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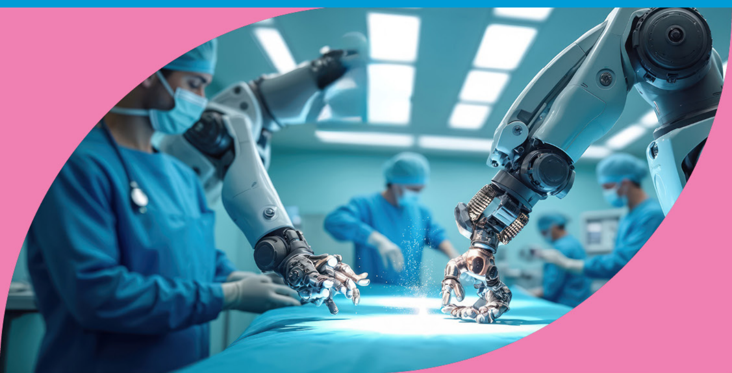
Output Report on ITU-D Question 2/2

Enabling technologies for e-services and applications, including e-health and e-education

Study period 2022-2025



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Enabling technologies for e-services and applications, including e-health and e-education: Output Report on ITU-D Question 2/2 for the study period 2022-2025

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The study groups of the International Telecommunication Union Telecommunication Development Sector (ITU-D) provide a neutral platform where experts from governments, industry, telecommunication organizations and academia from around the world gather to produce practical tools and resources to address development issues. To that end, the two ITU-D study groups are responsible for developing reports, guidelines and recommendations based on input received from the membership. Questions for study are decided every four years by the World Telecommunication Development Conference (WTDC). The ITU membership, assembled at WTDC-22 in Kigali in June 2022, agreed that, for the period 2022-2025, Study Group 2 would deal with seven Questions within the overall scope of digital transformation.

This report was prepared in response to Question 2/2: **Enabling technologies for e-services and applications, including e-health and e-education**, under the overall guidance and coordination of the management team of ITU-D Study Group 2 led by Mr Fadel Digham (Arab Republic of Egypt), as Chair, supported by the following Vice-Chairs: Mr Abdelaziz Alzarooni (United Arab Emirates), Ms Zainab Ardo (Federal Republic of Nigeria), Mr Javokhir Aripov (Republic of Uzbekistan), Ms Carmen-Mădălina Clapon (Romania), Mr Mushfig Guluyev (Republic of Azerbaijan), Mr Hideo Imanaka (Japan), Ms Mina Seonmin Jun (Republic of Korea), Mr Mohamed Lamine Minthe (Republic of Guinea), Mr Víctor Antonio Martínez Sánchez (Republic of Paraguay), Ms Alina Modan (Romania),[1] Mr Diyor Rajabov (Republic of Uzbekistan),[1] Mr Tongning Wu (People's Republic of China), and Mr Dominique Würges (France).

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[1] Stepped down during the study period.

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Executive summary

According to the International Telecommunication Union (ITU), mobile communication network coverage extends to 97 per cent of the world's population, and at least 93 per cent of people have access to third generation (3G) or higher broadband services. However, only about half (53 per cent) of the world's population (4.1 billion people) actually uses mobile communication networks, leaving the remaining 3.6 billion unable to access the benefits of globally deployed communication and information technologies. In 47 developing countries, 80 per cent of the population remains unconnected, and the gap is widening even among developing countries with some countries having an Internet usage rate of only two per cent in extreme cases. Given this context, Q2/2 has focused on how to promote the adoption of applications on communication networks, specifically e-services.

The COVID-19 pandemic resulted in unprecedented lockdowns around the world, forcing hundreds of millions of office workers to work from home and halting business trips for millions of companies, customers and partners. Children were required to leave their schools and classrooms to stay at home while hospitals had to prioritize COVID-19 patients and seek alternative solutions for those with other medical conditions. E-services were at the core of the pandemic response. For example, health authorities developed mobile applications for COVID-19 contact tracing and used mobile networks to provide remote consultations on telemedicine platforms. Mobile networks were also used to deliver financial assistance to the most vulnerable and to provide education to those who did not have computers. Even in the post-pandemic society, information communication technology (ICT) services continue to be indispensable in connecting people.

Over the past four years, significant technological advancements have taken place. Fifth generation (5G) mobile phone services have become widespread worldwide and low earth orbit (LEO) satellite constellation networks have made it possible to transmit high-definition images with low latency at speeds of 200 Mbit/s on a global scale. Until recently, remote medical care focused on "diagnostic support", but, as described in this Report, remote robotic surgery using high-definition video images with low latency is now being used to perform certain operations.

Furthermore, the emergence of deep learning has dramatically improved the performance of artificial intelligence (AI), such as improving image matching capabilities using convolutional neural networks (CNN) and forward prediction of linear waveforms using recurrent neural networks (RNN). When this AI technology is linked with communication technology and when data can be reused across borders, it will bring great benefits to humanity in various fields such as data and insights on past patients and drug effects. AI and drug discovery, AI and voice recognition, and AI-related standardization in ITU-T SG21 Question 2[2] are introduced in this report.

[2] See the terms of reference of ITU-T SG21 Question 2/21 (Study Period 2025-2028).

The conversational AI "ChatGPT", released by OpenAI in 2022, is a type of "generative AI" capable of autonomously searching online data such as text, image and voice data, and of generating new content based on user input. In addition to standardizing communication technologies, enabling cross-border data reuse will require ensuring the protection of original data rights and establishing clear frameworks. These topics are also discussed in this Report.

These developments will have a major impact not only on developed countries but also on developing countries, and the discussions in Q2/2 on user-oriented applications and e-services will play an extremely important role.

Abbreviations and acronyms

Abbreviation	Term
5G	fifth generation mobile technology[3]
ABDM	Ayushman Bharat Digital Mission
ACR	American College of Radiology
AI	artificial intelligence
ARCO	Action Research for Co-Development
BDT	Telecommunication Development Bureau
CDA	clinical document architecture
CT	computed tomography
DICOM	digital imaging and communications in medicine
ECMO	extracorporeal membrane oxygenation
FAR	false acceptance rate
FG-AI4H	Focus Group on Artificial Intelligence for Health
GI-AI4H	Global Initiative on AI for Health
HER-SYS	health centre real-time information-sharing system on COVID-19
HL7	Health Level Seven
ICT	information and communication technology
ITU-D	ITU Telecommunication Development Sector
ITU-R	ITU Radiocommunication Sector
ITU-T	ITU Telecommunication Standardization Sector
JAM	JanDhan, Aadhar, Mobile
LEO	low Earth orbit
M2M	machine-to-machine
MEO	medium Earth orbit
MERIT-9	medical record, image, text, information exchange

[3] While care was taken in this document to properly use and refer to the official definition of IMT-generations (see Resolution ITU-R 56, "*Naming for International Mobile Telecommunications*"), parts of this document contain material provided by the membership which refers to the frequently used market names "xG". This material cannot necessarily be mapped to a specific IMT-generation, as the underlying criteria from the membership are not known, but in general, IMT-2000, IMT-Advanced, IMT-2020 and IMT-2030 are known as 3G/4G/5G/6G, respectively.

