calculated for each individual, and then outcome variables, such as medical expenditure, are compared for individuals whose scores are close. One treatment subject is matched to one control subject who has similar characteristics, thus reducing sample selection bias. The effect of time trends, including development of medical technologies, improvement of patient environments and ageing of the population, are particular to long-term data. In an econometric sense, adopting panel data analysis is one of the ways to cope with such unobserved time effects, but they cannot be effectively analysed by PSM alone.

4.1.6 Travel-cost method

This method seeks to measure benefit in terms of the costs incurred by patients to get to medical institutions or by medical staff to travel to a patient's residence. If they are willing to bear those costs, it may be inferred that the services are worth that amount, which can be interpreted as benefit.

4.1.7 Hedonic approach

E-health has various benefits, of which those discussed thus far are only some. All benefits will ultimately affect the level of wages or land price in the areas near to the e-health project. A successful e-health system in a region may attract people to live there, which will raise the price of land there. This can be considered as its benefit, encapsulating all direct and indirect effects.

4.1.8 Conclusion

Although telemedicine or e-health has been implemented all over the world, there are still many obstacles to further implementation, such as legal frameworks, the economic foundations of projects and other regulations. All medical systems were established in the age of face-to-face medicine, prior to the advent e-health. One important step towards overcoming these obstacles is demonstrating its effectiveness, i.e. that e-health both contributes to the efficiency of medical services and enhances the health and wellness of people, in particular inhabitants of less populated, mountainous and remote areas who have been suffering in terms of access to medical institutions. Strong support for reimbursement of e-health will be contingent on the existence of clear evidence of economic benefits based on a solid scientific methodology. Without this, further promotion of e-health will not be achieved.

4.2 Health projects under the universal service fund

4.2.1 Universal service funds and digital inclusion

Examples of current best practices with respect to the management of a universal service fund (USF) vary from region to region. There are specific elements in many individual funds which, if combined in a single framework and one administrative package, would yield a USF that is efficient, effective and well governed.

One of the key success factors for laying a solid and nurturing foundation for USFs is a legal or regulatory framework that is flexible enough so as not to impede evolution and change as and when required. This flexibility is critical to the successful ongoing functioning of a USF. There are some countries that have been able to adjust the scope and/or direction of the USF thanks to this underlying flexibility. An example is provided by the National Telecommunications Commission (CONATEL) of Paraguay.[50]

4.2.2 Paraguay success story

Paraguay's telecommunication regulatory agency, the *Comisión nacional de telecomunicaciones* (CONATEL) (National Telecommunications Commission), has a National Telecommunications Plan 2016-2020, in which the following action items are prescribed:[51]

- Strategic programme B.2: Collaborate in promotion of the information society
- Structural project B.2.2: E-health - Promote efficient health care for the population, through informatization.

In this connection, CONATEL signed a Framework Cooperation Agreement with the Ministry of Public Health and Social Welfare to support Internet connectivity at sites identified by the ministry in order to promote digital inclusion in public health, and specifically for the ministry's National Telehealth Programme.

The Ministry of Public Health and Social Welfare had unveiled to the public the National Telemedicine System (e-health) project, executed with technical cooperation from experts. According to the project coordinator, the initiative constitutes the continuation of work started under a pilot plan, which successfully developed a concept of the country's need to respond to important issues such as strengthening and promoting the health system, and strengthening hospital management in order to offer quality, efficiency and safety to the most remote populations, as well as creating an information system that can be used to make timely decisions in public health.

Use of the universal service fund

Under the provisions of the Telecommunication Law, CONATEL levies a universal service fund (USF) contribution on commercial operations (equal to 1 per cent of the gross operating revenues of telecommunication service providers).

The purpose of the USF thus constituted is to subsidize providers of public telecommunication services in areas where this is justified. CONATEL has drawn on USF resources to carry out projects for the promotion of telemedicine:

- *Project execution for Internet access and data transmission services to provide connectivity to operational units of the Ministry of Public Health and Social Welfare for the promotion of telemedicine*: Through a public tender, a subsidy was awarded to a telecommunication service provider for the provision of connectivity in 176 sites (hospitals, health centres and family health units) in the country. The level of connectivity was set at 1, 2 and 5 Mbit/s, for a period of 810 days. In addition, the service provider was obligated to donate two Internet access accounts for 540 days. The amount of the subsidy was PYG 3 478 260 930 (USD 751 406).

[50] ITU-D SG2 Documents SG2RGQ/59 from Paraguay and 2/303 from Tokai University (Japan)
[51] Comisión Nacional de Telecomunicaciones (CONATEL). Plan nacional de telecomunicaciones Paraguay 2016-2020. February 2016. [in Spanish]

- *Connectivity projects and office systems required by the Ministry of Public Health and Social Welfare for the promotion of telemedicine*: Through two public tenders, a subsidy was awarded to a telecommunication provider for the provision of connectivity to two sites in Central Department and 18 in Guairá Department, for a period of 1 245 days. The amount of the subsidy was PYG 5 726 877 992 (USD 1 010 150).

Impact of the projects

According to reports received from the Ministry of Public Health and Social Welfare, the projects have helped facilitate and expedite access to information for family health units (FHU), health centres, district hospitals, regional hospitals and other units under the ministry's jurisdiction, which are now being equipped with computer equipment as well as Internet access.

By virtue of this support received from the telecommunication regulatory agency, through the ministry's different health units public health has been brought to far-flung places in the Paraguayan territory in an effective and agile manner, and they now receive specialized medical attention in a shorter time-frame thanks to the use of applied technologies for rapid response and decision-making.

It is worth mentioning that, as a result of their computerization, the units now benefit from specialized medical studies, access to patients' clinical records, examination records, patient analysis, distribution and administration of medication, oxygen monitoring and intelligent beds.

The ministry indicates that, in this way, doctors and nurses save a lot of valuable time, which they can devote to assisting other patients, thereby strengthening the performance of the health units.

Chapter 5 – Human resource development

5.1 Basic concept

Human resource development (HRD) is extremely important for maintaining independent and sustainable telemedicine. In this chapter, we will introduce HRD content specifically required for medical students, as well as doctors and ICT engineers working in e-health; content to analyse the underlying aspects of e-health for healthcare specialists and workers; and MBA and DBA courses on offer to e-health researchers in developing countries who are already well-informed and have high-level knowledge in this field.

5.2 Courses for medical students, doctors and ICT engineers[52]

The active implementation of information technologies in the work of medical institutions has long been a routine fact of life in the majority of developed countries. The key objectives of such implementation are to improve the quality of health care, make it more widely accessible and reduce costs.

In pursuit of those objectives, WTDC-06 (Doha, 2006) approved a regional initiative for the Commonwealth of Independent States (CIS) region on the "Introduction of integrated, ubiquitous telemedicine technologies and systems for bridging the digital divide", the implementation of which involved studies on issues associated with the standardization and unification of telemedicine equipment and exchange of medical data as well as the development of telemedicine networks within the region.[53]

The studies showed, among other things, that one of the key problems hampering the active implementation of ICTs in the healthcare field in the CIS countries was the inadequate level of human capacity development in that sphere. For instance, only half of the region's medical universities had departments whose curricula included such disciplines as IT studies, medical informatics, IT in the pharmaceutical sphere, and so forth. There were virtually no specialized departments dealing with ICTs and telemedicine, while regular lecturers in medical universities lacked basic training in the areas of computer engineering or software engineering.

The ITU Plenipotentiary Conference (Busan, 2014), in approving Resolution 183 (Rev. Busan, 2014), on telecommunication/ICT applications for e-health, invited Member States "to consider developing appropriate legislation, regulations, standards, codes of practice and guidelines to enhance the development and application of e-health telecommunication/ICT services, products and terminals", and encouraged them "to participate actively in e-health-related studies in ITU-R, ITU-T and ITU-D through contributions and by other appropriate means".

Participants in the ITU Regional Workshop for the CIS countries on the use of ICTs for health protection and telemedicine services, including in rural and remote areas (7-9 October 2015)

52 ITU-D SG2 Document 2/43 from the A.S. Popov Odessa National Academy of Communications (Ukraine)
53 ITU. WTDC-06 Final Report, §3.5.2. CIS regional initiatives.

noted the need to implement projects, including as part of CIS regional initiatives, to develop technologies and build capacity in the field of e-health, including the development of specialized training courses, as well as the need to develop ways of encouraging medical staff to introduce ICTs into health care.[54]

This led naturally to the adoption at WTDC-17 (Buenos Aires, 2017) of the CIS regional initiative on "Development of e-health to ensure healthy lives and promote well-being for all, at all ages". Expected results of this initiative include training courses focusing on the training of medical students, and enhancing the skills of practising medical staff, in the use of ICTs in health care, including telemedicine, as well as courses for IT specialists on working with medical information systems.[55]

It is planned to divide these training courses ideologically into three standalone courses: "ICT for medical students" (a course for medical students on the use of ICTs in health care); "ICT for doctors" (an advanced course for practising medical staff on the use of ICTs in health care); and "E-health for ICT engineers" (a course for ICT specialists on working with medical IT systems). In terms of structure, it was proposed that each course be divided into thematic modules with tests. Each course must be colourful in design and include text, drawings, photos, video clips and animated film clips, with professional sound recording. The interface must be adapted for use over the Internet on different operating systems and web browsers. The course interface will be designed along the lines of the multimedia distance-learning courses on safe use of Internet resources ("advanced" level),[56] taking account of the particular requirements of the target audience.

"ICT for medical students" course

This course is intended to train medical students in the use of ICTs in health care. It comprises 61 interactive screens with 21 photos, 50 drawings and two animated clips. It is structured in seven modules, with a test after each module. Details of the modules and topics covered can be found in §A2.1 of **Annex 2** to this report.

"ICT for doctors" course

This course is intended to provide more advanced training for practising medical staff in the use of ICTs in health care. It comprises 41 interactive screens with 12 photos, 25 drawings and two animation clips. It is structured in five modules, with tests after each module. Details of the modules and topics covered can be found in §A2.2 of **Annex 2**.

"E-health for ICT engineers" course

This course in intended for ICT specialists working with specialized medical IT systems or planning to work in that area. It comprises 40 interactive screens with 10 photos, 19 illustrations and two animation clips. It is structured in five modules, with a test after each module. Details of the modules and topics covered can be found in §A2.3 of **Annex 2**.

54 ITU. ITU Regional Workshop for CIS countries on the use of ICT for health protection and telemedicine services, including in rural and remote areas. Tashkent, Uzbekistan, 7-9 October 2015.
55 ITU-D. CIS regional initiatives. Buenos Aires Action Plan 2018-2021.
56 https://onlinesafety.info [in Russian]

5.3 Underlying aspects of e-health for healthcare specialists[57]

The lack of human resources trained in e-health is an area of weakness in developing countries. Like all new disciplines, e-health requires a competent and qualified workforce for its operation and sustainable development. To begin with, medical personnel must be able to use basic ICT applications, i.e. for sending e-mails, scanning documents or performing Internet searches, before they can master techniques specific to telemedicine, in which interaction occurs with a machine holding the patient's data rather than with patients themselves. To address this issue, the public healthcare system and public and private hospitals should provide for the training of their staff with a view to the successful operation of e-health technology.

In this context, a number of underlying challenges of e-health need to be covered.

5.3.1 Scepticism surrounding the reliability and capacity of technology

There is a serious shared concern among healthcare professionals regarding the reliability of e-health systems, given the level of connectivity in some rural communities. This concern is also present among the potential beneficiaries of the telemedicine system. Here, the reliability of system components and telecommunication links connecting different points holds the key. To inspire and maintain confidence in remote health care, the design and development of equipment and components used for telemedicine have to meet the rigorous technical standards that apply to the medical field. Telecommunication links between different points must be supported by backup links that can be called into action at a moment's notice.

With regard to access to broadband, stakeholders must commit to its installation. As a workaround, telemedicine devices are optimized to operate normally at low connection speeds, since broadband is often lacking in remote and rural areas.

5.3.2 Lack of awareness

Raising awareness of the benefits of e-health among all actors in the medical chain is an important step towards the adoption of this new means of healthcare delivery. The fact that telemedicine is practised remotely, more often than not excluding contact with healthcare actors, and patients in particular, has not yet been fully accepted as the norm among the broader public. Patients remain attached to the traditional healthcare system, which is essentially based on contact with medical personnel.

Under the traditional approach to health care, the doctor examines the patient; the physical contact of the examination and consultation gives the patient mental comfort. From the patient's point of view, the quality of care offered by physical examinations cannot be bettered.

There is also a reluctance to adopt telemedicine among medical personnel, who have many questions concerning this new way of doing things. They sometimes wonder if they should return to education to study information technology and telecommunications.

To address this major challenge, an awareness-raising campaign should be launched by government authorities and other entities, with a specific message for each category of healthcare actors. This campaign must be able to convince healthcare actors to embrace this

[57] ITU-D SG2 Document SG2RGQ/263 from the Co-Rapporteurs for Question 2/2

new technology so that they can draw on its various benefits. They must be made to understand the benefits of telemedicine, much like with mobile telephony and the Internet, which have revolutionized long-distance communication. The continued promotion of telemedicine as a short-cut to reaching everyone more quickly should be an ongoing exercise.

5.3.3 Security and ethical considerations

Patients' medical data circulate on telemedicine networks. These data, which are accessible to system employees, can be used for other purposes, entailing a risk to patients' privacy. Patients are particularly hesitant when it comes to using telemedicine services such as videoconferencing. They prefer face-to-face consultations.

To overcome this challenge, ethical procedures must be established regarding access to patients' medical data. Only personnel duly authorized and directly involved in the treatment of the patient should have access to sensitive data.

5.3.4 Government policy and financing

The policy adopted by governments on e-health plays a key role in its development. Governments must have a vision for the practice of telemedicine, just as they develop strategic plans for traditional healthcare systems based on face-to-face practice. In all countries, the State funds healthcare systems to ensure access to basic health care for all.

In e-health, the State still needs to take action at two levels, namely through the adoption of a relevant policy and through funding.

The State should have a vision and adopt a policy for the sustainable development of telemedicine. Government financing should support the development of e-health.

The establishment of vital local facilities, the development of transport infrastructure and the procurement and installation of all kinds of equipment require massive funding. The successful introduction of telemedicine will depend to a large extent on government funding and planning.

For telemedicine to serve everyone's needs, governments must have an overarching plan and make provision in the national budget line to finance it.

5.3.5 Poor infrastructure

The practice of telemedicine requires telecommunication systems to transport medical data from one point to another, using telecommunication infrastructure deployed across the country. Many developing countries, however, are lacking in adequate telecommunication infrastructure. The shortage of modern telecommunication infrastructure has a negative impact on the development of telemedicine and is more acutely felt in remote and rural areas, which have the greatest need for telemedicine due to a crucial lack of hospitals and healthcare centres. The establishment and management of local networks are huge tasks that require robust equipment, material and technology in order to be able to respond at all times.

To allow patients to tap into the benefits of telemedicine, telecommunication systems (telecommunication networks/Internet) must deliver on the following three criteria: coverage, speed and quality.

Nationwide coverage of telecommunication networks is essential so that all residents can enjoy free access to telemedicine services.

Broadband is essential to the real-time practice of telemedicine, as exchange of information must be immediate in this vital and crucial area. The quality of telecommunication services is also critical in this context in terms of ensuring round-the-clock network availability. The reliability of telecommunication systems used for telemedicine must be a given; electricity remains an absolute prerequisite for connectivity.

To deal with this challenge, the national policy for the development of national infrastructure must focus on the deployment of quality high-speed telecommunication networks nationwide to ensure that telemedicine works for the benefit of all residents.