(continued)

Abbreviation	Term
MFS	mobile financial services
ML	machine learning
MML	medical markup language
MRI	magnetic resonance imaging
NCCP	National Cloud Computing Policy
openEHR	open electronic health record
OTT	over-the-top
PaaS	platform as a service
POU	personal health device observation upload
SaaS	software as a service
SDG	sustainable development goal
SG2	Study Group 2
SS-Mix	standardized structured medical record information exchange
UHD	ultra-high definition
WHO	World Health Organization
WTDC	World Telecommunication Development Conference

Chapter 1 – Overview

1.1 M-services

M-services are services that can be accessed through mobile handsets independent of temporal and spatial restraints.

Q2/2 covers applications that use mobile communication circuits and the technologies that support them. Users of m-services use mobile phones, but special applications that connect to communication lines such as 5G are also included. Biometrics for mobile phones is a technology that accurately identifies individuals, and that will have an impact on e-services in general. For example, identity verification using biometric authentication could be an efficient method for validating the identity of a patient receiving medical treatment or medical expenses reimbursement.

1.2 E-services and applications

E-services are online services available over the Internet that enable valid buying and selling (procurement) transactions. E-services are distinct from traditional websites in that on traditional websites only descriptive information is available and no online transaction is possible.

Q2/2 covers e-services from the perspective of communications technology, such as cloud computing networks, and important technological developments employed in e-application services, such as for example, the emergence of blockchain as a digital, distributed, public ledger that exists on a network of computer systems.

1.2.1 E-education

A key issue addressed by the sustainable development goals (SDGs) adopted by the United Nations is that of education and access to education resources. Education is an integral part of any solution to development issues and is essential to the creation of a better society. International organizations, developing countries, and developed countries, have been working to solve the problem of access to education under the slogan "Education for All". E-education using information and communication technology (ICT) is a key example of the type of technology impact that the International Telecommunication Union (ITU) envisions and promotes. E-education is being introduced not only at a basic level, such as for example, in providing primary education resources, but also in various specialized fields with the aim of reducing geographical and time constraints.

1.2.2 E-health

The term e-health refers to a healthcare service that effectively utilizes ICT. E-health has developed from "telemedicine" as an emerging application of face-to-face medical consultations via a communication circuit. E-health is broadly interpreted to mean the use of ICT in the fields of medicine, nursing care and healthcare. As healthcare is generally a public policy challenge with a significant budget in countries around the world, the aim is to use ICT to expand the target population and improve the efficiency of operations. Telemedicine/e-health has been an ongoing topic of discussion (Q6/2, Q14/2) since the 1990s, when ITU-D Study Group 2 (SG2) was launched.

1.2.3 E-government

The simplest form of e-government is the streamlining of administrative processes through the introduction of intranets, the introduction of administrative activities on websites, information disclosure, and the provision of information on administrative services. In a broader sense, it is not necessarily limited to the executive branch but can also include the use of electronic technologies related to the legislative branch, such as electronic voting and citizen legislation. In many developing countries, e-services provided primarily by the government are considered to be a form of e-government. The issue of e-government was previously addressed in SG2 Q17/2.

1.2.4 E-agriculture, e-fisheries

It is expected that future advances in e-agriculture and e-fisheries will be achieved with the development of the global network technology of 5G circuits and low earth orbit (LEO) satellite constellations.

Chapter 2 – E-services and applications

2.1 E-health

2.1.1 Trends in e-health

When SG2 began in 1998, e-health was positioned as one of the most significant research topics and has remained a priority topic over the succeeding 28 years. E-health can be considered the longest-standing topic in SG2 related to applications and services.

The positioning of e-health as an SG2 research topic originated with the identified need for telemedicine that would enable medical professionals to remotely examine patients through low-latency communication networks. In 2002, Resolution 41 (Resolution for e-health) was adopted at WTDC 2002 (Istanbul), and today e-health encompasses a wide range of topics related to healthcare, epidemiology, and public health issues.

During the COVID-19 pandemic, the use of videophone consultations became globally widespread as an efficient way to prevent infections among medical staff. Once a specialized approach, e-health has now become integrated into routine medical practice. Moreover, the social value of e-health has been clearly demonstrated by enabling remote medical care and the communication of vital information to the public through the Internet. Worldwide and in every country, healthcare markets are complex and comprised of a variety of parties. The main players in the market are users of healthcare services, insurers, and healthcare providers. Healthcare providers are a distinctive concept in the healthcare market, encompassing medical institutions as well as those who provide healthcare services, such as hospitals, pharmacies, doctors, pharmacists, and nurses.

Over the past few years, the benefits of e-health have been reported as comprising the increased integration of patient data, improved diagnostic skills attained by medical professionals through the provision of accurate information, improved judgment by patients through online materials, and reduced errors and increased efficiency in the work of healthcare providers. These reported benefits apply not only to developed countries but also to developing countries in general.

Outsourcing of the medical administration of multiple hospitals via the Internet has created significant business opportunities. In the clinical field, e-health technology is widely used not only in internal medicine but also in perinatal medicine, psychiatry, dermatology, and in other healthcare fields. Problematic issues persist however related to the sharing of e-health patient information. The most profitable form of remote imaging diagnosis and treatment involves sexually transmitted diseases, as patients often prefer to keep such matters private from their families. These cases are typically handled as elective care, with patients opting to pay out-of-pocket rather than use insurance coverage. The use of the personal medical information over the Internet could potentially have dramatic consequences for both individuals and medical institutions in cases where for example, hospital servers are hacked, resulting in ransomware demands for payment. The protection of patient information and the important distinction between using an intranet and using the Internet when working with the private medical information of patients needs to be considered. Another issue not to be overlooked is that use of e-health technology can create a serious digital divide for elderly people and those who cannot use the Internet. Overcoming these challenges will require cooperation with and consideration of other study group Questions dealing with these topics.

2.1.2 E-health good practice models

Artificial intelligence (AI) is being used to develop and advance healthcare by improving diagnostics, predicting disease outbreaks, and enhancing patient care. Machine learning (ML) algorithms now analyse vast volumes of medical data to identify patterns and make accurate predictions, enabling early disease detection and personalized treatment.

The ITU released the AI for Good - Innovate for Impact - Final Report 2024,[4] at the AI for Good summit meeting during the World Artificial Intelligence Conference, in July 2024. The report features 53 exemplary cases from 19 countries, selected from over 200 global submissions, all addressing global challenges and means of advancing social welfare.

In the field of healthcare, the report includes cases from China,[5] the United States,[6] United Republic of Tanzania,[7] Kingdom of Cambodia[8] and People's Republic of Bangladesh,[9] showcasing multilingual and multimodal AI models, advanced algorithms, and utilization of computational power to optimize every aspect of healthcare. Specifically, AI empowers healthcare services, alleviating issues such as resource shortages and remote diagnostics. In medical research, AI is used to build clinical data governance capabilities and clinical research indicator systems, supporting data retrieval and processing services. During treatment, AI enhances image planning and intraoperative navigation by employing image recognition and nanosecond pulse technology. In this way AI contributes to the optimizing of treatment plans, improving precision, and increasing efficiency in the therapeutic process.