In terms of infrastructure, it is also important to stress the need to set up private networks in order to provide a certain level of autonomy in the use of telemedicine.

5.3.6 Payment for services

One of the biggest obstacles to the introduction of telemedicine is the difficulty and confusion associated with the payment for services provided. Doctors and other providers will not move away from the traditional system to provide virtual and online services if there is no guarantee that they will be paid.

A logical and fair approach would be to introduce legislation guaranteeing that online service providers will be paid at the same rates as traditional system practitioners.

5.3.7 Issues of territorial competence

The practice of telemedicine may encounter an issue of territorial competence as, in some countries, doctors are authorized to practise only in a specific geographic region, state or province. They cannot practise outside of that area. In telemedicine, however, the concept of distance does not apply, which raises an issue of territorial competence, as a doctor examining a patient outside his/her territorial competence via a telemedicine link may be breaking the law.

To overcome this obstacle, an exception must be made to allow doctors to practise telemedicine outside their territorial competence.

5.3.8 Viability of e-health

Ensuring the viability of telemedicine must be a matter of concern to all actors in the medical chain. Given the potential of this new form of medical practice and the healthcare needs to be satisfied, telemedicine must be incorporated into sustainable development. Doing so would allow the most vulnerable populations to tap into its potential and benefits. The practice of telemedicine must no longer merely be part of a doctor's work experience.

To ensure the sustained practice of telemedicine, it must form part of medical students' university curriculum. With such training, they will already be ready to incorporate telemedicine into their medical practices.

5.3.9 Need for a critical mass of users and specialists

In order to reap the financial benefits of telemedicine and see the resulting savings, a critical mass of usage must be achieved. An initial investment in technology, training and resources is necessary for the adoption and introduction of telemedicine. If only a small number of doctors subsequently practise telemedicine, there will be no return on investment. For telemedicine to become a standard, regular practice, a significant number of patients and doctors must adopt the practice, which will inevitably then attract interest.

Once critical mass has been achieved, telemedicine will become a lasting part of national and global medical practice.

5.3.10 Culture and behaviour

The introduction of e-health into medical practices does not always go smoothly. It is no simple task to change the culture and behaviour of complex systems, such as the healthcare system, where processes are interdependent and no change can be dealt with in isolation. The introduction of e-health in the existing system is proving to be a battle against the status quo. It will be difficult to change behaviour without ensuring that the practice of telemedicine is easy, or easier than existing processes, and/or by promising quality of service or financial incentives to encourage the adoption of new practices. Incentives can motivate, reward change and provide support for the earlier adoption of new processes.

The introduction of telemedicine requires incentivization at five levels:

1) Governments and insurance companies can save money and resources and improve services
2) Patients can receive better and more convenient and accessible services
3) Local medical personnel supporting patients can provide additional care
4) Specialists at connected establishments can receive the same pay as practitioners under the traditional system
5) Hospitals can be provided with resources to host and install telemedicine equipment and connections, along with human resources to coordinate appointments.

5.3.11 Conclusion

With developing countries experiencing critical healthcare needs, e-health offers a short-cut to meeting them once and for all. It is the responsibility of all actors in the medical chain to do everything possible to seize the opportunity afforded by e-health through synergy. The current challenges can be overcome if, and only if, there is a manifest willingness to make e-health a driver for change in the field of health care.

5.4 E-health Academy (MBA, DBA course)[58]

This section describes a special educational programme which explores some of the greatest challenges and opportunities facing the healthcare business today, in order to improve management of e-health projects in developing countries. The programme is designed for business professionals who want to apply modern ICT for new advanced services in healthcare

[58] ITU-D SG2 Document SG2RGQ/21 from the Dominic Foundation (Switzerland)

practice with a focus on developing countries. Each student will have a highly qualified supervisor from the beginning through to the end of their studies.

WHO has adopted the following broad description of e-health/telemedicine:[59]

"The delivery of healthcare services, where distance is a critical factor, by all healthcare professionals using information and communication technologies for the exchange of valid information for diagnosis, treatment and prevention of disease and injuries, research and evaluation, and for the continuing education of healthcare providers, all in the interests of advancing the health of individuals and their communities".

E-health refers to the use of modern ICTs to meet the needs of citizens, patients, healthcare professionals, healthcare providers and policy-makers.

In sum, WHO has underlined that e-health includes four elements:[60]

- Its purpose is to provide clinical support.
- It is intended to overcome geographical barriers, connecting users who are not in the same physical location.
- It involves the use of various types of ICT.
- Its goal is to improve health outcomes.

E-health has a very important role to play in healthcare delivery in developing countries, where the acute shortage of doctors, nurses and paramedics is directly proportional to the enormous unsatisfied demand for health services. Some developing countries have already successfully implemented pilot e-health projects. They are also looking to proceed further by considering the development of e-health master plans, as recommended by WHO in its Resolution WHA58.28 of May 2005,[61] which aims at reducing disparities with regard to medical services between urban and rural areas and pays special attention to the least developed countries (LDCs). Yet, the implementations of e-health in the developing world has not reached the necessary level in order to significantly influence healthcare systems.

In some developing countries, the number of mobile phones has overtaken the number of fixed phones, and mobile telecommunication networks could be considered a more attractive platform for the introduction of e-health services.

According to recent research, we could face a serious medical professional shortage across the world in the next 10 to 15 years. What does this mean for us – and our healthcare system?

- Not enough doctors to go around
- The crisis is and will be international
- Both developed and developing countries will be affected.

The shortage that many developing countries are facing today, and will face in the future, is and will be much more serious than the shortage in developed countries. The chronic shortages of

[59] WHO. A health telematics policy in support of WHO's Health-For-All strategy for global health development. Report of the WHO group consultation on health telematics, Geneva, 11–16 December 1997, p. 10. WHO, 1998.

[60] WHO. Telemedicine: Opportunities and developments in Member States. Report on the second global survey on e-health. *Global Observatory for e-health series* - Volume 2, p. 9. WHO, 2010.

[61] WHO. 58th World Health Assembly. Resolution WHA58.28, on e-health.

trained medical professionals are attributable to lack of training, limited finances (poor working conditions) and brain drain.

The question is: What can we do? The answer is: Foster worldwide e-health implementation as fast as possible. Of course, e-health implementation will not be the miracle solution to all problems; but it will provide a chance to still offer citizens worldwide affordable, high-quality health care.

The DBA programme is in two parts, and is currently run at the Swiss School of Management.[62] The first part deals with the different fields of research according to the student's area of interest and available courses; and the second part is based on healthcare management under the title "E-health Academy". E-health Academy will offer two additional workshops:

- Overview of e-health services implemented in developing countries
- How to develop a national e-health policy.

[62] Swiss School of Management (SSM). Doctorate of Business Administration (DBA).

Chapter 6 – Country reports and best practices

6.1 Africa

Benin

E-health in Benin: Initiatives and outlook[63]

Benin's ambition is to become the digital service platform for the whole of West Africa and to make ICTs the principal driver of its socio-economic development by 2021.

The objective is to put the digital transition in motion by facilitating the emergence of digital enterprises. In this regard, the digital economy is recognized as an essential lever of public policies to improve living standards, in particular for the more disadvantaged population groups.

Health care being one of the five areas identified for action for the period 2016-2021, the government has opted to reorganize the healthcare system and provide more efficient healthcare coverage through:

- Improved governance and management of healthcare sector resources (e.g. incentive bonuses granted to all healthcare workers in June 2019)
- Universal access to healthcare services and better quality of care
- Improved partnerships in health care and promotion of ethics and medical responsibility, etc.

Benin's e-health initiatives are intended to contribute to the implementation of operational strategies for the development of digital technology and to the achievement of healthcare system objectives, including facilitating public access to health care and medical information.

In Benin, it is recognized that all innovations remain at the embryonic stage, meaning that the authorities need to promote the development of these noble innovations.

Innovations in health care must ensure enhanced quality of care and resolve geographic and regional disparities and social inequalities in the distribution and quality of healthcare services.

In conclusion, Benin puts forward the following recommendations for consideration under Question 2/2:

- Harmonize projects, integrating them into global healthcare strategies and adapting them to local contexts
- Promote the creation of dedicated national e-health agencies
- Effect profound changes and transformation in order to be able respond to the public's new healthcare requirements and to put people at the centre of health care
- Gather and analyse successful experiences and scale up those with the most potential
- Establish an e-health observatory.

[63] ITU-D SG2 Document SG2RGQ/131 from Benin

Start-ups as a motor of sustainable socio-economic development in the creation of smart cities and societies and e-health[64]

Several initiatives aiming to improve the organization of start-ups have been launched by the Government of Benin with its development partners and by non-governmental structures.

A number of discussions and initiatives are in progress under the auspices of ITU, involving researchers, engineers, practitioners, entrepreneurs and policy-makers in efforts to draft guidelines to help national administrations develop policies ensuring the safe and appropriate use of ICTs, in particular AI, in health care and other fields. Particular attention, however, needs to be paid to start-ups, which can contribute effectively to sustainable socio-economic development and to the emergence of e-health in LDCs.

Encouraging and supporting start-ups in the use of ICTs for socio-economic development and e-health will contribute effectively to attainment of the SDGs and promote the creation of smart cities and societies. To that end, strategies must be put in place that take start-ups into account and support them in their endeavours. These include:

a) Establishment of a national e-health strategy for 2018-2022 with the backing of ITU and other technical and financial partners.
b) Establishment by the government of frameworks to promote the development of start-ups, including a dedicated national start-up development strategy built on three main pillars:
   - introduction of a "start-up" label, the criteria for which will be laid down in a regulatory act;
   - offering tax breaks, by decree, for enterprises with the start-up label, with the establishment of four support systems: "incubator", "brooder", "accelerator" and "nursery";
   - establishment of a public-private partnership framework.
c) Organization by the Ministry of the Digital Economy and Communication of a "Benin Start-up Week" involving regular meetings and seminars with start-ups from around the country. This will serve as a forum for start-ups in Benin's digital sector, enabling them to make their expectations known and learn about available business development opportunities created by the authorities.
d) Organization of a competition for the best start-ups in health care and various other socio-economic fields.
e) Creation of an authority dedicated to protecting and promoting start-ups in Benin.
f) A project to create a national technology innovation fund.
g) Creation of a national start-up database/directory.
h) Organization of forums facilitating contacts and exchanges between start-ups, industries, policy-makers and development organizations/actors.
i) Introduction of a sharing and exchange platform.
j) Other initiatives.

[64] ITU-D SG2 Document SG2RGQ/24 from Benin

Burkina Faso

Use of mobile technologies to combat cervical cancer in Burkina Faso[65]

In Burkina Faso, cancer is a national concern. It ranks third in terms of morbidity and mortality after infectious and cardiovascular diseases. Alone, it accounts for 60 per cent of the State's budget for emergency evacuations abroad.

According to GLOBOCAN 2012 statistics, cervical cancer is the second most common cancer among women in Burkina Faso. It has high mortality rates due to insufficient means of prevention, early detection, examination, specific treatment and supportive care. In 2012, GLOBOCAN estimates 1 155 recorded cases, including 845 deaths, with a projected 1 415 cases, including 1 044 deaths, for 2020.

With this in mind, progress in the fight against cervical cancer has been achieved through capacity building, strengthening the technical platform and the introduction of mechanisms for control of the disease, including Burkina Faso's participation in ITU's Be He@lthy, Be Mobile programme.

The support and contribution of technical and financial partners in facilitating agreements with governments participating in the programme is requested.

The following outcomes and activities may serve as lessons learned and suggested best practices, where appropriate:

Outcome 1: The use of health care and health promotion services is improved through the adoption of mobile technologies:

- Activity 1: An innovative e-services system for the promotion of health via mobile technology is available on a platform
- Activity 2: Awareness-raising messages are sent to target populations by SMS.

Outcome 2: An innovative electronic system is implemented to optimize the monitoring and treatment of patients:

- Activity 1: Data from consultations, screenings and treatment of precancerous lesions are recorded for better monitoring of patients in healthcare structures
- Activity 2: Reference and counter-reference modules are available for continuity of care
- Activity 3: An appointment reminder and treatment follow-up system integrated into the patient's electronic file is available.

Outcome 3: Medical staff are trained in screening, treatment, raising patient awareness and ICT tools:

- Activity 1: An ICT training programme for healthcare professionals is available
- Activity 2: An electronic platform for training and decision-making support is available (continuous training, forum for discussion, treatment instructions or guidelines by SMS)
- Activity 3: A stakeholder training plan is available.

65 ITU-D SG2 Document SG2RGQ/125 from Burkina Faso

Outcome 4: An electronic cervical cancer register integrated into the National Health Information System is deployed:

- Activity 1: A database for cases of cervical cancer (detected and treated) for stakeholders involved in care (clinical, anatomical and pathological, biological and therapeutic)
- Activity 2: Integration of data from the electronic cervical cancer register in the National Health Information System to facilitate strategic decision-making (health indicators in the course of routine reporting, module for interoperability/exchange of data (extraction and transfer)).

Implementation of "Be He@lthy Be Mobile" in Burkina Faso[66]

The initiative "Be Healthy Be Mobile (BHBM) m-Cervical Cancer in Burkina Faso" was officially launched on 2 May 2017 in Ouagadougou. It is a product of the Be He@lthy Be Mobile programme piloted by ITU in partnership with WHO.

The initiative's overall objective is "the use of mobile technology applications in the fight against cervical cancer".

Following the launch of the BHBM m-Cervical Cancer initiative in Burkina Faso, the pilot phase actually got under way thanks to the support of all the project's stakeholders. This experimental phase made it possible to identify more clearly the challenges facing the project and to provide a more focused response in order to achieve the objectives set. It will pave the way for a smoother transition to roll-out of the initiative at the national level.

Democratic Republic of the Congo

Pan-African e-network project e-VidyaBharati and e-AarogyaBharati (e-VBAB) for telemedicine and tele-education[67]

The emergence of e-health poses a major challenge for the improvement of primary health care and education in the Democratic Republic of the Congo (DRC). Cooperation between developed and developing countries in telemedicine and tele-education in higher and university education helps less developed countries to gain new experience via ICTs as a means of accelerating their socio-economic development. In this context, a Pan-African e-network project has been implemented by India in 48 African countries, including DRC.

In September 2004, the then Indian President, Dr A. P. J. Abdul Kalam, initiated the Pan-African e-network project connecting the 53 Member States of the African Union with Indian institutions by satellite and optical fibre. After being approved by the different parties, the project received funding and was effectively launched on 26 February 2009.

For DRC, three sites were chosen to host project infrastructure, namely:

1) the UNIKIN Polytechnic Faculty, for tele-education;
2) the Medical Faculty, particularly the Kinshasa University clinics, for telemedicine;
3) the Presidential Office of the Republic.

With regard to the Medical Faculty, particularly the university clinics, the effective launch took place on 1 April 2012, with the Indian ICT specialist responsible for monitoring project

66 ITU-D SG2 Document SG2RGQ/126 from Burkina Faso
67 ITU-D SG2 Document 2/130 from the Democratic Republic of the Congo

implementation present on site. Three years later, however, the implementation of the project gradually began to experience difficulties, leading to the shutdown of equipment. The telemedicine project has come to an end, having proved unsuccessful for the Kinshasa University Medical Faculty.

e-VBAB network project

The e-VBAB network project is essentially a technological upgrade and extension of the Pan-African e-network project (Phase 1) implemented in 48 African partner countries between 2009 and 2017.

Phase 1 of the project helped to deliver tele-education (e-VidyaBharati) and telemedicine (e-AarogyaBharati), connecting Indian hospitals and educational establishments with those of the participating African countries.

The e-VBAB network project will last five years. Each year, it will offer tele-education courses in various university disciplines to 4 000 African students. The project will also provide ongoing medical training free of charge (1 000 students per year) for practitioners, doctors/nurses and African paramedical staff. In addition, under this project, Indian doctors will be giving free medical advice to African doctors in need of such advice.

The e-VBAB network project will be wholly funded by the Indian Government for the entirety of its duration and open to all African partner countries. It will represent another significant step in the development partnership between India and Africa.

Senegal

"Digital Senegal 2025" strategy: The use of ICTs in the health system in Senegal[68]

One of the major challenges of the *Sénégal Numérique 2025* (SN2025) strategy (Digital Senegal 2025) is economic and social transformation through the dissemination of digital technology in the priority sectors identified by Senegal's national socio-economic policy document, the *Plan Senegal Emergent* (PSE) (Emergent Senegal Plan).

Digital technology, recognized as a major lever for changing the living conditions of populations, particularly the underprivileged, offers opportunities for modernizing and promoting socio-economic sectors with high growth potential, through production techniques and technologies, but also trade in goods and services.

By relying on the performance of the digital sector, Senegal wishes to boost and accelerate the key drivers of growth with a view to improving the production and innovation capacities of growth sectors.

The chosen option is to speed up the spread of digital technology in these priority sectors identified by the PSE, in order, on the one hand, to promote access to basic social services (health, education, financial services) and, on the other, to raise productivity significantly by focusing on the increased use of digital technology in agriculture, animal farming, fishing and trade.

[68] ITU-D SG2 Documents SG2RGQ/58 and 2/206 from Senegal [in French]

The SN2025 strategy highlights the transversal nature of telecommunications/ICTs for the PSE priority sectors in general, and the health sector in particular.

Considering the main orientations of SN2025 (Axis 4: Digitalization of priority economic sectors), and taking into account the decision of the Senegalese Government to make equitable access to quality health services a national priority, Senegal, through the *Ministère de la Santé et de l'Action Sociale* (MSAS) (Ministry of Health and Social Action), has resolutely committed, together with all the stakeholders, to a process of establishing a national strategy for the development of digital health ("National Digital Health Strategy").

Senegal remains open to forging fruitful partnerships in the field of telecommunications/ICT in general and in the handling of the crucial issue of "ICT for health" in particular.

Senegal puts forward the following recommendations:

1) Create strong synergy between the many initiatives in the field of "e-health" and harmonize interventions at national, regional and international levels
2) Strengthen awareness and training of populations and all other stakeholders on the real issues of the use of ICT in sectors such as health
3) Take into account the transversal nature of digital technology for other sectors of the economy in the elaboration of telecommunication/ICT development policies and strategies
4) Involve the actors of the targeted priority economic sectors throughout the process of establishing these policies
5) Strengthen the legal and institutional framework governing action
6) Strengthen cooperation in the field of e-health among stakeholders involved in the process of establishing an inclusive and sustainable information society
7) Invite ITU and its partners to strengthen the Union's support for developing countries in the implementation of ICT for development (ICT4D) initiatives.

E-health initiatives in Senegal: Lessons learned and recommendations[69]

Some of the major positive impacts of digital technology are the democratization of services, quick and easy sharing of information, greater affordability and optimization of costs. Applied to health, these impacts are multiplied and contribute to reducing inequalities in health care between social categories who all participate in the effort to create wealth.

In order to correct these inequalities, the Senegalese State, as the guarantor of fundamental rights and social cohesion, has, since the Alma-Ata conference in 1978,[70] been committed to better facilitating access to primary health care and promoting community participation in the public health effort. Several strategies have been tried, *inter alia*:

- Facilitating access to certain drugs with the Bamako initiative
- Involving the community in the management of health structures
- Compulsory health insurance for private-sector workers
- Authorizing private insurance
- Launch of universal health coverage in 2013.

[69] ITU-D SG2 Document SG2RGQ/65 from Senegal [in French]
[70] WHO. Declaration of Alma-Ata. *International Conference on Primary Healthcare*, Alma-Ata (USSR), 6-12 September 1998.

Implementation of the policies corresponding to these strategies has allowed significant progress to be made, and the budget of the ministry in charge of health in Senegal has seen regular increases even though it remains below the 15 per cent target set by the Economic Community of West African States (ECOWAS) for all its member countries.

However, despite all this political will, having and maintaining good health remains a major challenge for most vulnerable Senegalese households.

In addition, unexpected health expenses are a cause of extreme poverty for the population. It should also be noted that, according to WHO data, at the global level, 100 million people fall below the poverty line each year because of unforeseen health expenses, and 32 per cent of health expenses are directly borne by households.

Due to its multiplier effect, digital technology can help to solve all these difficulties, especially in a country like Senegal, which is showing real ambition with the "Digital Senegal 2025" strategy, whose vision is to create a "digital Senegal" by 2025: "In 2025, digital for all and for all uses in Senegal with a dynamic and innovative private sector in an efficient ecosystem", with a budget of USD 58 million planned for the health sector.

Recommendations for stakeholders:

- Strengthen cooperation between ITU and WHO, following the example of the "Be He@lhy, Be Mobile" initiative.
- Launch a global online observatory to track all digital health initiatives in order to share experiences, develop synergies and collaboration and attract funding.
- Launch a joint WHO/ITU annual prize to identify and reward the best digital health projects listed by the global observatory.
- Encourage member countries to support the award-winning projects.
- Encourage countries to develop and implement national digital health strategies and measure progress.
- Encourage ITU Academia to integrate digital health training into their curricula.
- Encourage the training of health professionals in digital tools.
- Encourage and support the creation of living labs that bring together researchers, academics, lawyers, regulators, economists, consumer associations and digital entrepreneurs to co-develop solutions adapted to demand. These living labs will carry out experiments and end-to-end pilot projects, from design to evaluation, and will share the results with the entire community.
- Organize an annual reverse innovation session during which international organizations working in the field of health present their pains and ambitions to digital entrepreneurs with the responsibility to come back to them with digital solutions.
- Encourage the participation of digital entrepreneurs (start-ups) in the work of ITU study groups dealing with e-health.

6.2 Asia and the Pacific

India[71]

The Indian Ministry of Health and Family Welfare (MoHFW) has undertaken various activities/tasks in pursuit of its aim of implementing e-health in an integrated manner.

[71] ITU-D SG2 Document SG2RGQ/159 from India

National Health Portal

The National Health Portal (NHP) serves as a single access point for authenticated health information for citizens, students, healthcare professionals and researchers.

The National Institute of Health and Family Welfare (NIHFW) has established a Centre for Health Informatics as the secretariat managing the NHP's activities.

The portal provides a range of information on various topics such as, *inter alia*, handy health tips, disease-based information, government health policies and programmes, health facilities around citizens, career options for students and other health-related information.

The information is broadly classified under a number of headings: healthy lifestyle; disease/condition information; directory services and regulations; professional enhancement; AYUSH (Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy).

With the overall objective of creating awareness among citizens in regard to health as well as government programmes and services in the health sector, NHP provides information to citizens and stakeholders in different languages (currently six languages: Hindi, English, Tamil, Gujarati, Bengali and Punjabi).

A voice portal, providing information through a toll-free number (1800-180-1104), and mobile apps, as listed below, are also available:

- *Health Directory services* provides information related to hospitals and blood banks across India.
- *India Fights Dengue* enables a user to check dengue symptoms, get the nearest hospital/blood-bank information and also share feedback.
- The *Swasth Bharat* app provides authentic and detailed information on healthy lifestyle, disease conditions, symptoms, treatment options, first aid and public health alerts.
- *Vaccine Tracker* (*Indradhanush Immunization*) helps parents track the immunization status/schedule of their children.
- The *Stress Management* app provides information about stress and also helps the user to understand their stress levels and ways in which stress can be reduced/managed.

Online Registration System

The Online Registration System (ORS) for public hospitals has brought about a significant change in the patient registration and appointment system, as a result of which patients no longer have to wait at hospitals for appointments. Today, all of the All-India Institutes of Medical Sciences (AIIMS), most central government hospitals and many state government hospitals are linked through ORS. ORS is a portal for online registration and appointment and for providing patient-centric services such as viewing lab reports, blood availability status, etc. The key benefits offered by ORS to citizens include:

- Hassle-free services using online facilities.
- Patients can avoid long queues at the hospital for obtaining outpatient appointments/registration and can pay the registration fee online.
- Single user-friendly portal countrywide for patient-centric services in hospitals across the country.
- Available to citizens via the web and on a mobile app, in both English and Hindi.

The ministry is deploying efforts to link more hospitals with ORS.

E-hospital

E-hospital is aimed at implementing the Hospital Management Information System (HMIS) for internal workflows of hospitals and data interoperability across hospitals in the future.

Benefits will include:

- Availability of an online patient-centric interface.
- Hospitals available on the cloud through a software-as-a-service (SaaS) model.
- Reduced service-side ICT, physical infrastructure, application and database-management costs for hospitals.

The targeted impacts of the E-hospital activity include smoother and easier hospital workflow management leading to better delivery of services to patients and improved efficiency of processes at hospitals. E-Hospital will help in the creation of electronic medical record (EMR) and electronic health record (EHR) systems for citizens and the exchange of records through the envisaged Integrated Health Information Platform (IHIP).

More than 30 large hospitals are using E-hospital and seven hospitals are using the cloud version of E-hospital.

Looking ahead, India observes that the introduction of e-health services faces a number of challenges such as ICT infrastructure, trained personnel, the need to establish central control with regional coordination, and awareness and acceptance on the part of citizens.

India has also been successful in conducting programmes to extend telemedicine services to several African countries and neighbouring countries in the South Asian Association for Regional Cooperation (SAARC). Digital health has huge potential for improving the healthcare delivery system and is capable of changing the landscape in the healthcare industry across the globe. The Government of India has been focusing increasingly on e-health/digital health to bring about improvements in Indian public healthcare delivery by progressively using ICT under the overall objective of Digital India. In this regard, Member States might be able to learn from India's example as described above on how to best assimilate ICTs and leverage them to the fullest extent, rapidly transforming health information with and for the benefit of all stakeholders, securing public support and buy-in, and creating a health-information database.

Japan

Providing safe and secure deliveries for expectant mothers' health care using ICTs[72]

Japan's perinatal and expectant mothers' mortality rates are among the lowest in the world, reflecting the advanced medical practices of Japanese perinatal care. However, the decreasing number of obstetricians and an increase in late child-bearing has made the perinatal care situation more challenging, especially in rural and remote areas, including outer islands where obstetricians and midwives are fewer in number, impacting on the health care available to expectant mothers.

A telemedicine cardiotocograph and a perinatal e-health platform were developed so that doctors in distant locations can diagnose the condition of expectant mothers and their fetuses irrespective of their geographical location. The "Petit Mobile CTG" cardiotocograph, which is

[72] ITU-D SG2 Document SG2RGQ/22+Annex from Tokai University and Melody International Ltd. (Japan)

a medical device loaded with ICTs, has been used in clinical trials at five different hospitals in Japan as well as in developing countries. Training of medical staff was also conducted in those locations.

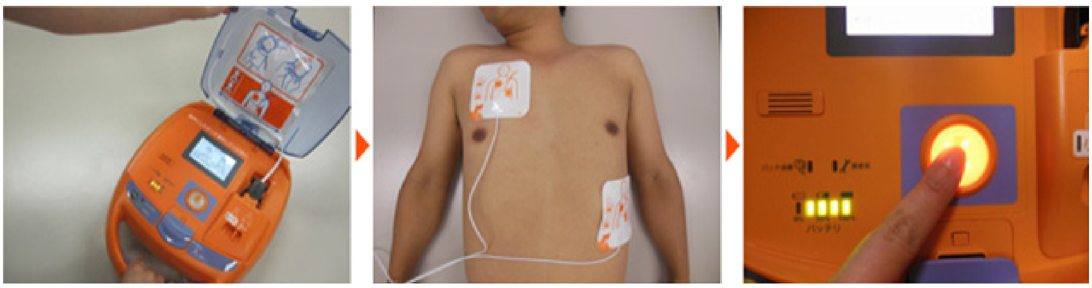
The establishment of operational structures to exploit this system is under way in developing countries (Thailand, Laos, Indonesia, South Africa and Myanmar) where the mortality of expectant mothers and fetuses remains high and the perinatal examination rate is low. By implementing this platform, it is expected that the examination rate (currently at only 10 per cent) will increase using CTG, leading to a significant decrease in perinatal mortality.

Automatic external defibrillator remote-monitoring system linked with wireless public networks[73]

An automatic external defibrillator (AED) remote-monitoring system which monitors the status of an AED on the general network and informs the user of its status by e-mail is commonly used in Japan. It receives the results of a daily self-test effected by the AED, the expiry date of the electrode pads and the battery expiry date/remaining battery charge by wireless signals via Bluetooth. It forwards this information to the server over the public network and sends a notification to the person in charge of managing the AED to check the information on its website. Using the LTE line makes it possible to install the system anywhere in a hospital, without any limitation on installation locations because the storage case, AC power supply, etc. are not required.

As the system is rolled out more widely, it becomes possible to ensure AEDs are properly maintained and to solve the management problem of AEDs in the public access defibrillation (PAD) market being unavailable or unusable when needed. There are approximately 680 000 AEDs currently deployed in public places. Delivery of AEDs may possibly be automated in the future, too, by drones using GPS.

Figure 9: AED: (1) Power turns on when lid is opened; (2) Apply electrode pads to chest; (3) Press button for electric shock



(a) (b) (c)

Source: Photos provided by Nihon Kohden Corporation Corp.

Telemedicine collaboration network system between medical professionals using mobile devices[74]

One effective tool to address the global social issue of insufficient and uneven distribution of medical resources is a telemedicine collaboration network system using smartphones. In this

[73] ITU-D SG2 Document SG2RGQ/23 from Japan
[74] ITU-D SG2 Document 2/334 from Japan

regard, Japan reports a successful test case of a smartphone-based communication application used between medical professionals.

The system is a mobile application for medical professionals that aims to improve the efficiency of information sharing in the field. As a chat-based communication tool, it is used not only for communication within one medical institution, but also as a platform for cooperation between local medical institutions and emergency services. It also serves as a mobile platform for medical information and supports hospital information systems, such as electronic medical records, picture archiving and communication systems (PACS), Health Level Seven (HL7), which is an international standard for medical information exchange,[75] Digital Imaging and Communications in Medicine (DICOM), a medical imaging standard,[76] electrocardiogram standard medical waveform format encoding rules (MFER),[77] etc.

Communication is achieved by enabling standardized medical information to be viewed on mobile devices such as smartphones. This system is very useful in areas where every second counts, such as cerebrovascular disease, cardiovascular disease and severe trauma. It has been developed with the aim of contributing to improving the safety and quality of medical care for diseases presenting a high level of urgency.

All data handled on the system are stored on the cloud, so telemedicine can be implemented simply by downloading a mobile application onto a smartphone. As a result, key features of the system are that initial costs are affordable and that it can be quickly accessed by medical professionals wherever they may be.

In Japan, it has been certified as a medical device programme pursuant to the "Pharmaceutical Affairs Act", renamed "Act on Securing the quality, efficacy and safety of products including pharmaceuticals and medical devices",[78] and has been included in the public insurance system since April 2016. Registration as a medical device has been completed with the Food and Drug Administration (FDA) in the United States, in Europe (CE marking), with the Brazilian Health Regulatory Agency (ANVISA) in Brazil, and elsewhere.

From the viewpoints of protecting personal information in medical records and cybersecurity, it complies with the medical information guidelines published by three ministries in Japan, including the Ministry of Health, Labour and Welfare.