2.1.2.1 Biometrics-based personal authentication in e-health (India)[10]

India has reported on the Ayushman Bharat Digital Mission (ABDM), that aims to develop the backbone necessary to support a national integrated digital health infrastructure. One feature of the ABDM, is a system called Aadhaar that enables identity authentication based on biometrics. This system was developed due to the fact that while it is difficult to obtain biometric authentication information from landlines without an accessory device at either end, it is relatively simple to authenticate biometrics of individuals from facial photos and fingerprints on mobile phones.

The current expansion of the existing strong public digital infrastructure in India, is aimed at providing a robust e-platform in the healthcare sector. The ADBM seeks to bridge existing gaps among various stakeholders in the healthcare ecosystem through the implementation of digital highways. In India, the existing public digital infrastructure, including that related to Aadhaar (the unique digital biometrics identifier), the unified payments interface, and the wide reach of

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4 ITU-T. AI for Good-Innovate for Impact Final Report. 2024.
5 *Ibid*. Use Case 17: Infervision AI International Hospital. Page 68.
6 *Ibid*. Use Case 37: Multilingual Medical Language Models: A Path to Improving Lay Health Worker Effectiveness. Page 147.
7 *Ibid*. Use Case 22: AI-Rapid TB Diagnosis. Page 87.
8 *Ibid*. Use Case 1: Neak Pean HealthTech - Khmer Telemedicine Chatbot. Page 8.
9 *Ibid*. Use Case 46: Improving early detection of neonatal asphyxia with smartphone-based AI technologies. Page 183.
10 ITU-D SG2 Document 2/108 from India.

Internet and mobile phones (popularly known as the 'JAM trinity' a linking of Jan Dhan bank accounts, Aadhaar identity cards of citizens, and mobile phone numbers of citizens), provided a strong platform for establishing the ABDM. The current ability to digitally identify people, doctors, and health facilities, and to facilitate electronic signatures, ensure non-repudiable contracts, make paperless payments, securely store digital records, and contact individuals, all provide opportunities to streamline healthcare information through digital management. This India case study illustrates the success of a State in providing e-health services to its citizens. It provides an indication of the cumulative effect of the incremental and progressive steps taken by India towards developing a smart digital society.

2.1.2.2 Medicine delivery service using drones (Republic of Rwanda)[11]

The Government of Rwanda is engaged in the deployment of various information technologies and has invested in ICT infrastructure and applications to enable national economic growth and social mobility. This contribution discusses a variety of aspects relating to drone-based delivery of medicines.

In 2016, the Government of Rwanda established a partnership with a drone service provider for the purpose of delivering blood and other medical supplies. The partnership aimed to use drones to rapidly deliver critical medical supplies to remote hospitals, reducing delivery times from hours or even days to minutes. Hospitals would then no longer have to worry about maintaining their supplies of refrigerated blood, medications, or other medical products such as frozen plasma, which require expensive equipment for transport and storage that small, local hospitals and clinics are often unable to afford.

Two drone delivery distribution centres were in operation at Kayonza and Muhanga, which delivered medications to over 400 hospitals and clinics across the provinces. These distribution centres provided hospitals and clinics with the blood, medication, and other supplies they needed within minutes of ordering, enabling them to effectively treat both everyday medical conditions and emergencies.

From the distribution centres, 75 per cent of the country's blood bank deliveries were made outside of the capital city, Kigali. Since the start of operations in 2016, to the time of writing, 167 000 drone deliveries of medical supplies have been carried out in Rwanda.

In 2022, the Ministry of Agriculture delivered more than 500 000 doses of animal health vaccines and more than 8 000 units of swine semen to veterinarians and farmers using drones. Also in 2022, the drone service provider partnership first established in 2016 was revised to expand services and so serve the entire country with instant, innovative and environmentally friendly delivery logistics.

Under the new partnership, Rwanda will triple its delivery volume by adding new drone delivery sites in rural and urban locations throughout the country and by opening a similar service for other state entities.

[11] ITU-D SG2 Document 2/118 from Rwanda.

2.1.2.3 Remote device for expectant mothers (Japan)[12]

Infant and maternal healthcare remains a major issue worldwide, and particularly in developing countries. Today there is increased expectation that new technologies will be able to provide safer, cheaper, and more effective methods to improve foetal health and make pregnancy safer. Melody International Ltd., a Japanese company, has developed a system to address this issue, which comprises a smart mobile foetal monitor that securely monitors maternal and foetal health by transmitting real-time data to healthcare providers' devices from anywhere. The remote foetal monitoring device developed by Melody International Ltd. enables at-home pregnancy health monitoring. The Federative Republic of Brazil became an early adopter of the Melody International Ltd. technology, and today the system is also utilised in Thailand and Kingdom of Bhutan. The device collects foetal heart-rate and uterine contractions data, transmitting it to doctors in real-time for analysis. Now being proposed for introduction into Japanese hospitals, this technology can be used to screen pregnant women, potentially reducing maternal and infant mortality by improving prenatal care globally.

2.1.2.4 Unified state healthcare information system (Russian Federation)[13]

In 2019, the implementation of a national Healthcare project began in the Russian Federation, with a deadline set for the end of 2024. The key aims of this project are to ensure sustainable population growth in the Russian Federation and to increase the life expectancy and quality of life of citizens. The main objectives of the project include:

- the optimization of operations in medical organizations;
- the implementation of innovative medical technologies, including an early diagnosis system and remote patient health monitoring;
- the creation of mechanisms for interaction of medical organizations based on a unified state information system in the field of healthcare.

The total costs for the implementation of the healthcare project amount to RUB 1 725.8 billion, of which RUB 177.6 billion were allocated for the creation of a single digital circuit in healthcare.

Within the framework of the national Healthcare project, eight federal projects were developed, including the project "Creation of a single digital circuit in healthcare based on a unified state information system in the field of healthcare (EGISZ)", which aims to improve the efficiency of the functioning of the healthcare system. The process of implementation of the project includes the creation of mechanisms for interactions between healthcare facilities based on a unified state system, and the introduction of digital technologies and platform solutions by the end of 2024.

As part of the project, an electronic prescription system and a state information system for compulsory medical insurance integrated with the EGISZ system have been created. Additionally, a centralized subsystem "Telemedicine Consultations" has been established to which all state medical organizations and municipal healthcare systems of the Russian Federation are connected.

Following the introduction of ICT services such as "My Health" on a public services portal, the waiting time for specialists will be reduced, the procedure for making an appointment with a doctor will be simplified, and it will be possible to obtain electronic prescriptions. In addition,

[12] ITU-D SG2 Document (workshop presentation) Q2/2-2023-04 from Melody International Ltd.
[13] ITU-D SG2 Document SG2RGQ/168 from Russian Federation.

the automation of workplaces will allow medical workers to serve patients more effectively. All regions of the Russian Federation will be capable of conducting telemedicine consultations.

An electronic card with the results of examinations and tests is made available to each patient. In addition, healthcare providers in accordance with their medical care profile should have access to complete electronic medical records containing information about the results of patients' treatment in medical organizations and including any tests conducted, conclusions and medical specialist appointments, while also being able to access medical images stored in centralized archives.

A system in the patient's personal "My Health" account, hosted on the public services portal, for making electronic appointments with doctors, including preventive medical examinations, vaccinations and planned hospitalization, will be available throughout the Russian Federation by 2025. Medical documents will also be made available to citizens, regardless of the subject, wherever the patient is located in the Russian Federation.

2.1.3 COVID-19

2.1.3.1 Experience with e-health technologies in response to the COVID-19 pandemic (Australia)[14]

This section presents a summary of initiatives by the Government of Australia to enable new and expanded e-health technologies in response to challenges posed by pandemics such as COVID-19 and natural disasters. Specifically, this contribution explores the implementation and effectiveness of two key e-health technologies, electronic prescribing and telehealth in the Australian healthcare system. These technologies rapidly adapted and expanded during the COVID-19 pandemic to support continuity of care and healthcare service delivery. Electronic prescribing proved to be a powerful tool, enabling quick and accurate transmission of prescriptions to pharmacies and ensuring patient access to vital medications despite pandemic related disruptions. Telehealth experienced significant growth during the pandemic and has since become a permanent feature of the Australian Medicare system, reflecting a shift in community expectations. The Government of Australia has recognized the value of digital health technologies in meeting consumer needs and in addressing evolving global health threats. The successful implementation of user-friendly e-health technologies showcased their significant capabilities in ensuring the continuity and effectiveness of healthcare services, particularly during crises such as the COVID-19 pandemic and natural disaster events such as floods and bushfires.

Electronic prescriptions for COVID-19 pandemic

In Australia, the successful implementation of electronic prescribing has been a significant development. In response to the COVID-19 pandemic in 2020, the Government introduced a national initiative for electronic prescribing. This allows healthcare providers to digitally create prescriptions that are then transmitted to the patient's smart phone. The patient can then transmit the prescription to a pharmacy. This enables patients to conveniently access their medications from any pharmacy across Australia. By providing an option for electronic prescriptions, instead of traditional paper prescriptions, this technology improves patient safety,

[14] ITU-D SG2 Document 2/194 from Australia.

streamlines healthcare processes, minimises the risk of dispensing errors, and enhances access to prescription medications.

Electronic prescribing, introduced in May 2020, has been well received:

- As of September 2023, more than 167 million original and repeat electronic prescriptions have been issued by more than 79 000 prescribers, general practitioners (GPs), and nurse practitioners.
- Faster dispensing times associated with electronic prescribing, resulting in workforce and consumer satisfaction.
- Today, more than 98 per cent of the nation's community pharmacies have adopted electronic prescribing.
- Agency research has found 77 per cent of prescribers and 75 per cent of dispensers surveyed who use electronic prescriptions were satisfied with them.
- More than 70 per cent of consumers who have used electronic prescriptions report being highly satisfied with their experience and consistently high numbers of Australians say that they intend to use them.
- Electronic prescribing also has the potential to mitigate fraudulent prescriptions by removing the opportunity for fraudulently handwritten or printed paper prescriptions to be generated, removing concerns related to stolen prescription pads or prescription papers.

In the event of a future pandemic, Australia is well-positioned to leverage electronic prescriptions as a powerful tool against the spread of infection. The Australian healthcare system has demonstrated how electronic prescriptions can enable quick and accurate transmission of prescriptions to pharmacies, ensuring patients have access to vital medications even when physical pharmacy outlets and healthcare services may be disrupted or inaccessible.

The 2023-24 budget announced AUD 111.8 million over four years and AUD 24.2 million ongoing funding to provide electronic prescription delivery infrastructure and services. This will create certainty for the exchange of nearly 300 million Pharmaceutical Benefits Scheme prescriptions each year between clinicians and pharmacists. Through this initiative, Australia can provide uninterrupted access to vital medications for its population whenever and wherever needed.

Telehealth during COVID-19

In Australia, telehealth refers to the use of technology to deliver healthcare services remotely, enabling patients to receive medical consultation and treatment virtually without physically visiting a healthcare facility. Recognising the need to cover the vast geographical territory of Australia, the Government has made significant investments in telehealth, acknowledging its potential to improve access to healthcare in rural and remote areas.

Telehealth was expanded in March 2020 to ensure the safety of patients and healthcare providers during the COVID-19 pandemic. The expansion of telehealth enabled healthcare providers to monitor patients with chronic health conditions remotely, continuing to supply them with their regular medications and issuing referrals and requests for routine testing.

Growth in telehealth use in Australia has been exponential:

- During the COVID-19 pandemic, between March 2020 and July 2022, 118.2 million telehealth services were delivered to 18 million patients and more than 95 000 practitioners used telehealth services.
- Over 85 per cent of people who had a telehealth consultation in 2021-2022 reported they would use a telehealth consultation again if offered.

The COVID-19 pandemic provided the impetus for the significant growth in telehealth usage, and this momentum has been sustained with Australian citizens now using telehealth as a means of taking control of their health journey. Telehealth is now a permanent feature of the Medicare system, recognising the shift in community expectations around engagement between healthcare providers and the people they care for, as well as its value in improving healthcare accessibility.

2.1.3.2 Digital management of COVID-19: screen testing process (Côte d'Ivoire)[15]

1. National plan

As part of efforts in Côte d'Ivoire to combat COVID-19 in 2020, the Ministry of Health and Public Hygiene, under its COVID-19 response plan, launched a comprehensive programme addressing all aspects of the pandemic, from prevention and medical care to post-treatment follow-up. A key component of the programme was a large-scale media campaign centred on digital communication and content. Social media platforms and advertisements across numerous websites were used to share essential information, such as toll-free helplines (100 and 111), contacts to notify of suspected cases, and locations of testing centres. Additionally, mobile apps and official information websites were developed to support these initiatives, including:

- **info-covid19.gouv.ci**

The Government prevention and information website (info-covid19.gouv.ci) provided daily updates on new cases, recoveries, and deaths, along with guidance on barrier measures, official announcements during the crisis, toll-free helplines, and district-level vaccination sites, among other resources. The aim was to keep the local population informed and to contribute to global pandemic statistics.

- **ma santé.ci (*my health*)**

A comprehensive website (ma santé.ci meaning '*my health*') was created offering access to various links, including those related to COVID-19 test results and vaccination certificates, through a dedicated platform. It also provided general information on vaccination, including effectiveness, certification, and validity.

Another aspect of the programme focused on logistics. In Abidjan and in the larger cities in the interior of the country, there were approximately 14 screening and collection centres and sites, as well as 116 rapid intervention teams and a further 6 000 five-person sample collection teams (30 000 sample collector agents) carrying out nasopharyngeal swab sampling. These resources were equipped with connected tablets for recording the data collected.

[15] ITU-D SG2 Document SG2RGQ/39 from Côte d'Ivoire.