Furthermore, it conforms to the relevant laws of each country where it has been implemented, such as the Health Insurance Portability and Accountability Act (HIPAA) in the United States and General Data Protection Regulation (GDPR) in Europe. Thus, it supports diagnosis and consultation in a secure environment based on accurate medical information, the quality of which is guaranteed by medical device certification.

The service was launched in August 2014, and telemedicine between medical professionals using this platform is currently being implemented in 18 countries. In Japan, the system has been introduced in more than 300 medical institutions, including approximately 40 university institutions, and is being used as a regional collaboration platform for acute care.

75 Health Level Seven International (HL7): https://www.hl7.org/
76 Digital Imaging and Communications in Medicine (DICOM): https://www.dicomstandard.org/about-home
77 ISO. Online browsing platform. ISO/TS 22077-2:2015. Health informatics – Medical waveform format – Part 2: electrocardiography.
78 Japanese Law translation. Act on Securing the quality, efficacy and safety of products including pharmaceuticals and medical devices. Amendment of Act No. 50 of 2015.

The Ministry of Internal Affairs and Communications (MIC) has conducted research projects using this system in five countries – Brazil, Chile, Columbia, Mexico and Peru – to verify the usefulness of medical mobile ICT in Latin America. For example, in Brazil, which has a population of over 200 million people and a geographic area of some 8.512 million km^2, the effectiveness of information sharing from pre-hospital medical care, such as in an ambulance, to hospitals was investigated, as well as multidisciplinary collaboration in medical institutions for stroke and acute cardiovascular disease. During the survey period of approximately one year, the system was introduced in more than 25 medical facilities and emergency services, and the impact of its use was measured. Today, the system has been introduced in more than 100 medical institutions. It has also been deployed in North America, Europe, Southeast Asia, the Middle East and Africa.

6.3 Commonwealth of Independent States

Russian Federation[79]

Telemedicine Act in the Russian Federation

Federal Act No. 242, on Amendments to certain legislative acts of the Russian Federation relating to the use of information technologies in the field of health care (hereinafter the Telemedicine Act), was adopted on 29 July 2017.

The Telemedicine Act was adopted not as a separate piece of legislation specifically for telemedicine technologies, but rather as a bill amending existing laws, including: Federal Act No. 323 of 21 November 2011 (on health care); Federal Act No. 3 of 8 January 1998 (on narcotic drugs and psychotropic substances); and Federal Act No. 61 of 12 April 2010 (on the circulation of medicinal products).

The advanced solutions and technologies that are legalized in the Telemedicine Act do not require actors to undertake any additional licensing: utilization of the new tools is covered by the existing medical practice licences. It should be noted that the Telemedicine Act does not cover all of the possibilities that modern technologies offer for health care in the Russian Federation; however, the new regulations do provide a framework for a smooth transition to innovative approaches to the interactions between healthcare actors.

Salient points of the new Telemedicine Act:

The concept of telemedicine technology is introduced and defined

The list of basic concepts set forth in Article 2 of Federal Act No. 323 has been expanded to define telemedicine technology as information technologies that support: remote interaction of healthcare practitioners with each other and with patients and their legal representatives; identification and authentication of those persons; and documentation of their actions during case conferences, consultations and remote health monitoring of patients.

Article 10 of Act No. 323 has been amended to recognize that telemedicine technologies now also ensure quality and accessibility in health care. Telemedicine is thus expected not only to improve access to health care, but also to have a favourable influence on the quality of treatment and health monitoring of patients and on the level of professional qualifications and skills among health care specialists.

[79] ITU-D SG2 Document 2/265 from the Russian Federation

The types of medical care to be provided by telemedicine are defined

To capitalize on the potential of telemedicine technologies, a new article has been added to Federal Act No. 323, Article 36.2, which deals with the delivery of health care using the above-mentioned technologies. Consultations, case conferences and remote patient health monitoring can now be conducted using telemedicine technologies that support remote interaction among doctors or between a doctor and a patient or the patient's legal representative. In the doctor-patient mode, telemedicine technologies may be used during visits to provide preventive care, collect information about the patient, assess therapeutic/diagnostic measures and correct them as required, and to monitor patient health. Remote patient monitoring is authorized only if the doctor has already seen the patient in person.

Remote interaction will require prior authentication and identification of the participants. All information will be liable to collection, storage and processing, subject to compliance with legislation on personal data and respecting the confidentiality of medical information.

The provision governing information policy in health care is amended

It is planned to set up and operate an integrated national healthcare information system in conjunction with the federal healthcare information systems, the information systems of the federal compulsory health insurance fund and the territorial patients' funds, the public information systems of the Russian Federation's constituent entities, and the medical information systems of medical and pharmaceutical organizations.

It is now permitted to create and issue medical documents and information in electronic form

Among the medical documents that can be issued under the Telemedicine Act are prescriptions, including those for highly potent substances (narcotics and psychotropics), which can be prescribed electronically with an enhanced encrypted and certified electronic signature. The necessary amendments have been made to Article 26 of Federal Act No. 3 and the applicable provisions of Federal Acts Nos. 323 and 61.

It is also permitted to use electronic formats to meet the requirement for free and informed consent of the patient (or legal representative) to medical treatment, or the refusal of such treatment, and, at the request of the patient (or legal representative), to issue documents and information regarding the patient's state of health.

The new Telemedicine Act clears the way for future innovation in the use of telemedicine for the provision of health care. As the technologies evolve and become widely adopted in health care, the question of inadequate access to medical help may be resolved in the foreseeable future.

It is important to note that the Telemedicine Act contains references to additional regulatory provisions to be adopted by the responsible federal executive body. In practical terms, the implementation of the Telemedicine Act will therefore in many cases be determined by regulatory acts issued by the Government of the Russian Federation, the Ministry of Health and delegated regulatory bodies. With the adoption of the Telemedicine Act, it has become necessary to amend and update a considerable number of existing regulatory texts and procedures and standards for providing health care, giving detailed guidance on which tools and instruments may be used, and in which situations.

6.4 Middle East

Syrian Arab Republic[80]

Dissemination of advanced information about new e-health applications using new technologies in the developing countries

The current ICT infrastructure available in the developing countries, even in the worst cases, is capable of implementing medical content-based image retrieval (CBIR) and content-based case retrieval (CBCR) on patient records, to help in diagnosis, in characterizing and describing human diseases and in formulating rules and building knowledge databases to support medical decision-makers and new doctors, especially in countries where the number of doctors and medical staff is constantly decreasing because of the poor economic and security situation.

The doctor describes the situation of the patient, assigning values to the attributes in the patient record and inputting blood test results and any medical images taken, as well as other multimedia information elements, and then, thanks to the system, receives all the cases that are similar to the case under consideration. Each case retrieved from the case base contains the diagnosis assigned by the medical expert, together with rules extracted from a medical knowledge database. This can help the decision-maker to assign a diagnosis to the case under consideration or to use association rule techniques to predict the underlying and potential patterns in a given disease. The end user can access these cases via a secure wireline or wireless network from his/her application, which might be installed on his/her mobile or PC according to predefined permissions. Knowledge elements can be extracted by combining results coming from different resources through the modern information fusion techniques proposed by Dezert-Smarandache theory (DSmT).[81] Knowledge bases can lead to the discovery of important unknown patterns and validate uncertain association rules.

The aforementioned systems and services do not need sophisticated facilities and expensive equipment that poor countries cannot afford. Currently available servers, data centres, wireless stations and networking equipment are already sufficient to fulfil this function. With this in mind, developing countries should always keep up to date with advanced services and solutions in the developed countries, and should pay special attention to research and strategies in this domain so as to be ready to develop their own systems when they have the opportunity and the means to achieve this goal, which should be a priority, since health is the ultimate and the most important issue for all. Nevertheless, as explicitly discussed and explained by Haiti,[82] e-health legislation and regulations, as well as cyberhealth, are still not well assimilated and are still paralysed by many challenges.

In spite of their limited resources and adverse economic situation, developing countries still have expert programmers, researchers, strategists and human resources capable of using the available ICTs to build valuable e-health systems and solutions. In particular, medical data-mining-based systems like CBIR and CBCR should be considered, together with medical information fusion. These systems do not require complex infrastructure and mainly depend on programming and database-management systems, which are of major importance in medicine. Their algorithms and techniques depend on similarity measurement of patient records, although

[80] ITU-D SG2 Document SG2RGQ/128+Annex from the Syrian Arab Republic
[81] For DSmT, see: http://fs.unm.edu/DSmT.htm
[82] ITU-D SG2 Document SG2RGQ/122 from Haiti

similarity estimation is complicated in the presence of imperfect and heterogeneous data and the multimodality of medical images. These difficulties are more marked in developing countries than in the developed world.

The Syrian Arab Republic has conducted and published research, proposing solutions within a unified mathematical framework. The annex to Document SG2RGQ/128 contains examples of an e-health system validated in hospitals in the Syrian Arab Republic and France. The challenges associated with e-health, and proposed solutions, are considered in Document SG2RGQ/122 from Haiti.

State of Palestine contributing under Resolution 99 (Rev. Dubai, 2018)

E-health activities in the State of Palestine[83]

Government and service institutions seek to ease the lives of citizens by providing them with the best available services.

The Ministry of Telecommunications and Information Technology of the State of Palestine links government bodies together electronically via the government network. These bodies include the Ministry of Health, public hospitals and certain primary healthcare centres providing e-services. These services give physicians and hospital and health-centre managers access to all administrative and medical procedures, analyses, imaging, etc. via a medical image management and archiving system. Additionally, a computerized health information system creates electronic medical files for all patients, containing all medical data from the moment they enter the hospital to the time they leave. Note that the medical image management and archiving system is an integrated system and is linked to the computerized health information system. This linkage allows a single file to be created for each patient, containing all of the patient's data and images from visits to hospital, outpatient clinics or primary healthcare centres. The systems allow physicians to access patient information from either the electronic file or the archive system.

The systems have improved the management of work in the ministry, public hospitals and connected primary healthcare centres. It is possible for any patient, upon entering any hospital, outpatient or inpatient clinic connected to the system, to access his/her medical file. Each patient has a single medical file, containing all medical information, images and reports from visits to public hospitals or primary healthcare centres. This makes it easier to study the condition of patients arriving at any location connected to these systems. Also, it removes the need to seek further clarification or to contact the location where patients' records are held for essential information prior to beginning treatment.

The systems have facilitated the provision of all medical services needed by patients in hospitals and in some primary healthcare centres, and saved a considerable amount of money as they dispense with the use of paper-based files; they are also environment-friendly. They have enabled the controlled and rationalized dispensing of medication and helped to improve the quality of medical services provided to citizens. Moreover, decision-makers in the Ministry of Health can now rely on accurate and up-to-date information, enabling them to plan properly and to take appropriate decisions for the development and operation of public hospitals and primary healthcare centres.

[83] ITU-D SG2 Document 2/153 from the State of Palestine under Resolution 99 (Rev. Dubai, 2018)

Digital transformation policy[84]

The national digital transformation policy is based on a number of principles which will help to ensure its successful application, the most noteworthy being:

1) Full integration and harmonization with national policies, strategies and initiatives designed to support digital transformation, in line with best regional and international practice.
2) Identification of drivers of digital transformation which are consistent to a large extent with aspects of the fourth industrial revolution and innovation ecosystem in the State of Palestine, including big data, AI, machine learning, cloud computing, blockchain, financial technology, smart cities and IoT.
3) Governance: Management of digital transformation processes in a manner consistent with the needs and aspirations of society.
4) Risk management: Digital transformation goes hand in hand with radical changes in processes and working methods, and any interruption of or breakdown in telecommunications could result in a complete national shutdown. Consequently, high-level security measures and precautions need to be taken and risk-management procedures adopted in order to ensure preparedness, readiness and sufficient resilience.
5) Future steps necessary for the preparation of action plans: A set of procedural measures is required for the preparation of implementation plans for resulting projects and the identification of implementation priorities.
6) SWOT analysis: Diagnosis of the current situation in terms of strengths, weaknesses, opportunities and threats.
7) A document that seeks to formulate a national digital transformation policy for the State of Palestine and a clear national framework that will provide a unified vision and help coordinate efforts to develop digital technology to serve society and the economy.

Key recommendations:

1) Adopt the mechanism for the preparation of implementation plans incorporated in the national digital transformation policy, with a view to ensuring timely completion of the digital transformation process.
2) Work to address weaknesses, identify threats and take advantage of opportunities outlined in the SWOT analysis.
3) Prepare a risk-management and post-disaster recovery plan based on a risk matrix.
4) Avoid rapid digital transformation to ensure that Palestinian society is first ready for it; the transformation should be gradual and traditional methods of service provision should be maintained in parallel as an alternative.
5) Implement pilot projects to ensure readiness and obtain feedback prior to large-scale roll-out.
6) Develop technological infrastructure, especially Internet access.

[84] ITU-D SG2 Documents 2/268 and SG2RGQ/230 from the State of Palestine under Resolution 99 (Rev. Dubai, 2018)

6.5 Latin America

Brazil

Brazilian national e-health programme[85]

Brazil has experience in the implementation of its national e-health programme, the *Programa Nacional Telessaúde Brasil Redes*, which is designed to strengthen and improve the quality of primary health care in the Brazilian public health system, the *Sistema Único de Saúde* (SUS).

One of the main assumptions of e-health in Brazil is that telediagnosis, teleconsulting and other health services using ICTs shall be offered in remote areas. The entire system is founded on supporting legislation.

Teleconsulting: Clarification of doubts about clinical procedures, health actions and questions related to work process, in a Q&A format, among health professionals. It works in synchronous mode - performed in real time, usually by chat, web conference, videoconference and telephone service; or in asynchronous mode - performed through offline messages that must be answered within 72 hours.

Second opinion: Systematic response, based on bibliographic review and scientific and clinical evidence, to questions arising from teleconsulting. The best are selected based on the criteria of relevance and pertinence in relation to SUS guidelines. They are published in the virtual health library of primary health care, *Portal da Biblioteca Virtual em Saúde da Atenção Primária à Saúde* (BPS APS).[86]

The role of the Brazilian telecommunication regulator is to guarantee access, quality, reliability and continuity of communication services, especially broadband and telephony, which are the pillars of e-health in the country.

E-health centre in the Brazilian state of Minas Gerais[87]

Brazil has established and developed an e-health system in the Brazilian state of Minas Gerais, in the south-eastern region of the country, including an e-health centre (*Centro de Telessaúde* – CTS) attached to one of the Minas Gerais Public University hospitals (*Hospital das Clínicas - Universidade Federal de Minas Gerais* – HC-UFMG).

In the compendium of ready-to-implement e-health services contained Annex 7 to the final report on Question 2/2 for the study period 2014-2017,[88] reference was made to the Brazilian service "Implementing a telecardiology strategy in a geriatric institution", using tele-electrocardiograms (tele-ECG) and specialized second opinion for the monitoring and identification of potential cardiovascular diseases in institutionalized elderly people. Today, more than 3.5 million tele-ECGs have been performed, diagnosing cardiac events and allowing immediate specialized counselling over the Internet.

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85 ITU-D SG2 Document SG2RGQ/34 from Brazil
86 *Programa Nacional Telessaúde Brasil Redes. Biblioteca Virtual em Saúde. BVS Atenção Primária à Saúde.* http://aps.bvs.br [in Portuguese]
87 ITU-D SG2 Document SG2RGQ/35 from Brazil
88 ITU. Final Report on ITU-D Study Group 2 Question 2/2 for the study period 2014-2017. Information and telecommunications/ICTs for e-health. ITU, 2017.