2. Data processing process

Once the nasopharyngeal swab samples are collected, the swab sample data is instantly recorded in the system using a connected tablet which generates a registration code. This code is noted on the sample, along the patient's personal details (name, etc.). The sample collector, who has a set of neutral codes pre-printed in the form of QR codes, links the patient's personal details that are encrypted into an eight to ten digit number to one of these QR codes, which becomes the code assigned to the sample, and this QR code is physically given to the patient in the form of a sticker. Using this QR code sticker, patients can consult their results (positive or negative) on the COVID-19 registration website. A confirmation SMS accompanies the results.

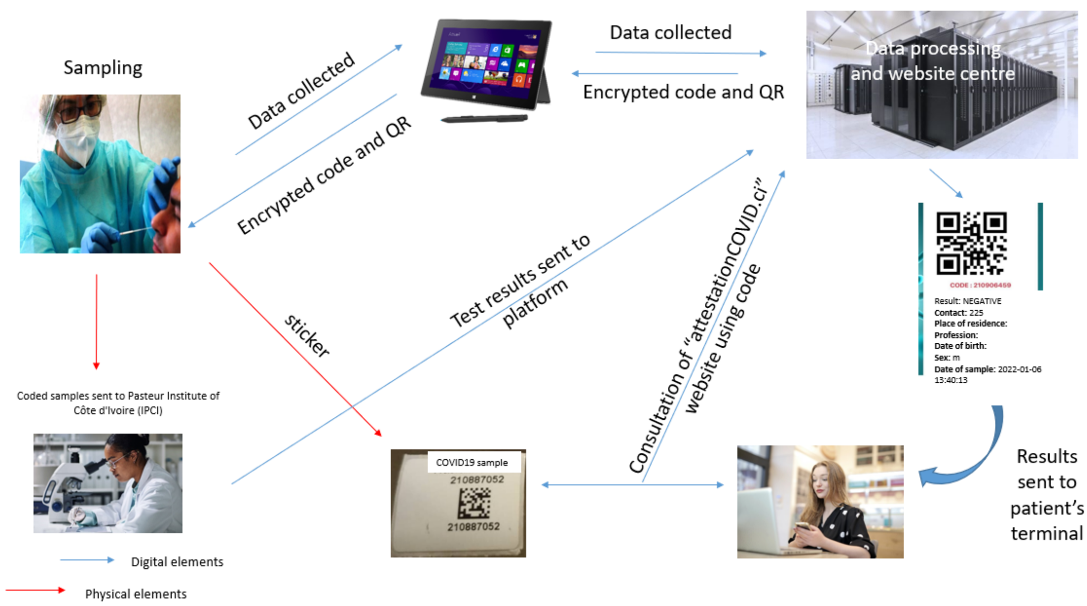
– **Who processes the samples?**

The Pasteur Institute is the reference laboratory in Côte d'Ivoire, and all nasopharyngeal samples collected by the National Institute of Public Hygiene as well as the screening centre results are sent there. Samples are processed by 20 dedicated devices with a maximum capacity of 20 000 tests per day. From 2020 to 2022, approximately 2 000 000 tests were carried out within processing times of 48 to 72 hours. During the period of the appearance of the Omicron variant, testing peaked at 12 000 to 15 000 tests per day.

– **Who processes the computer data?**

Data processing was entrusted to SAH Analytics International, a service provider acting under the supervision of the State, using modern Tier 3 data centres capable of high capacity, fluidity and reliability. SAH Analytics International has its own cloud and guarantees the protection of personal data.

Figure 1: Overview of COVID-19 data processing in Côte d'Ivoire



The COVID-19 pandemic brought numerous digital opportunities to the forefront of public attention, many of which were actively embraced. This was especially true for teleworking, e-services and e-commerce (which is highly developed in Côte d'Ivoire), as well as for e-health. Now that this digital shift to e-health has begun, particularly in Africa where it was still in its early stages, the focus is on sustaining the momentum and seizing the opportunities it presents.

2.2 E-education

2.2.1 Wireless Reach 5G Smart School programme (United States)[16]

This section describes the "Qualcomm Wireless Reach 5G Smart School" programme, recently implemented in Italy in collaboration with various stakeholders that aims to provide schools with next generation wireless technology solutions so that teachers and students can take advantage of digital tools, content, and experiences to enhance learning. Education is a key driver for growth, economic development, and the advancement of societies. The adoption of new tools and cutting-edge technology in the classroom is fundamental to leveraging growth and the creation of a better learning experience. Wireless technologies can bring high-quality educational tools to all communities, regardless of income, status, or location.

The Wireless Reach project aims to transform lives and strengthen communities, with the goal of developing innovative and thoughtful solutions that enable individuals to reach their full potential and enhance the quality of life in communities.

Implementation details:

- **Phase I**: This phase focused on the use of digital tools by introducing teaching methodologies that are optimized for blended learning in the classroom, thereby encouraging students to engage more deeply with content while gaining new digital competencies. In phase I, educators learned how to design courses that would engage their students with activities, tutorials, and short learning modules using techniques such as cooperative learning, gamification, and role play.
- **Phase II**: This phase focused on the creation and introduction of additional science, technology, engineering and mathematics (STEM) specific content and on incorporating virtual reality (VR) headsets into classrooms. Integrating VR into lessons is expected to help students learn faster and retain information more efficiently.
- **Phase III:** Building upon Phases I and II, Phase III focused on expanding access to and effective utilization of virtual reality (VR) technology in the classroom. The original plan had been to incorporate educational robots, but the curriculum offered in Italian was limited, so efforts have been re-directed to expand the use of VR in addition to provision of 5G PCs for teachers and Wi-Fi-enabled Chromebooks for students. Phase III worked with Qualcomm, Inc.'s external evaluation partner, Action Research for Co-Development (ARCO), to assess the qualitative and quantitative impact of the suite of innovative technology solutions on teaching and learning. Phase III also focuses on underserved schools in rural and mountainous regions.
- **Phase IV:** Phase IV, which was scheduled for the 2024-2025 school year, would continue to be implemented in a network of schools across Italy while also expanding into Spain. This phase would enable students to access an outdoor experience-based educational programme aimed at understanding and nurturing mental health, fostering a sense of community, and developing lucrative digital skills. Students and teachers would be supported by a complete set of technologies, including 5G enabled devices such as PCs and tablets, VR headsets, and 360 cameras. Thanks to improved connectivity, including the low latency and high bandwidth of 5G, Phase IV extends digital tools beyond the classroom. This innovation allows students to engage in a more immersive and cooperative learning experience. It also helps students to reflect on challenging subjects such as mental health, in an engaging way while enhancing their technological literacy.

[16] ITU-D SG2 Documents SG2RGQ/65 and SG2RGQ/178 from Qualcomm, Inc.

Collaborators/key players:

- **ARCO** is a university-based organization providing impact evaluations for all phases of the programme.
- **ClassVR/Avantis education** provided 'standalone' (not connected to a computer) virtual reality headsets and content to raise engagement and increase knowledge retention for students of all ages.

Benefits:

- In addition to the 2 000 students and 100 teachers already enrolled across eight schools in Phase I and Phase II, Phase III finalized the process of enrolling an additional 60 classes and 120 teachers from four middle- and high- schools in both urban and rural areas.
- Phase IV will continue scaling across Italy and expanding into Spain with an additional 40 classrooms and 80 teachers.

2.2.2 Initiatives to connect schools in Asia and the Pacific region (ITU)[17]

In Asia and the Pacific region, ITU has been promoting school connectivity through various means. The ITU Regional Office undertook a study to assess the level of school connectivity in Thailand. This study applied a method to collect school connectivity data and so estimate the number of unconnected schools in the country. ITU then implemented a school connectivity project in Republic of Indonesia, funded by the Foreign, Commonwealth and Development Office (FCDO) of the United Kingdom of Great Britain and Northern Ireland. Based on the available school connectivity data and partnerships, the school connectivity project recommended several ways forward to ensure all schools are connected. ITU has also been promoting the Smart Islands and Smart Villages programme, which includes school connectivity as part of the "whole of society" initiative.

2.2.3 Telecommunication/ICT education in medical universities (Russian Federation)[18]

In 2018, a Presidential Decree was signed in the Russian Federation, which approved national projects aimed at developing human capital for the period up to 2024, creating a comfortable living environment and stimulating economic growth. One of the key initiatives of the Presidential Decree was the national "Digital Economy" programme, which was designed to accelerate the introduction of digital technologies in the economic and social spheres.

This national programme comprises several federal projects, among which the "Development of human resources in the IT industry" project is being actively implemented. The goal of this project is to respond to labour market demand for the development of the digital competencies of citizens of the Russian Federation. The project aims to achieve digital maturity in key sectors of the economic and social spheres, including healthcare and education, as well as public administration. The project objectives are expected to be achieved by increasing the numbers of qualified personnel in the IT industry and so maintaining a balance of supply and demand in the labour market.

[17] ITU-D SG2 Document (workshop presentation) Q2/2-2023-01 from ITU BDT.
[18] ITU-D SG2 Document SG2RGQ/169 from Russian Federation.

In 2022, to achieve the goals set within the framework of this project, the implementation of a "Digital Departments" project began in universities with various specializations. Since 2022, one of the key outcomes of the "Digital Departments" project has been that over 278 000 students from participating universities have attained additional qualifications in IT-related fields through specialized programmes offered by the newly established digital departments within their institutions. Students initially select their primary field of study and starting in their second year, they have the option to enrol in an additional programme offered through the digital department. The content of these supplementary programmes is determined by each specific university.

I.M. Sechenov First Moscow State Medical University (Sechenov University) is one of the leading medical universities in the Russian Federation and comprises an extensive educational and scientific complex for the professional training of medical professionals. Sechenov University leads the educational and methodological association of medical and pharmacological universities of the Russian Federation. The university participates in project programmes for development of IT industry human resources, which enabled the creation of a "digital department".

Currently, the university is offering courses for students in the following fields:

- Digital medical services developer: The programme will explore approaches to the development of medical decision support systems as well as applications using AI and means of remote communication between patients and doctors.
- Medical data scientist: Students are trained in the fields of 1) analysis of medical data to identify patterns relevant to clinical practice; 2) creation of databases and visualization tools for medical data; 3) application of machine learning and deep learning methods for analysing medical data; 4) development of client-server systems for storing and processing large medical data.
- Developer of virtual and augmented reality solutions in medicine: The programme covers areas such as 1) development of applications based on virtual and augmented reality for teaching and simulating medical procedures; 2) creation of virtual training tools for doctors and medical personnel; 3) application of virtual reality for the diagnosis and treatment of various types of disorders; 4) development of augmented reality to improve the visualization of medical information and help doctors make decisions.
- DevOps in medicine: The programme allows students to gain theoretical knowledge and practical skills in 1) organization and placement of medical information systems for operation in modern infrastructure; 2) organization of uninterrupted operation of medical information applications; 3) ensuring a guaranteed level of performance; 4) approaches to backup and data integrity.

2.3 E-government

2.3.1 Unified e-government service portal - Hukumati (State of Palestine)[19]

The Government of the State of Palestine aims to accelerate its digital transformation and modernize its administrative services to provide such services electronically and so enhance their efficiency and quality of service for Palestinians everywhere.

[19] ITU-D SG2 Document SG2RGQ/144 from the State of Palestine.
The State of Palestine is not an ITU Member State; the status of the State of Palestine in ITU is the subject of Resolution 99 (Rev. Dubai, 2018) of the ITU Plenipotentiary Conference.

The Ministry of Telecommunications and Information Technology (MTIT) plays a crucial role in coordinating the digitalization and online provision of government services and has launched a project aiming to create an inventory of government services and prioritize their digitalization for more efficient implementation. The goal is to streamline service delivery and so save time, effort and money. This initiative is a cornerstone in the digital transformation of government services. These government services will then be integrated into the unified government services portal known as *Hukumati* (My Government), enabling the online provision of services and electronic payments.

The project focuses on enhancing the delivery of government services by making them more accessible online and specifically aims to:

- increase access to high-speed broadband services; and
- increase access to selected e-services for the public and for commercial enterprise.

In this context, the terms of reference of the current project clearly define its overall objectives as follows:

- conduct an inventory of services and set priorities with a view to establishing a comprehensive list of digital and non-digital government services based on categorization, analysis and legal review, and
- provide recommendations for the operational re-engineering of some government services. This will involve an index list of all government to citizen (G2C), government to business (G2B) or government to government (G2G) services, provided by all government institutions and ministries.

Government services inventory

A comprehensive inventory is to be developed of all current government services, whether G2C, G2B or G2G, from all service providers and ministries by means of posting a questionnaire on the government service inventory website containing clearly defined questions aimed at collecting the necessary service information. The questionnaire refers to detailed information such as:

- the digital infrastructure and capabilities of stakeholders and end users of systems to be developed;
- the existing relevant information systems of the competent authorities responsible for administrative services;
- levels of service delivery and current degree of digitalization;
- conditions/legal requirements/standards/eligibility criteria;
- where to request a service;
- documents required to obtain the service;
- cost (if a paid service);
- time required to obtain the service;
- steps involved in requesting the service (in sequence);
- legislation and laws related to the service;
- other fields.

2.3.2 Debt/Credit Inquiry and Payment/Refund Transactions service (Türkiye)[20]

Electronic communication service subscribers (users) regularly have debts or credits in their accounts for various reasons such as unpaid bills, service cancellation, refund decisions following audits, overcharging by operators or overpayment by subscribers, etc. In order to address this issue, the Information and Communication Technologies Authority (BTK) of Türkiye introduced a regulation in 2014 to enable inquiries, payments and refunds relating to these debts/credits through the Debt/Credit Inquiry and Payment/Refund Transactions service, accessed through the e-Government gateway (eDK) site. According to the regulation, subscribers who log into the eDK using a password, electronic signature, mobile signature, or e-ID card, or through online banking credentials, can access the service. After authentication, the system displays the subscriber's active or inactive subscriptions, and any related debt or credit information by the operator. Through a section listing detailed information, some additional information about their debt or credit information for each subscription is displayed. The page also provides links to the operators' websites where the subscriber can make payments or request refunds.

The Debt/Credit Inquiry and Payment/Refund Transactions service is widely used in Türkiye and was accessed approximately 155 million times in 2022, reaching almost 173 million in 2023. As of 2023, the scope of the service was expanded to cover two new target groups: heirs of deceased subscribers and corporate subscribers.