The CTS e-health centre is formed by a team of ICT and health professionals, alongside health managers, aiming to provide services and research in the field of e-health, with emphasis on teleconsulting. It is part of a large public hospital (HC-UFMG), occupies an area of 222m^2 and coordinates the Minas Gerais teleconsulting network (*Rede de Teleassistência de Minas Gerais* - RTMG), a partnership among seven universities located in this region.

The state has a population of approximately 21 million inhabitants in 853 municipalities. CTS serves 847 of them, which generates savings of more than USD 50 million by reducing the number of medical referrals. In the capital, Belo Horizonte, CTS serves 156 health centres, most of which are for primary health care, i.e. preventive and curative actions (diagnosis, treatment and medical referral to differentiated levels), rehabilitation care (personnel or specialized equipment) and health promotion measures.

The main services offered are teleconsulting, telediganosis and tele-education.

Teleconsulting: Provides transmission, storage and retrieval of medical information in digital form between doctors, nurses and other medical staff to discuss doubts or clinical cases remotely, using ICTs. In synchronous teleconsulting (online), the discussion takes place in real time, whereas in asynchronous mode (offline), questions sent by the requester is answered later by the medical professional.

Telediagnosis: Remote diagnosis, defined as follows by the Ministry of Health: "*Use of ICT to perform diagnosis support services over distance or time*". Specialties: ECG, ambulatory blood-pressure monitoring (ABPM), 24-hour Holter monitoring and retinography.

Tele-education: Distance training and webconferences. It is worth highlighting the possibility of monitoring special interest groups and the Formative Second Opinion service.

In order to sustain the results achieved and even expand projects such as e-health, and for initiatives like these to be encouraged, it is necessary to regulate telecommunications in the country, promoting universal broadband service, mainly outside the large metropolitan centres, ensuring access to and continuity of Internet connectivity with higher quality.

Chapter 7 – Conclusions and recommendations

Based on the experiences collected during the implementation of Question 2/2 in this study period, the following recommendations were found to be essential for health policy-makers and decision-makers in developing countries.

1. New technology

New technologies can create new businesses and improve the efficiency of healthcare systems.

- Artificial intelligence (AI):
  - Image diagnosis support with matching technology
  - Prediction of infectious disease outbreaks
  - Diagnosis of rare incurable diseases
- Blockchain:
  - Effective in streamlining medical expenses and sharing patient data
- 5G:
  - Supports rural clinical medicine and emergency medical care
  - Robotic remote surgery: By using a low-latency link like 5G, it is possible to perform surgery or surgical treatment on a patient remotely.

2. Standardization

ITU-D must introduce and fully explain the e-health standards adopted by ITU-T to the developing countries. In addition, technical guidance should be given on putting the standards into practice by actually using standardized equipment.

3. Social acceptance

Economic evaluation is essential for e-health to operate sustainably and autonomously.

If subsidies are necessary, consider allocating some of the USF funding to public applications such as e-health for high-cost areas.

4. Human resource development

Adequate e-health education opportunities must be provided to medical students, health specialists and researchers in developing countries. Otherwise, continuous sustainable operation will not be possible.

5. Sustainable Development Goals

E-health is an essential ICT tool for realizing the SDGs.

What emerges from the country reports is that ITU needs to present a best-practice e-health model to developing countries and continue to provide technical support.

6. Coronavirus pandemic

It was confirmed that e-health plays an extremely important role in the COVID-19 pandemic environment.[89] In particular, chest image (X-ray, CT, MRI) diagnosis using artificial intelligence can assist in the diagnosis of patients.

The need to provide remote psychiatric support via the communication network was also highlighted.

[89] Some examples of digital technology uses to support healthcare and public policy measures during the COVID-19 pandemic may be found in ITU-D SG2 Document SG2RGQ/270+Annex from the BDT Focal Point for Question 2/2

Annexes

Annex 1: List of standards relating to e-health

Table 1A: Standards for e-health in ITU-T

Number	Title
ITU-T H.810	Interoperability design guidelines for personal connected health systems: Introduction
ITU-T H.811	Interoperability design guidelines for personal connected health systems: Personal Health Devices interface
ITU-T H.812	Interoperability design guidelines for personal connected health systems: Services interface
ITU-T H.812.1	Interoperability design guidelines for personal connected health systems: Services interface: Observation Upload capability
ITU-T H.812.2	Interoperability design guidelines for personal connected health systems: Services interface: Questionnaire capability
ITU-T H.812.3	Interoperability design guidelines for personal connected health systems: Services interface: Capability Exchange capability
ITU-T H.812.4	Interoperability design guidelines for personal connected health systems: Services interface: Authenticated Persistent Session capability
ITU-T H.813	Interoperability design guidelines for personal connected health systems: Healthcare Information System interface
ITU-T H.830.1	Conformance of ITU-T H.810 personal health system: Services interface Part 1: Web services interoperability: Health & Fitness Service sender
ITU-T H.830.2	Conformance of ITU-T H.810 personal health system: Services interface Part 2: Web services interoperability: Health & Fitness Service receiver
ITU-T H.830.3	Conformance of ITU-T H.810 personal health system: Services interface Part 3: SOAP/ATNA: Health & Fitness Service sender
ITU-T H.830.4	Conformance of ITU-T H.810 personal health system: Services interface Part 4: SOAP/ATNA: Health & Fitness Service receiver
ITU-T H.830.5	Conformance of ITU-T H.810 personal health system: Services interface Part 5: PCD-01 HL7 Messages: Health & Fitness Service sender
ITU-T H.830.6	Conformance of ITU-T H.810 personal health system: Services interface Part 6: PCD-01 HL7 Messages: Health & Fitness Service receiver
ITU-T H.830.7	Conformance of ITU-T H.810 personal health system: Services interface Part 7: Consent Management: Health & Fitness Service sender
ITU-T H.830.8	Conformance of ITU-T H.810 personal health system: Services interface Part 8: Consent Management: Health & Fitness Service receiver

Table 1A: Standards for e-health in ITU-T (continued)

Number	Title
ITU-T H.830.9	Conformance of ITU-T H.810 personal health system: Services interface Part 9: hData Observation Upload: Health & Fitness Service sender
ITU-T H.830.10	Conformance of ITU-T H.810 personal health system: Services interface Part 10: hData Observation Upload: Health & Fitness Service receiver
ITU-T H.830.11	Conformance of ITU-T H.810 personal health system: Services interface Part 11: Questionnaires: Health & Fitness Service sender
ITU-T H.830.12	Conformance of ITU-T H.810 personal health system: Services interface Part 12: Questionnaires: Health & Fitness Service receiver
ITU-T H.830.13	Conformance of ITU-T H.810 personal health system: Services interface Part 13: Capability Exchange: Health & Fitness Service sender
ITU-T H.830.14	Conformance of ITU-T H.810 personal health system: Services interface Part 14: Capability Exchange: Health & Fitness Service receiver
ITU-T H.830.15	Conformance of ITU-T H.810 personal health system: Services interface Part 15: FHIR Observation Upload: Health & Fitness Service sender
ITU-T H.830.16	Conformance of ITU-T H.810 personal health system: Services interface Part 16: FHIR Observation Upload: Health & Fitness Service receiver
ITU-T H.841	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 1: Optimized Exchange Protocol: Personal Health Device
ITU-T H.842	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 2: Optimized Exchange Protocol: Personal Health Gateway
ITU-T H.843	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 3: Continua Design Guidelines: Personal Health Device
ITU-T H.844	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 4: Continua Design Guidelines: Personal Health Gateway
ITU-T H.845.1	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5A: Weighing scales
ITU-T H.845.2	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5B: Glucose meter
ITU-T H.845.3	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5C: Pulse oximeter
ITU-T H.845.4	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5D: Blood pressure monitor
ITU-T H.845.5	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5E: Thermometer
ITU-T H.845.6	Conformance of ITU-T H.810 personal health devices: PAN/LAN/TAN interface Part 5F: Cardiovascular fitness and activity monitor: Agent

Table 1A: Standards for e-health in ITU-T (continued)

Number	Title
ITU-T H.845.7	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5G: Strength fitness equipment
ITU-T H.845.8	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5H: Independent living activity hub
ITU-T H.845.9	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5I: Adherence monitor
ITU-T H.845.10	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5I: Insulin pump
ITU-T H.845.11	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5K: Peak expiratory flow monitor
ITU-T H.845.12	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5L: Body composition analyser
ITU-T H.845.13	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5M: Basic electrocardiograph
ITU-T H.845.14	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5N: International normalized ratio
ITU-T H.845.15	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5O: Sleep apnoea breathing therapy equipment
ITU-T H.845.16	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5P: Continuous glucose monitor
ITU-T H.845.17	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5Q: Power status monitor
ITU-T H.846	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 6: Personal Health Gateway
ITU-T H.847	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 7: Continua Design Guidelines for Bluetooth Low Energy: Personal Health Devices
ITU-T H.848	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 8: Continua Design Guidelines for Bluetooth Low Energy: Personal Health Gateway
ITU-T H.849	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 9: Transcoding for Bluetooth Low Energy: Personal Health Devices
ITU-T H.850	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 10: Transcoding for Bluetooth Low Energy: Personal Health Gateway - General requirements
ITU-T H.850.1	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 10A: Transcoding for Bluetooth Low Energy: Personal Health Gateway - Thermometer

Table 1A: Standards for e-health in ITU-T (continued)

Number	Title
ITU-T H.850.2	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 10B: Transcoding for Bluetooth Low Energy: Personal Health Gateway - Blood pressure
ITU-T H.850.3	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 10C: Transcoding for Bluetooth Low Energy: Personal Health Gateway - Heart-rate
ITU-T H.850.4	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 10D: Transcoding for Bluetooth Low Energy: Personal Health Gateway - Glucose meter
ITU-T H.850.5	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 10E: Transcoding for Bluetooth Low Energy: Personal Health Gateway - Weighing scales
ITU-T H.850.6	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 10F: Transcoding for Bluetooth Low Energy: Personal Health Gateway - Pulse oximeter
ITU-T H.850.7	Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 10G: Transcoding for Bluetooth Low Energy: Personal Health Gateway - Continuous glucose monitoring
ITU-T H.862.0	Requirements and framework for ICT sleep management service models
ITU-T H.862.1	Data model for sleep management services
ITU-T H.862.3	Requirements of voice management interface for human-care services

Table 2A: Standards for medical information and medical data exchange systems in ISO

Number	Title
ISO 10159:2011	Health informatics - Messages and communication - Web access reference manifest
ISO/IEEE 11073-00103:2015	Health informatics - Personal health device communication - Part 00103: Overview
ISO/IEEE 11073-10101:2004	Health informatics - Point-of-care medical device communication - Part 10101: Nomenclature
ISO/IEEE 11073-10102:2014	Health informatics - Point-of-care medical device communication - Part 10102: Nomenclature - Annotated ECG
ISO/IEEE 11073-10103:2014	Health informatics - Point-of-care medical device communication - Part 10103: Nomenclature - Implantable device, cardiac
ISO/IEEE 11073-10201:2004	Health informatics - Point-of-care medical device communication - Part 10201: Domain information model
ISO/IEEE 11073-10404:2010	Health informatics - Personal health device communication - Part 10404: Device specialization - Pulse oximeter

Table 2A: Standards for medical information and medical data exchange systems in ISO (continued)

Number	Title
ISO/IEEE 11073-10406:2012	Health informatics - Personal health device communication - Part 10406: Device specialization - Basic electrocardiograph (ECG) (1- to 3-lead ECG)
ISO/IEEE 11073-10407:2010	Health informatics - Personal health device communication - Part 10407: Device specialization - Blood pressure monitor
ISO/IEEE 11073-10408:2010	Health informatics - Personal health device communication - Part 10408: Device specialization - Thermometer
ISO/IEEE 11073-10415:2010	Health informatics - Personal health device communication - Part 10415: Device specialization - Weighing scale
ISO/IEEE 11073-10417:2014	Health informatics - Personal health device communication - Part 10417: Device specialization - Glucose meter
ISO/IEEE 11073-10418:2014	Health informatics - Personal health device communication - Part 10418: Device specialization - International Normalized Ratio (INR) monitor
ISO/IEEE 11073-10420:2012	Health informatics - Personal health device communication - Part 10420: Device specialization - Body composition analyzer
ISO/IEEE 11073-10421:2012	Health informatics - Personal health device communication - Part 10421: Device specialization - Peak expiratory flow monitor (peak flow)
ISO/IEEE 11073-10441:2015	Health informatics - Personal health device communication - Part 10441: Device specialization - Cardiovascular fitness and activity monitor
ISO/IEEE 11073-10442:2015	Health informatics - Personal health device communication - Part 10442: Device specialization - Strength fitness equipment
ISO/IEEE 11073-10471:2010	Health informatics - Personal health device communication - Part 10471: Device specialization - Independent living activity hub
ISO/IEEE 11073-10472:2012	Health Informatics - Personal health device communication - Part 10472: Device specialization - Medication monitor
ISO/IEEE 11073-20101:2004	Health informatics - Point-of-care medical device communication - Part 20101: Application profiles - Base standard
ISO/IEEE 11073-20601:2010	Health informatics - Personal health device communication - Part 20601: Application profile - Optimized exchange protocol
ISO/IEEE 11073-30200:2004	Health informatics - Point-of-care medical device communication - Part 30200: Transport profile - Cable connected
ISO/IEEE 11073-30300:2004	Health informatics - Point-of-care medical device communication - Part 30300: Transport profile - Infrared wireless
ISO/IEEE 11073-30400:2012	Health informatics - Point-of-care medical device communication - Part 30400: Interface profile - Cabled Ethernet
ISO 11073-90101:2008	Health informatics - Point-of-care medical device communication - Part 90101: Analytical instruments - Point-of-care test
ISO 11073-91064:2009	Health informatics - Standard communication protocol - Part 91064: Computer-assisted electrocardiography

Table 2A: Standards for medical information and medical data exchange systems in ISO (continued)

Number	Title
ISO/TS 11073-92001:2007	Health informatics - Medical waveform format - Part 92001: Encoding rules
ISO/TR 11487:2008	Health informatics - Clinical stakeholder participation in the work of ISO TC 215
ISO 11615:2012	Health informatics - Identification of medicinal products - Data elements and structures for the unique identification and exchange of regulated medicinal product information
ISO 11616:2012	Health informatics - Identification of medicinal products - Data elements and structures for the unique identification and exchange of regulated pharmaceutical product information
ISO/TR 11633-1:2009	Health informatics - Information security management for remote maintenance of medical devices and medical information systems - Part 1: Requirements and risk analysis
ISO/TR 11633-2:2009	Health informatics - Information security management for remote maintenance of medical devices and medical information systems - Part 2: Implementation of an information security management system (ISMS)
ISO/TR 11636:2009	Health Informatics - Dynamic on-demand virtual private network for health information infrastructure
ISO 12052:2006	Health informatics - Digital imaging and communication in medicine (DICOM) including workflow and data management
ISO/TR 12300:2014	Health informatics - Principles of mapping between terminological systems
ISO/TR 12309:2009	Health informatics - Guidelines for terminology development organizations
ISO/TR 12773-1:2009	Business requirements for health summary records - Part 1: Requirements
ISO/TR 12773-2:2009	Business requirements for health summary records - Part 2: Environmental scan
ISO 12967-1:2009	Health informatics - Service architecture - Part 1: Enterprise viewpoint
ISO 12967-2:2009	Health informatics - Service architecture - Part 2: Information viewpoint
ISO 12967-3:2009	Health informatics - Service architecture - Part 3: Computational viewpoint
ISO/TR 13054:2012	Knowledge management of health information standards
ISO 13119:2012	Health informatics - Clinical knowledge resources - Metadata
ISO 13120:2013	Health informatics - Syntax to represent the content of healthcare classification systems - Classification Markup Language (ClaML)
ISO/TR 13128:2012	Health Informatics - Clinical document registry federation
ISO/TS 13131:2014	Health informatics - Telehealth services - Quality planning guidelines