2.3.3 Enhancing e-government through digital interoperability (Republic of Madagascar)[21]

In 2022, the Government of Madagascar embarked on a significant digital transformation journey to enhance the efficiency and accessibility of public services through the establishment of an interoperability framework. This initiative formed part of a broader e-governance strategy aimed at improving revenue management and facilitating access to public services for both businesses and the general public. The framework enables seamless information sharing among various public administration entities and external users, covering interactions between government departments, businesses and citizens.

Key components of this framework include legal, organizational, semantic and technical interoperability, ensuring that data and services are accessible and usable across different systems and sectors. The Digital Governance Unit, operating under the office of the President, spearheads these efforts, promoting coordinated collaboration across diverse sectors such as justice, health, education and finance. The implementation of digital platforms has led to the development of 11 services, including services for online tax declaration, birth registration with unique identification numbers and a COVID−19 vaccination management portal. These platforms aim to simplify administrative procedures, reduce delays and improve transparency.

[20] ITU-D SG2 Document 2/306 from Türkiye.
[21] ITU-D SG2 Document 2/243 from Madagascar.

2.4 E-tourism and culture

2.4.1 Digital art museum initiative (China)[22]

The Shenzhen Art Museum has embraced digital transformation, evolving from a traditional object-focused institution into a dynamic, people-centred digital art museum. This shift aligns with the strategic vision of Shenzhen to become a cultural and artistic hub, integrating public cultural services into urban development. The museum leverages cutting-edge technologies such as Internet of things (IoT), cloud computing, big data and artificial intelligence (AI) to enhance visitor experiences through smart service, management and protection applications.

Smart service applications include 3D virtual galleries and augmented reality (AR) mobile navigation, offering immersive and interactive experiences. Visitors benefit from diverse services such as group tours, multimedia displays and online education channels. Smart management improves operational efficiency with systems for art collection management, exhibition planning and audience engagement. Advanced digital technologies ensure the preservation and protection of cultural artifacts through high-definition data capture and art authentication systems.

The digital transformation has brought significant economic benefits, boosting art collection funds and promoting Shenzhen's cultural and tourism industries. Socially, the digital transformation has enhanced cultural communication, public education and international exchanges. Looking forward, the Shenzhen Art Museum plans to expand virtual reality experiences and foster global cultural collaborations, positioning itself as a leader in digital art innovation and cultural exchange, and strengthening the cultural influence of Shenzhen worldwide.

2.4.2 Transforming cultural tourism through digital technology integration (China)[23]

The integration of digital technology in cultural tourism is reshaping the way consumers engage with cultural attractions. The fusion of online and offline experiences enables tourists to plan and book their trips seamlessly, enhancing convenience, and meeting diverse consumer needs. Digital platforms such as social media platforms and short online videos increase online visibility for tourist destinations, sparking interest that translates into offline, in-person visits.

Digital technology is unlocking new values in cultural consumption by transforming cultural resources into innovative products such as digital collections and interactive games. These offerings not only capitalize on the intellectual property value of cultural relics but also cater to public demand for culturally rich experiences. Virtual reality (VR) further enriches cultural tourism by providing immersive experiences that blend virtual and real-world interactions, enhancing visitor engagement and satisfaction.

[22] ITU-D SG2 Document 2/175 from China.
[23] ITU-D SG2 Document SG2RGQ/213 from China Mobile Communications Co. Ltd.

Telecommunication operators in China are leveraging 5G, cloud computing and VR technologies to support cultural tourism. The "Enjoy Beijing, Tianjin and Hebei with One Code" platform simplifies tourism consumption, offering comprehensive services and promotional discounts. At the Liangzhu archaeological site, 5G and VR technologies allow visitors to immerse themselves in ancient cultural experiences, boosting the site's historical value and driving tourism consumption. These initiatives demonstrate how digital technology is revolutionizing cultural tourism, creating exciting new avenues for consumer engagement.

Chapter 3 – Global digital e-health policy

3.1 Digital Health Business Case[24]

A Digital Health Business Case provides stakeholders with a comprehensive overview of the potential benefits and costs associated with investing in evidence-based digital health solutions. By synthesizing current evidence on the clinical effectiveness of digital health interventions, a business case can help stakeholders identify which interventions are evidence-based and therefore likely to deliver the desired health outcomes. Moreover, a business case can help stakeholders understand the potential economic impact of digital health interventions, including the potential cost savings that could be achieved through improved health outcomes and increased efficiency of health service delivery.

A Digital Health Business Case is being developed by the United Nations Interagency Task Force (UNIATF) on noncommunicable diseases (NCDs) in collaboration with ITU. This initiative aims to assess the costs and benefits of implementing digital health solutions for noncommunicable diseases in order to provide policymakers with compelling economic arguments for investing in evidence-based e-health services. The Digital Health Business Case is being developed to promote the application of relevant digital health solutions to prevent and control NCDs, address common NCD risk factors (e.g. tobacco use, unhealthy diets, physical inactivity, etc.), and support mental healthcare provision, as well as to improve universal health coverage (UHC). The business case will review and assess existing evidence-based digital health solutions, the key enabling factors and the cost-effectiveness of implementing and scaling-up various digital health interventions, how they impact health, social and economic outcomes, and what return-on-investment they will provide.

In response to requests from various countries, the Digital Health Business Case also includes country-tailored modules for national investment cases. These modules are designed to assist nations in implementing and scaling digital health solutions effectively.

Approach

The development of the Digital Health Business Case and corresponding country-tailored modules involves the following steps:

1. Desk research (literature review) and stakeholder consultations (including academia, digital health companies, governments and non-governmental organisations) to gather systematic data on the implementation of digital health solutions including enabling factors, impacts and costs:
   - Identify key cost-effective digital health solutions that have proved their workability in low- and middle-income countries and ways to scale up those solutions in other environments
   - Develop targeted digital health product recommendations ("best buys") to build or buy given the current portfolio and overall digital vision and goals.

[24] ITU-D SG2 Documents SG2RGQ/75 and 2/205 from ITU BDT.

2. Develop a set of case studies to demonstrate the implementation and efficiency of digital health solutions.
3. Develop a business case report that outlines a clear, compelling and evidence-based theory of change, focusing on the ways in which digital solutions may contribute to advancing the NCDs, mental health and UHC agenda.
4. Develop an economic modelling methodology for digital health intervention modules for national investment cases to quantify the economic costs, efficiency and return-on-investment of digital health interventions on a country level.
   - Utilize a costing model to effectively estimate the investments required for implementation and scaling-up of cost-effective digital solutions, including in resource-constrained environments
   - Compare the health, social and economic benefits of different digital health interventions among various population/patient groups, with different levels of coverage.
   - Develop national data collection spreadsheets.

Relevance

In addition to providing a practical synthesis of current evidence, a Digital Health Business Case can also provide arguments that health sector stakeholders can use to advocate for investment in digital health solutions. By clearly articulating the benefits and costs associated with investing in digital health, a business case can help stakeholders build a compelling case for investment and demonstrate the potential value that digital health solutions can bring to their health systems. Ultimately, a Digital Health Business Case can help to ensure that limited health sector resources are directed towards evidence-based solutions that have the potential to deliver significant benefits to patients, health workers and healthcare systems.