Table 2A: Standards for medical information and medical data exchange systems in ISO (continued)

Number	Title
ISO/TS 13582:2013	Health informatics - Sharing of OID registry information
ISO/TS 14265:2011	Health Informatics - Classification of purposes for processing personal health information
ISO/TR 14292:2012	Health informatics - Personal health records - Definition, scope and context
ISO/TR 14639-1:2012	Health informatics - Capacity-based eHealth architecture roadmap - Part 1: Overview of national eHealth initiatives
ISO/TR 14639-2:2014	Health informatics - Capacity-based eHealth architecture roadmap - Part 2: Architectural components and maturity model
ISO/TR 16056-1:2004	Health informatics - Interoperability of telehealth systems and networks - Part 1: Introduction and definitions
ISO/TR 16056-2:2004	Health informatics - Interoperability of telehealth systems and networks - Part 2: Real-time systems
ISO/TS 16058:2004	Health informatics - Interoperability of telelearning systems
ISO/TS 16791:2014	Health informatics - Requirements for international machine-readable coding of medicinal product package identifiers
ISO 17090-1:2013	Health informatics - Public key infrastructure - Part 1: Overview of digital certificate services
ISO 17090-2:2008	Health informatics - Public key infrastructure - Part 2: Certificate profile
ISO 17090-3:2008	Health informatics - Public key infrastructure - Part 3: Policy management of certification authority
ISO 17090-4:2014	Health informatics - Public key infrastructure - Part 4: Digital Signatures for healthcare documents
ISO 17115:2007	Health informatics - Vocabulary for terminological systems
ISO/TS 17117:2002	Health informatics - Controlled health terminology - Structure and high-level indicators
ISO/TR 17119:2005	Health informatics - Health informatics profiling framework
ISO 17432:2004	Health informatics - Messages and communication - Web access to DICOM persistent objects
ISO/TS 17439:2014	Health informatics - Development of terms and definitions for health informatics glossaries
ISO/TR 17791:2013	Health informatics - Guidance on standards for enabling safety in health software
ISO 18104:2014	Health informatics - Categorial structures for representation of nursing diagnoses and nursing actions in terminological systems
ISO 18232:2006	Health Informatics - Messages and communication - Format of length limited globally unique string identifiers

Table 2A: Standards for medical information and medical data exchange systems in ISO (continued)

Number	Title
ISO/TR 18307:2001	Health informatics - Interoperability and compatibility in messaging and communication standards - Key characteristics
ISO/TS 18530:2014	Health Informatics - Automatic identification and data capture marking and labelling - Subject of care and individual provider identification
ISO 18812:2003	Health informatics - Clinical analyser interfaces to laboratory information systems - Use profiles
ISO/TR 19231:2014	Health informatics - Survey of mHealth projects in low and middle income countries (LMIC)
ISO 20301:2014	Health informatics - Health cards - General characteristics
ISO 20302:2014	Health informatics - Health cards - Numbering system and registration procedure for issuer identifiers
ISO/TR 21089:2004	Health informatics - Trusted end-to-end information flows
ISO 21090:2011	Health informatics - Harmonized data types for information interchange
ISO 21091:2013	Health informatics - Directory services for healthcare providers, subjects of care and other entities
ISO/TS 21298:2008	Health informatics - Functional and structural roles
ISO 21549-1:2013	Health informatics - Patient healthcard data - Part 1: General structure
ISO 21549-2:2014	Health informatics - Patient healthcard data - Part 2: Common objects
ISO 21549-3:2014	Health informatics - Patient healthcard data - Part 3: Limited clinical data
ISO 21549-4:2014	Health informatics - Patient healthcard data - Part 4: Extended clinical data
ISO 21549-5:2008	Health informatics - Patient healthcard data - Part 5: Identification data
ISO 21549-6:2008	Health informatics - Patient healthcard data - Part 6: Administrative data
ISO 21549-7:2007	Health informatics - Patient healthcard data - Part 7: Medication data
ISO 21549-8:2010	Health informatics - Patient healthcard data - Part 8: Links
ISO 21667:2010	Health informatics - Health indicators conceptual framework
ISO/TR 21730:2007	Health informatics - Use of mobile wireless communication and computing technology in healthcare facilities - Recommendations for electromagnetic compatibility (management of unintentional electromagnetic interference) with medical devices
ISO/HL7 21731:2014	Health informatics - HL7 version 3 - Reference information model - Release 4
ISO/TS 22220:2011	Health informatics - Identification of subjects of health care
ISO/TR 22221:2006	Health informatics - Good principles and practices for a clinical data warehouse

Table 2A: Standards for medical information and medical data exchange systems in ISO (continued)

Number	Title
ISO/TS 22224:2009	Health informatics - Electronic reporting of adverse drug reactions
ISO 22600-1:2014	Health informatics - Privilege management and access control - Part 1: Overview and policy management
ISO 22600-2:2014	Health informatics - Privilege management and access control - Part 2: Formal models
ISO 22600-3:2014	Health informatics - Privilege management and access control - Part 3: Implementations
ISO/TS 22789:2010	Health informatics - Conceptual framework for patient findings and problems in terminologies
ISO/TR 22790:2007	Health informatics - Functional characteristics of prescriber support systems
ISO 22857:2013	Health informatics - Guidelines on data protection to facilitate trans-border flows of personal health data
ISO/TS 25237:2008	Health informatics - Pseudonymization
ISO/TS 25238:2007	Health informatics - Classification of safety risks from health software
ISO/TR 25257:2009	Health informatics - Business requirements for an international coding system for medicinal products
ISO 25720:2009	Health informatics - Genomic Sequence Variation Markup Language (GSVML)
ISO/TS 27527:2010	Health informatics - Provider identification
ISO 27789:2013	Health informatics - Audit trails for electronic health records
ISO/TS 27790:2009	Health informatics - Document registry framework
ISO 27799:2008	Health informatics - Information security management in health using ISO/IEC 27002
ISO/TR 27809:2007	Health informatics - Measures for ensuring patient safety of health software
ISO/HL7 27931:2009	Data Exchange Standards - Health Level Seven Version 2.5 - An application protocol for electronic data exchange in healthcare environments
ISO/HL7 27932:2009	Data Exchange Standards - HL7 Clinical Document Architecture, Release 2
ISO/HL7 27951:2009	Health informatics - Common terminology services, release 1
ISO/HL7 27953-1:2011	Health informatics - Individual case safety reports (ICSRs) in pharmacovigilance - Part 1: Framework for adverse event reporting
ISO/HL7 27953-2:2011	Health informatics - Individual case safety reports (ICSRs) in pharmacovigilance - Part 2: Human pharmaceutical reporting requirements for ICSR
ISO/TR 28380-1:2014	Health informatics - IHE global standards adoption - Part 1: Process

Table 2A: Standards for medical information and medical data exchange systems in ISO (continued)

Number	Title
ISO/TR 28380-2:2014	Health informatics - IHE global standards adoption - Part 2: Integration and content profiles
ISO/TR 28380-3:2014	Health informatics - IHE global standards adoption - Part 3: Deployment
ISO/TS 29585:2010	Health informatics - Deployment of a clinical data warehouse
IEC 80001-1:2010	Application of risk management for IT-networks incorporating medical devices - Part 1: Roles, responsibilities and activities
IEC/TR 80001-2-1:2012	Application of risk management for IT-networks incorporating medical devices - Part 2-1: Step by Step Risk Management of Medical IT-Networks; Practical Applications and Examples
IEC/TR 80001-2-2:2012	Application of risk management for IT-networks incorporating medical devices - Part 2-2: Guidance for the communication of medical device security needs, risks and controls
IEC/TR 80001-2-3:2012	Application of risk management for IT-networks incorporating medical devices - Part 2-3: Guidance for wireless networks
IEC/TR 80001-2-4:2012	Application of risk management for IT-networks incorporating medical devices - Part 2-4: General implementation guidance for Healthcare Delivery Organizations
IEC/TR 80001-2-5:2014	Application of risk management for IT-networks incorporating medical devices - Part 2-5: Application guidance - Guidance for distributed alarm systems
ISO/TR 80001-2-6:2014	Application of risk management for IT-networks incorporating medical devices - Part 2-6: Application guidance - Guidance for responsibility agreements
ISO/TR 80001-2-7:2015	Application of risk management for IT-networks incorporating medical devices - Application guidance - Part 2-7: Guidance for Healthcare Delivery Organizations (HDOs) on how to self-assess their conformance with IEC 80001-1

Annex 2: Training courses developed under the CIS regional initiative on e-health

Three distinct training courses for different target groups have been developed, as follows:

A2.1 Course: "ICT for medical students"

Module 1: General information on medical IT systems and e-health

1.1 Use of information technologies in medicine and health care
1.2 Conceptual framework and principles of e-health
1.3 Classification of medical IT systems
1.4 Basic principles of automation of the treatment-diagnostic process

Module 2: General information on computers and computer networks

2.1 PC structure
2.2 The worldwide Internet: Basic information
2.3 Popular medical IT resources
2.4 Safety and security online

Module 3: Specialized medical IT systems

3.1 Organizing the automated workplace for medical staff
3.2 Online patient histories and treatment records: Basic principles
3.3 Expert medical systems
3.4 IT systems for managing health care
3.5 Conceptual framework and principles of e-pharmacy

Module 4: Telemedicine

4.1 Telemedicine and its basic tools
4.2 Types of telemedicine services
4.3 Organizing remote healthcare monitoring
4.4 Basic principles of building and operating telemedicine networks
4.5 Family telemedicine

Module 5: Specialized e-health systems

5.1 Medical computer systems
5.2 Automated laboratory testing systems
5.3 Computer simulators in e-health

Module 6: Searching for medical information and working with databases

6.1 Searches on the Internet
6.2 Using cloud technologies to store medical data
6.3 Databases for storing medical data

6.4 Overview of the main programs for working with medical data

Module 7: Examples of best practice in the use of ICTs in health care

7.1 Organizing operational and traffic control of emergency medical services
7.2 Successful telemedicine projects
7.3 Best practices and initiatives in e-health.

A2.2 Course: "ICT for doctors"

Module 1: General information on medical IT systems in e-health

1.1 Use of IT in medicine and health care
1.2 Conceptual framework and principles of e-health
1.3 Classification of medical IT systems
1.4 Basic principles of automation of the diagnostic and treatment process

Module 2: Specialized medical IT systems

2.1 Organizing the automated work place for medical staff
2.2 Expert medical systems
2.3 IT systems for managing health care
2.4 Conceptual framework and principles of e-pharmacy

Module 3: Telemedicine

3.1 Telemedicine and its basic tools
3.2 Types of telemedicine services
3.3 Videoconferencing in telemedicine
3.4 Basic principles of building and operating telemedicine networks

Module 4: Specialized e-health systems

4.1 Medical computer systems
4.2 Automated laboratory testing systems
4.3 Computer simulators in e-health

Module 5: Examples of best practice in use of ICT in health care

5.1 Organizing operational and traffic control of emergency medical services
5.2 Successful telemedicine projects
5.3 Popular programmes and hardware systems in e-health

A2.3 Course: "E-health for ICT engineers"

Module 1: The role of e-health in the developing world

1.1 Conceptual framework and basic elements of e-health
1.2 Basic problems in developing e-health
1.3 World Health Organization: Basic objectives and goals

1.4 Basic e-health concepts

Module 2: Telemedicine and the potential of mobile technologies for e-health

2.1 Particular aspects of building telemedicine networks
2.2 Basic telemedicine services and principles of their implementation
2.3 Mobile technologies and healt hcare
2.4 Successful telemedicine projects

Module 3: E-health management systems

3.1 Principles and circulation of information in e-health
3.2 Particular aspects of building e-health management systems
3.3 Expert medical systems
3.4 Remote-monitoring systems in e-health

Module 4: Basic principles of providing e-health services

4.1 Particular aspects of organizing automated workplaces for purposes of e-health
4.2 Specialized software for providing e-health services
4.3 Basic principles of developing operational and traffic control of emergency medical services
4.4 Conceptual framework and principles of mobile health care

Module 5: Specialized e-health equipment

5.1 Medical computerized systems
5.2 Automated laboratory test systems
5.3 Computer simulators in e-health

Annex 3: Lessons learned from the workshops and webinar held under the auspices of Question 2/2[90]

Two workshops and one webinar were held under the auspices of Question 2/2 during the 2017-2021 study period:

- Workshop on the adoption of new digital health technologies (Geneva, Switzerland, 5 October 2018)
- Workshop on new communication technologies for e-health and socio-economic issues (Geneva, Switzerland, 14 October 2019)
- Webinar on new e-health solutions to combat pandemics with ICT (Virtual meeting, 6 July 2020)

These sessions contribute to implementation of the Question 2/2 workplan and are intended for representatives of ministries, regulators, telecom operators, universities and general education institutions, telecommunication equipment manufacturers, research and design institutes, software developers and other interested stakeholders from ITU Member States, Sector Members, Associates and Academia.

New technologies are opening up new opportunities to attain the Sustainable Development Goals, and particularly SDG 3, that were not possible before. New trends such as AI, 5G, IoT and big data are enabling prevention, early diagnosis, treatment and early warning for maternal and child health, non-communicable diseases, infectious diseases, and such like. Their adoption will remain dependent, however, on their affordability, accessibility, integration with existing systems and sustainable business models. The sessions showcase examples of some of the most promising technologies for e-health and discuss challenges for their large-scale adoption and ways of addressing those challenges.

Workshop on the adoption of new digital health technologies[91] (Geneva, Switzerland, 5 October 2018)

Session 1 – New technology for new business

Session 1 presented some examples of the most promising technologies for new e-health business:

- Resilient health care by IT support[92]
  Mr Jun Miyazaki, OrangeTechLab, Inc. (Japan)

This contribution proposes a resilient healthcare approach using several IT technologies: statistical analysis, process mining, AI based analysis.

- Automated external defibrillator (AED) remote-monitoring system
  Mr Kenichi Ashizawa, Ministry of Internal Affairs and Communications (MIC) (Japan)

The system receives the results of a daily self-test effected by the AED, the expiry date of the electrode pads and the battery expiry date/remaining battery charge by wireless signals via Bluetooth. Using the LTE line makes it possible to install the system anywhere in a hospital,

90 ITU-D. Workshops and other events of the seventh study period of ITU-D study groups (2018-2021)
91 ITU-D. Session on the adoption of new digital health technologies. Geneva, 5 October 2018.
92 See also ITU-D SG2 Document 2/31 from OrangeTechLab, Inc. (Japan)

without any limitation on installation locations because the storage case, AC power supply, etc. are not required.

- Providing safe and secure deliveries around the world
  Ms Yuko Ogata, Melody International Ltd. (Japan)

A telemedicine cardiotocograph and a perinatal e-health platform were developed so that doctors in distant locations can diagnose the condition of expectant mothers and their fetuses irrespective of their geographical location. The establishment of operational structures to exploit this system is under way in developing countries (Thailand, Laos, Indonesia, South Africa and Myanmar).

- Communications satellite technology for e-health
  Mr Mikhail Y. Natenzon, National Telemedicine Agency Research and Production Union (Russian Federation)

The group in the Russian Federation has created a satellite mobile communication system that helps control tuberculosis, HIV/AIDS and other virulent diseases, and/or performs early diagnosis in rural or isolated areas.

- E-health standardization for new business
  Mr Done-Sik Yoo, Electronics and Telecommunications Research Institute (ETRI) (Republic of Korea), Co-Rapporteur

This contribution introduces advanced e-health devices which are developed and/or produced commercially in the Republic of Korea, and the "sleepless management business" whose standardization is proposed in ITU-T SG16.

Session 2 - Social acceptance and academic support

Session 2 discussed economic indicators and academia activities related to e-health:

- Long-term effect of telecare intervention on patients with chronic diseases
  Mr Masatsugu Tsuji, Ministry of Internal Affairs and Communications (MIC) (Japan)

This study examines the long-term effects of the use of telecare (e-health) on the residents of a Japanese town. It is shown that telecare users require fewer days of treatment and incur lower medical expenditure than non-users with respect to the chronic diseases of stroke, hypertension, heart failure and diabetes.

- E-health Academy
  Mr Leonid Androuchko, Dominic Foundation (Switzerland), Vice-Rapporteur

This contribution describes a special educational programme which explores some of the greatest challenges and opportunities facing healthcare business today, in order to improve management of e-health projects in developing countries. It is designed for business professionals who want to apply modern ICT for new advanced services in healthcare practice, with a focus on developing countries.

Key learnings from the workshop

- In developing countries, public service policies – especially healthcare policies which manage people's health and treat sick persons – are not satisfactory.

- The United Nations has set the SDGs, one of the stated targets of which is that everyone on the planet have access to health care and medical treatment by 2030. E-health using ICT is one of the solutions for attaining this goal.
- Advanced technologies such as AI medical diagnosis and medical treatment using robotics having gradually become more widespread in the developed countries, the knowledge and policies relating to such technologies should be shared with the developing countries.
- New digital health technologies using AI, IoT and satellite communication are being used in the trial phase, with a view to their standardization.
- Field surveys are being conducted on social receptivity to e-health at the economic level, including indexes.
- High-level e-health education (MBA and DBA) for specialists can help overcome obstacles and create a pool of talented experts for advancing e-health projects in developing countries.

Workshop on new communication technologies for e-health and socio-economic issues[93] (Geneva, Switzerland, 14 October 2019)

Session 1 – Emerging technologies for e-health

Session 1 presented some examples of the use of emerging technologies for new e-health business:

- 5G for e-health (5G utilization in telemedicine)
  Mr Yukihiko Okumura, NTT Docomo (Japan)

The presentation introduced several field trials on "Visiting Medical Care" with remote support using 5G at the Wakayama prefecture, in cooperation with Tokyo Women's Medical University. An advanced paramedic service using 5G was presented to recognize the effects and efficiency of emergency patient transport and was compared with the image quality obtained through 4G networks. It was noted that a data speed of up to 700 Mbit/s uplink (forward link) was possible from the site to the centre via 5G.

- E-health application of artificial intelligence, trends in Japanese telecommunication companies
  Mr Masahito Kawamori, Keio University (Japan)

This presentation explained the background of the e-health situation in Japan, where the quantity of MRI equipment is very large and diagnostic images are overflowing in the medical field. It is extremely useful to make use of AI for the analysis of this medical imaging information in order to ensure early detection of cancer and oversight of doctors. Also, as a case report, a health-management system linking mobile phones and AI was introduced.

Session 2 – ICTs, social acceptance and financing for e-health

Session 2 continued the discussion on the role of ICTs for e-health, and explored social acceptance and financing aspects related to e-health:

- Robotic remote surgery: Application of ICTs for craniotomy
  Mr Mahdi Orooji, Tarbiat Modares University (Islamic Republic of Iran)

[93] ITU-D. Session on new communication technologies for e-health and socio-economic issues. Geneva, 14 October 2019.

The presentation described a test-bed system that can be used when ultra-emergency surgery is required to save a patient's life in cases where qualified surgeons are not physically present at the site of the accident, for example in the case of intracranial bleeding to remove the accumulated blood and discharge the haematoma, so as to quickly reduce the pressure on the brain. The system includes a precision robot and its accompanying fixtures at the patient's location, a set of command and control consoles and systems at both the surgeon's and patient's locations, as well as an ultra-reliable low-latency (URLL) wireless link for the remote surgeon to perform surgery from a distance and monitor the patient.

– Willingness to pay in e-health

  Mr Masatsugu Tsuji, Professor, Kobe International University (Japan)

The presentation explains and analyses the applicability of the contingent valuation method (CVM) for the economic assessment of e-health systems. By focusing on the notions of willingness to pay (WTP) and willingness to accept (WTA), it demonstrates their importance in the economic evaluation of e-health. An e-health system has the following effects: (a) stabilizing the condition of diseases; (b) raising health consciousness; (c) decreasing anxiety towards health; and (d) reducing medical expenditure. WTP thus encompasses all these benefits which users can envisage. It also explains how to design questions to obtain accurate values of WTP, namely using the dichotomous choice model; and the estimation method based on respondents' resulting WTP.

Key learnings from the workshop

– 5G systems and technology have the power to revolutionize emergency medical care in the ambulance.
– Medical robots can be combined with high-speed 5G communication to enable remote surgery.
– AI will greatly contribute to preventive medicine, epidemiology and clinical medicine.
– Socio-economic analysis is essential for sustainable operation of e-health and telemedicine.

Webinar on new e-health solutions to combat pandemics with ICT[94] (Virtual meeting, 6 July 2020)

This remote meeting was held on 6 July 2020 from 1200 to 1330 hours UTC, moderated by Mr Hani Eskandar, Focal Point for Question 2/2 and Senior Coordinator of Digital Services, ITU, and featuring six experts in this field.

Opening remarks

The meeting was opened by Mr Ahmad Reza Sharafat, Islamic Republic of Iran, Chairman of ITU-D Study Group 2.

Presentations

– Importance of 5G and AI for pandemics (COVID-19)

  Mr Turhan Muluk, Telecom Policy Director, Intel Corporation (United States)
  Mr Mario Romao, Global Director for Digital Health Policy, Intel Corporation (United States)

[94] ITU-D. Public Webinar on new e-health solutions to combat pandemics with ICT. 6 July 2020.

The world faces an enormous challenge in fighting COVID-19. Behind it all, Intel is committed to accelerating access to technology that can combat the current pandemic and enable scientific discovery that better prepares society for future crises. 5G and AI are very important for new e-health solutions and already helping with COVID-19.

Figure 1A: Slide from presentation "Importance of 5G and AI for pandemics (COVID-19)"

– [Medical image AI trial in India]
  Mr Hirokazu Tashiro, Senior Expert, NTT Data Corporation (Japan)

A real-life example was shared by NTT Data Corporation, whose recent proof-of-concept combines existing medical technology like radiology with AI and machine learning. Initial testing of the model in an Indian COVID-designated hospital revealed that the AI matched human radiologists' performance in detecting the presence of COVID-19 from chest X-rays. The company said that the results of the initial testing show that medical image AI has the potential to be used as an effective triage support when polymerase chain reaction (PCR) testing systems are not in place. PCR is a chemical reaction that identifies bits of DNA to diagnose an infection and is currently the standard test for detecting SARS CoV-2.

– Mental health in the COVID-19 pandemic
  Ms Malina Jordanova, Associate Professor, Bulgarian Academy of Sciences, Sofia (Bulgaria)

WHO defines mental health as "a state of well-being in which every individual realizes his or her own potential, can cope with the normal stresses of life, can work productively and fruitfully, and is able to make a contribution to his or her community".[95] The outbreak of coronavirus disease (COVID-19) has put a stress on our mental health.

The widespread distribution of COVID-19 and the enforced social distancing and isolation are accompanied by increasing fear and anxiety about our personal health and the health of our loved ones, often compounded by panic due to job loss and financial difficulties. All these factors cause changes in our sleep or eating patterns; difficulty concentrating; exacerbation of

[95] WHO. Newsroom. Fact sheets. Mental health: Strengthening our response. 30 March 2018.

chronic health problems, including mental health conditions; increased use of alcohol, tobacco and drugs; etc. Mental health problems related to COVID-19 have already been observed at the level of the population, including anxiety-driven panic buying and paranoia about attending community events. This once again underlines the necessity to pay more attention to widespread application of virtual mental health services, which help in coping with some of the problems. It is in line with the strategic goals of Question 2/2 to focus, among all other topics, on the following issues:

- Urging ITU members to extend the application of ICT for tele-mental health support of patients diagnosed with mental health disorders and borderline cases, as well as their family members. Focusing on prophylaxis and prevention of depression will be quite helpful.
- Application of ICT for tele-mental health support of healthy citizens and health-service providers during the pandemic.
- Providing tele-mental health services to vulnerable groups of the society – teenagers, citizens living alone, older persons, etc.
- Application of ICT in the mental health domain as an educational tool, increasing the qualifications of staff and educating citizens.

The first steps that Question 2/2 could undertake may include raising awareness among healthcare professionals, decision-makers and donors by providing references, good-practice models, treatment protocols, etc.

– Concept of TAP: Drug distributions and remote consultation just before the outbreak
  Mr Isao Nakajima, Professor, Seisa University (Japan)

The concept of targeted antivirus prophylaxis (TAP) involves distributing antiviral drugs to citizens in advance of a pandemic, akin to the idea of medicine sales conceived in Toyama in Japan during the Edo period.[96] Unfortunately, there are few optimal antiviral drugs (Avigan, etc.) in sight for the current COVID-19 pandemic. But during the influenza virus pandemic in 2009, it was verified in the United Kingdom and elsewhere that Tamiflu could be distributed in advance, and then administered to each individual by doctors and nurses via telemedicine over the Internet or other means. The Guidelines for the prevention and control of pandemic influenza (Phase 4 onwards) issued in 2007 by the Pandemic Influenza Expert Advisory Committee under the auspices of the Ministry of Health, Labour and Welfare (MHLW) of Japan also include a similar concept, emphasizing the importance of "preventive administration" in families and workplaces.[97]

In a pandemic situation, one may expect the amount of browsing of e-pharmacy and/or drug information websites on mobile phones to explode. Telephone calls to specialists will generate a huge volume of traffic, and extremely serious communication failures will occur, so telecommunication carriers need to make thorough preparations.

In the same vein, we recommend that iodine preparations should be provided on a regular basis to residents within a 30km radius of nuclear facilities, along with education about thyroid protection, side effects of the drug, when and how it should be administered, and other relevant guidance.

[96] For the Toyama "use first, pay later" drug delivery system, see, for example: https://www.toyama-kusuri.jp/en/aboutus/medicine.html
[97] See: Ministry of Health, Labour and Welfare. Pandemic influenza and Avian influenza

– Medical ICT platform for COVID-19 and stroke

Mr Teppei Sakano, CEO and Founder, Allm Inc. (Japan)

The doctor-to-doctor telemedicine smartphone app "Join" has been rolled out in 21 countries, focusing on time-sensitive acute disease such as strokes. Medical doctors are able to share medical data such as CT images and communicate to make quick decisions to deal with a case. Under an SDG project undertaken by the Ministry of Internal Affairs and Communications of Japan, the use of Join has been expanded to communicable diseases, starting with COVID-19, thus connecting infectious disease specialists and providing teaching files, teleradiology services and AI-based diagnosis support. The personal health record app "MySOS" and the patient-monitoring system "Team" have been integrated in order to support recuperation of non-severe COVID-19 patients at home. The data gathered from MySOS are monitored and scored to catch any signs of increased severity. The image-processing feature of MySOS measures severity indicators such as SpO2 and respiration rate without the use of any medical equipment.

Figure 2A: Slide from presentation "Medical ICT platform for COVID-19 and stroke"

Web-based discussion: "Combating pandemics"

The ensuing web-based e-discussion was run by the co-rapporteurs and vice-rapporteurs, focusing on "Combating pandemics" A summary of the discussions is given below:

1) A mobile phone service that notifies the patient in the event of approach/contact is one of the systems that prevent the spread of infection. Here, attention must be paid to the protection of personal information.
2) Detection of abnormalities on medical images (CT-SCAN, MRI, chest X-ray) by AI (e.g. convolutional neural network - CNN) can offer professional advice to medical staff and hence support efficient diagnosis.
3) If residents are kept in a closed space for a long period of time, stress may accumulate and their mental health may deteriorate. It is important to support such residents remotely with telepsychiatry.
4) Immediately before an outbreak of a highly contagious infectious disease, when implementing policies such as distributing therapeutic drugs to patients, many mirror sites are used for the web system that provides drug information to patients and/or suitable medical advice through telemedicine. It should be borne in mind that, in such a social environment, severe congestion may occur due to the volume of calls exceeding the daily communication capacity.
5) When collecting and managing information access in relation to infected patients, sufficient consideration should be given to the protection of personal information.

Annex 4: List of contributions and liaison statements received on Question 2/2

Contributions on Question 2/2

Web	Received	Source	Title
2/416 +Ann.1-3	2021-03-09	Intel Corporation (United States)	Importance of Terrestrial High-Speed and High-Quality Broadband for Digital Equity
2/412	2021-03-02	ATDI (France)	Deletion of e-health terminology and addition of abbreviations and acronyms
2/408	2021-03-03	Co-Rapporteurs for Question 2/2	Proposed liaison statement from ITU-D Study Group 2 Question 2/2 to ITU-R Working Party 4B on Output Report of Question 2/2
2/403	2021-03-02	Co-Rapporteurs for Question 2/2	Proposed liaison statement from ITU-D Study Group 2 Question 2/2 to ITU-R Working Party 5D on Output Report of Question 2/2
2/395 +Ann.1	2021-02-17	EMEA Satellite Operators Association (ESOA/GSC)	Proposed observations and suggestions for final report on Question 2/2
2/389	2021-02-01	BDT Focal Point for Question 2/2	Health Apps Assessment Frameworks report by the European mHealth Hub
2/386	2021-01-28	Haiti	Phases involved in the implementation of telemedicine in hospitals
RGQ2/TD/28	2020-10-14	Co-Rapporteurs for Question 2/2	Proposed liaison statement from ITU-D Study Group 2 Question 2/2 to ITU-R Working Party 5D on 5G in the medical field - "Infected patient care system using 5G"
RGQ2/TD/27	2020-10-13	Co-Rapporteurs for Question 2/2	Proposed liaison statement from ITU-D Study Group 2 Question 2/2 to ITU-R Working Parties 4A, 4B and 4C on Satellite Communications for eHealth
RGQ2/TD/26 +Ann.1	2020-10-13	Japan	Report on an example of measures against infectious diseases that applies 5G - Development and demonstration of infected patient care system using network-typed unit
RGQ2/TD/25	2020-10-13	Co-Rapporteur for Question 2/2	Information about a possible new liaison statement from ITU-R Working Party 5D
RGQ2/270 (+Ann.1)	2020-09-22	BDT Focal Point for Question 2/2	Digital Health Tools for COVID-19 Response
RGQ2/267	2020-09-22	Republic of Korea	Proposed text for Chapter 3 (eHealth Standardization) of the Final Report of Question 2/2

(continued)

Web	Received	Source	Title
RGQ2/260 +Ann.1	2020-09-18	Japan	Report on an example of measures against infectious diseases that applies 5G - Development and demonstration of infected patient care system using network-typed unit
RGQ2/255	2020-09-14	Co-Rapporteurs for Question 2/2, Vice-Rapporteurs for Question 2/2	Proposal for the future of the Question 2/2 ICTs for eHealth
RGQ2/254	2020-09-12	Co-Rapporteurs for Question 2/2, Vice-Rapporteurs for Question 2/2	Proposal for new Resolution "Using information and communication technologies to combat pandemics such as Corona virus infections"
RGQ2/250 (Rev.1)	020-09-08	Intel Corporation (United States)	Updated Information on the Global Status of 5G
RGQ2/236	2020-08-20	EMEA Satellite Operators Association (ESOA/GSC)	Case Studies - Satellite for eHealth
RGQ2/230	2020-08-19	State of Palestine under Resolution 99 (Rev. Dubai, 2018)	National digital transformation strategy
RGQ2/217	2020-07-31	Haiti	eHealth terminology
2/TD/28	2020-02-26	Tokai University (Japan)	Proposed liaison statement from ITU-D Study Group 2 Question 2/2 to ITU-R Working Party 4A on ambulance communications
2/TD/27	2020-02-26	Tokai University (Japan)	Proposed liaison statement from ITU-D Study Group 2 Question 2/2 to ITU-Working Party 5G on 5G in the medical field
2/TD/26 (Rev.1)	2020-02-14	BDT	ITU-WHO-EU mHealth and Innovation Hub
2/334	2020-02-11	Japan	Telemedicine collaboration network system between medical professionals using mobile devices
2/313	2020-02-03	Co-Rapporteur and Vice-Rapporteur for Q2/2	eHealth terminology for an annex of the Final Report of Q2/2
2/304	2020-01-08	Tokai University (Japan)	Draft to encourage discussion for the work plan of the next study cycle
2/303	2020-01-08	Tokai University (Japan)	Draft document for the Final Report - Section 5.2 ("E-health project related to the Universal Service Fund")
2/302	2020-01-08	Tokai University (Japan)	Draft document for the Final Report - Section 5.1. ("Study on economic aspects of digital health")

(continued)

Web	Received	Source	Title
2/294	2020-01-09	Japan	5G trends in Japan and report on an example of efforts for utilization in telemedicine
2/278 (Rev.1)	2020-01-08	Tokai University (Japan)	A nationwide study on optical analysis to support ambulance communications
2/273	2020-01-02	Senegal	Report of workshop on Capacity Building for Digital Health Leadership, 25 November-4 December 2019, Cotonou, Benin
2/268	2019-12-30	State of Palestine under Resolution 99 (Rev. Dubai, 2018)	Digital transformation policy
2/265	2019-12-27	Russian Federation	The Telemedicine Act in the Russian Federation
2/254	2019-12-16	Haiti	E-health opportunities for stakeholders
RGQ2/169	2019-09-13	Tokai University (Japan)	How to measure economic benefits of e-health
RGQ2/168	2019-09-12	Tokai University (Japan)	Blockchain and eHealth
RGQ2/163	2019-09-10	BDT Focal Point for Question 2/2	ITU-WHO-EU mHealth and Innovation Hub
RGQ2/160 +Ann.1	2019-09-09	BDT Focal Point for Europe	ITU Office for Europe 2019 actions and 2020 plan
RGQ2/159	2019-09-06	India	ICT solutions and practices employed in providing holistic e-health services in India
RGQ2/149	2019-08-22	Tokai University (Japan)	Proposed text for Chapter 3 of the Final Report for Question 2/2
RGQ2/138	2019-08-02	Tarbiat Modares University (Islamic Republic of Iran)	ICTs for digital health: robotic remote surgery
RGQ2/131	2019-07-26	Benin	E-health in Benin: initiatives and outlook
RGQ2/128	2019-07-22	Syrian Arab Republic	Dissemination of advanced information about new e-health applications using new technologies in the developing countries
RGQ2/126	2019-07-19	Burkina Faso	Implementation of "Be He@lthy Be Mobile" in Burkina Faso
RGQ2/125	2019-07-19	Burkina Faso	The use of mobile technologies to combat cervical cancer in Burkina Faso
RGQ2/122	2019-07-09	Haiti	Challenges related to the introduction of e-health in developing countries
RGQ2/110	2019-03-14	Sri Lanka	Telecommunication/ICTs for eHealth

(continued)

Web	Received	Source	Title
2/215	2019-03-12	BDT Focal Point for Question 2/2	Report about ITU-WHO Regional Capacity Building for Digital Health Leaders, 21-30 November 2018 in Maseru, Lesotho
2/211	2019-03-12	Intel Corporation (United states)	Importance of smart cities, 5G, IoT and AI
2/206	2019-03-11	Senegal	Plan Stratégique Santé Digitale: cas du Sénégal
2/203	2019-03-11	A.S. Popov Odessa National Academy of Telecommunications (Ukraine)	A set of guidelines on the construction of telemedicine networks at the local (individual settlements), regional (districts, regions) and national levels
2/189	2019-02-21	A.S. Popov Odessa National Academy of Telecommunications (Ukraine)	The report of ITU Regional Workshop for Europe and CIS on eHealth development, Odessa, Ukraine, October 17-19, 2018
2/153	2019-02-03	State of Palestine under Resolution 99 (Rev. Dubai, 2018)	Contribution from Palestine
2/148	2019-01-23	Tokai University (Japan)	The report of Japan-Russia eHealth Workshop 2018
2/130	2019-01-07	Democratic Republic of the Congo	Pan-African e-network project e-VidyaBharati and e-AarogyaBharati (e-VBAB) for telemedicine and tele-education
RGQ2/TD/7	2018-10-01	Russian Federation	ITU-D SG1 and SG2 coordination: Mapping of ITU-D Study Group 1 and 2 Questions
RGQ2/70	2018-09-18	Egypt	Main architecture elements of a smart city
RGQ2/65	2018-09-15	Senegal	Initiatives e-santé au Sénégal : leçons apprises et recommandations
RGQ2/64	2018-09-14	BDT Focal Point for Question 2/2	Digital Health Platform: a foundation for scaling up integrated digital health applications
RGQ2/59	2018-09-12	Paraguay	Paraguay experience in connectivity to public health units
RGQ2/58	2018-09-12	Senegal	La stratégie «Sénégal Numérique 2025 » : l'utilisation des TIC dans le système de santé au Sénégal
RGQ2/35	2018-08-16	Brazil	Presentation of Centro de Telessaúde/ HC-UFMG in Brazilian state of Minas Gerais
RGQ2/34	2018-08-16	Brazil	Presentation of the "Programa Nacional Telessaúde Brasil Redes"
RGQ2/31	2018-08-16	OrangeTechLab Inc. (Japan)	Resilient health care by IT support

(continued)

Web	Received	Source	Title
RGQ2/27 +Ann.1	2018-08-15	Japan	Long-term effect of telecare intervention on patients with chronic diseases
RGQ2/24	2018-08-14	Benin	Start-ups as a motor of sustainable socio-economic development in the creation of smart cities and societies and e-health
RGQ2/23	2018-08-14	Japan	AED remote monitoring system linked with wireless public networks
RGQ2/22 +Ann.1	2018-08-12	Tokai University; Melody International Ltd (Japan)	Providing safe and secure deliveries for expectant mothers' health care using ICTs - Perinatal eHealth platform called "Melody-i" for rural and remote areas
RGQ2/21	2018-08-10	Dominic Foundation (Switzerland)	E-health Academy
2/94	2018-04-26	BDT Focal Point for Question 2/2	Digital Health Platform: a foundation for scaling up integrated digital health applications
2/86	2018-04-23	Tokai University (Japan)	Bird-to-Bird packet communication using wireless token rings
2/51	2018-03-21	China	Application of blockchain in the field of digital health
2/43	2018-03-06	A.S. Popov Odessa National Academy of Telecommunications (Ukraine)	Series of specialized multimedia training courses on e-health

Incoming liaison statements for Question 2/2

Web	Received	Source	Title
2/421	2021-03-15	ITU-R Working Party 5D	Liaison statement from ITU-R Working Party 5D to ITU-D Study Group 2 Question 2/2 on telecommunications/ICTs for e-health
2/358	2020-11-03	ITU-R Working Party 4B	Liaison statement from ITU-R Working Party 4B to ITU-D SG2 Q2/2 on telecommunications/ICTs for eHealth
2/356	2020-10-21	ITU-R Working Party 5D	Liaison statement from ITU-R Working Party 5D to ITU-D SG2 Q2/2 on telecommunications/ICTs for e-Health
RGQ2/210 +Ann.1	2020-07-13	ITU-R Working Party 5D	Liaison statement from ITU-R Working Party 5D to ITU-D SG2 Q2/2 on telecommunications/ICTs for e-Health
RGQ2/208	2020-06-04	ITU-R Working Party 4B	Liaison statement from ITU-R Working Party 4B to ITU-D SG2 Q2/2 on ambulance communications
RGQ2/116 +Ann.1-2	2019-05-29	ITU-T Study Group 20	Liaison statement from ITU-T SG20 to ITU-D SG1 and SG2 on ITU inter-sector coordination
RGQ2/114 +Ann.1-2	2019-06-12	ITU-T Study Group 5	Liaison statement from ITU-T SG5 to ITU-D SG1 and SG2 on ITU inter-sector coordination
2/138 +Ann.1	2019-01-16	ITU-T Study Group 20	Liaison statement from ITU-T SG20 to ITU-D SG2 Q2/2 on the invitation from ITU-D SG2 to collaborate on relevant topics of e-health
RGQ2/TD/9	2018-10-01	ITU-R study groups - Working Party 7B	Liaison statement from ITU-R WP7B to ITU-D SG2 Q2/2 on contribution concerning Bird-to-Bird packet communication
RGQ2/8	2018-07-02	ITU-R study groups - Working Party 1B	Liaison statement from ITU-R WP 1B to ITU-D SG2 Q2/2 on the contribution concerning Bird-to-Bird packet communication
RGQ2/5	2018-06-01	ITU-R Working Party 5A	Liaison Statement from ITU-R WP5A to ITU-D SG2 Q2/2 on the contribution concerning Bird-to-Bird packet communication
2/25	2017-11-24	ITU-T Study Group 20	Liaison Statement from ITU-T SG20 to ITU-D SG2 Question 2/2 on Final Report for ITU-D SG2 Q2/2 (eHealth)
2/21	2017-11-24	ITU-T Study Group 20	Liaison Statement from ITU-T SG20 to ITU-D SG2 Question 2/2 on collaboration on eHealth

Office of the Director
International Telecommunication Union (ITU)
Telecommunication Development Bureau (BDT)
Place des Nations
CH-1211 Geneva 20
Switzerland

Email: bdtdirector@itu.int
Tel.: +41 22 730 5035/5435
Fax: +41 22 730 5484

Office of Deputy Director and Regional Presence
Field Operations Coordination Department (DDR)
Place des Nations
CH-1211 Geneva 20
Switzerland

Email: bdtdeputydir@itu.int
Tel.: +41 22 730 5131
Fax: +41 22 730 5484

Digital Networks and Society (DNS)

Email: bdt-dns@itu.int
Tel.: +41 22 730 5421
Fax: +41 22 730 5484

Digital Knowledge Hub Department (DKH)
Email: bdt-dkh@itu.int
Tel.: +41 22 730 5900
Fax: +41 22 730 5484

Partnerships for Digital Development Department (PDD)
Email: bdt-pdd@itu.int
Tel.: +41 22 730 5447
Fax: +41 22 730 5484

Africa

Ethiopia

International Telecommunication Union (ITU) Regional Office
Gambia Road
Leghar Ethio Telecom Bldg. 3rd floor
P.O. Box 60 005
Addis Ababa
Ethiopia

Email: itu-ro-africa@itu.int
Tel.: +251 11 551 4977
Tel.: +251 11 551 4855
Tel.: +251 11 551 8328
Fax: +251 11 551 7299

Cameroon

Union internationale des télécommunications (UIT)
Bureau de zone
Immeuble CAMPOST, 3e étage
Boulevard du 20 mai
Boîte postale 11017
Yaoundé
Cameroon

Email: itu-yaounde@itu.int
Tel.: + 237 22 22 9292
Tel.: + 237 22 22 9291
Fax: + 237 22 22 9297

Senegal

Union internationale des télécommunications (UIT)
Bureau de zone
8, Route des Almadies
Immeuble Rokhaya, 3e étage
Boîte postale 29471
Dakar - Yoff
Senegal

Email: itu-dakar@itu.int
Tel.: +221 33 859 7010
Tel.: +221 33 859 7021
Fax: +221 33 868 6386

Zimbabwe

International Telecommunication Union (ITU) Area Office
TelOne Centre for Learning
Corner Samora Machel and Hampton Road
P.O. Box BE 792
Belvedere Harare
Zimbabwe

Email: itu-harare@itu.int
Tel.: +263 4 77 5939
Tel.: +263 4 77 5941
Fax: +263 4 77 1257

Americas

Brazil

União Internacional de Telecomunicações (UIT)
Escritório Regional
SAUS Quadra 6 Ed. Luis Eduardo Magalhães,
Bloco "E", 10º andar, Ala Sul
(Anatel)
CEP 70070-940 Brasilia - DF
Brazil

Email: itubrasilia@itu.int
Tel.: +55 61 2312 2730-1
Tel.: +55 61 2312 2733-5
Fax: +55 61 2312 2738

Barbados

International Telecommunication Union (ITU) Area Office
United Nations House
Marine Gardens
Hastings, Christ Church
P.O. Box 1047
Bridgetown
Barbados

Email: itubridgetown@itu.int
Tel.: +1 246 431 0343
Fax: +1 246 437 7403

Chile

Unión Internacional de Telecomunicaciones (UIT)
Oficina de Representación de Área
Merced 753, Piso 4
Santiago de Chile
Chile

Email: itusantiago@itu.int
Tel.: +56 2 632 6134/6147
Fax: +56 2 632 6154

Honduras

Unión Internacional de Telecomunicaciones (UIT)
Oficina de Representación de Área
Colonia Altos de Miramontes
Calle principal, Edificio No. 1583
Frente a Santos y Cía
Apartado Postal 976
Tegucigalpa
Honduras

Email: itutegucigalpa@itu.int
Tel.: +504 2235 5470
Fax: +504 2235 5471

Arab States

Egypt

International Telecommunication Union (ITU) Regional Office
Smart Village, Building B 147,
3rd floor
Km 28 Cairo
Alexandria Desert Road
Giza Governorate
Cairo
Egypt

Email: itu-ro-arabstates@itu.int
Tel.: +202 3537 1777
Fax: +202 3537 1888

Asia-Pacific

Thailand

International Telecommunication Union (ITU) Regional Office
Thailand Post Training Center
5th floor
111 Chaengwattana Road
Laksi
Bangkok 10210
Thailand

Mailing address:
P.O. Box 178, Laksi Post Office
Laksi, Bangkok 10210, Thailand

Email: ituasiapacificregion@itu.int
Tel.: +66 2 575 0055
Fax: +66 2 575 3507

Indonesia

International Telecommunication Union (ITU) Area Office
Sapta Pesona Building
13th floor
JI. Merdan Merdeka Barat No. 17
Jakarta 10110
Indonesia

Mailing address:
c/o UNDP – P.O. Box 2338
Jakarta 10110, Indonesia

Email: ituasiapacificregion@itu.int
Tel.: +62 21 381 3572
Tel.: +62 21 380 2322/2324
Fax: +62 21 389 5521

CIS

Russian Federation

International Telecommunication Union (ITU) Regional Office
4, Building 1
Sergiy Radonezhsky Str.
Moscow 105120
Russian Federation

Email: itumoscow@itu.int
Tel.: +7 495 926 6070

Europe

Switzerland

International Telecommunication Union (ITU) Office for Europe
Place des Nations
CH-1211 Geneva 20
Switzerland
Email: eurregion@itu.int
Tel.: +41 22 730 5467
Fax: +41 22 730 5484

International Telecommunication Union
Telecommunication Development Bureau
Place des Nations
CH-1211 Geneva 20
Switzerland

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