Work conducted to date

Extensive desk research (literature review) and stakeholder consultations have been conducted to assess the existing evidence on the clinical effectiveness of digital health interventions in addressing common NCDs and mental health conditions. More than 400 research publications and reports have been reviewed. Interviews with more than 50 stakeholders have been conducted, including public institutions, private companies, United Nations agencies, non-governmental organizations, research organizations and people with lived experiences.

Four digital health intervention categories have been identified for in-depth analysis: mobile messaging interventions, telemedicine, chatbots and electronic health records. The evaluation and analysis of evidence is ongoing.

Preliminary results indicate that investing in the implementation and scaling-up of selected digital health interventions for disease prevention and management can generate significant positive returns over a medium-term period. However, the analysis has also identified some important gaps in research.

While recent advances in research have led to a better understanding of the clinical effectiveness of some digital health solutions, there are still important gaps in scientific evidence. Available meta-analysis and systematic reviews are characterized by the high heterogeneity of intervention designs, which often limits the general applicability of findings. Additionally, the lack of data on digital health intervention implementation costs is a significant barrier to cost-benefit analysis.

Most of the available evidence on the clinical effectiveness of digital health interventions comes from high- and upper-middle-income countries, highlighting the need for more research involving populations from low- and middle-income countries. It is also important to note that appropriate legal and regulatory environments, including clear laws, standards and multi-stakeholder collaboration frameworks, are crucial for the successful implementation of digital health solutions. This is a prominent and recurrent theme emphasized by both the literature and interviewed stakeholders.

3.2 National e-health strategies

3.2.1 National E-health Strategy Toolkit (WHO, ITU)[25]

With few exceptions, national e-health strategies are the pivotal tools upon which the launch or refocusing of national e-health programmes is hinged. The process of their development needs cross-sector ministerial commitment led by the Ministry of Health. Yet countries often grapple with the task of strategy development and best efforts frequently fail to address strategic components of e-health to ensure successful implementation and stakeholder engagement. These challenges can result in strategies that are narrowly focused with an overemphasis placed on achieving technical outcomes. Without a clear link to a broader vision of health system development and a firm commitment from partners, the ability of a strategy to shape the development of a national e-health framework will be undermined and crucial momentum for implementation will be lost. The World Health Organization (WHO) and ITU have sought to address this issue through the development of the National E-health Strategy Toolkit that provides a basis for the components and processes to be considered in a strategy development or refocusing exercise.

One of the key objectives of the World Health Organization global strategy on digital health for 2020-2025 is to advance the implementation of national digital health strategies[26] and to stimulate and support every country to own, adapt and strengthen its strategy on digital health in a way that best suits its vision, national context, health situation and trends, available resources and core values.

3.2.2 Transforming health systems through digital innovation (Republic of Cameroon)[27]

Cameroon is undertaking an initiative to transform its health sector through digital technologies. The National Digital Health Strategic Plan 2020-2024 is designed to leverage information and communication technology (ICT) to advance universal health coverage and meet sustainable development goals (SDGs). By 2024, the plan aims to improve governance, legal frameworks, human resources, investment, services, infrastructure and interoperability within digital health. A national committee for digital health supervision has been established to prioritize leadership and governance. Legal enhancements are focused on creating a conducive environment for partnerships and ensuring compliance with standards. Investment strategies include mobilizing national resources and establishing a digital health fund. Health service improvements target

[25] Clayton Hamilton. WHO. The WHO-ITU national e-health strategy toolkit as an effective approach to national strategy development and implementation. Proceedings of the 14th World Congress on Medical and Health Informatics, Volume 192, Pages 913-916, 2013.

[26] World Health Organization. Global strategy on digital health 2020-2025.

[27] ITU-D SG2 Document 2/109 from Cameroon.

telemedicine and mobile applications, while infrastructure development aims to enhance data sharing capabilities. Interoperability challenges underscore the necessity for a common language for data exchange, crucial for effective health data management. The architecture incorporates business, data, applications and technology components to optimize health service delivery. Cameroon is actively addressing challenges such as software interoperability and organizational readiness, demonstrating commitment to enhancing its digital health infrastructure.

3.2.3 Advancing digital health transformation through strategic ICT integration (Republic of Chad)[28, 29]

The Ministry of Telecommunications and the Digital Economy of Chad has launched a strategic plan for digital transformation, aiming to make ICT a cornerstone of national development. A key focus of the plan is e-government initiatives, particularly in the health sector, to meet SDG 3 aims "to ensure healthy lives and promote well-being for all, at all ages." The strategy emphasizes strengthening of critical infrastructure in domains such as health, education and telecommunications. E-health initiatives are crucial for improving healthcare quality, with telemedicine playing a pivotal role. A pilot project launched in 2023, implemented telemedicine units across four cities, enhancing healthcare delivery through digital consultations and real-time diagnostics. This initiative is supported by a national e-health programme and aligns with the strategic health plan for 2024-28. The project comprises trained specialists and support staff, utilizing cutting-edge ICT tools to reduce consultation times and improve healthcare outcomes. Expanding telemedicine to refugee camps is also part of the strategy, aiming to provide equitable access to quality healthcare.

Since 2023, efforts have expanded telemedicine hubs from four to eight hubs, further strengthening the digital health infrastructure in Chad. The integration of digital medical terminals facilitates remote consultations, allowing rapid diagnosis and treatment of severe illnesses, significantly enhancing care quality and reducing consultation waiting times. Additionally, digitalization of health services and community healthcare through specialized applications is underway, streamlining healthcare delivery and strengthening technical capacity. Distance education initiatives aim to address the shortage of specialized medical personnel, with training sessions enhancing the skills of healthcare staff and embracing telemedicine tools.

[28] ITU-D SG2 Document SG2RGQ/108 from Chad.
[29] ITU-D SG2 Document 2/369 from Chad.

Chapter 4 – Standardization of e-health

This chapter presents United Nations trends in international standardization related to the communication and exchange of medical information.

Medical information

Interoperability between systems is impossible without a standard unless one party is fixed. Standards widely used in the medical field include the digital imaging and communications in medicine (DICOM) standard for medical images and the health level seven (HL7) standard for non-medical image information. The final report of the Standard Electronic Medical Record Promotion Committee members recommends the HL7 v.2.5 DICOM data format, and the recommended document format is HL7 clinical document architecture release 2 (CDA R2).

Integrating the Healthcare Enterprise (IHE)

Sponsored mainly by the Radiological Society of North America and the Japan Medical Information and Management Systems Society (HIMSS), the Integrating the Healthcare Enterprise (IHE) was established in 1999 and has evolved as a guideline for sharing information systems within medical institutions.

The IHE initiative aims to improve the capacity of computer information systems used in healthcare to share medical information. IHE supports the interoperability of DICOM and HL7. In 2004, the organization was joined by the American College of Cardiology (ACC), and today there are also branches in Asia and Europe.

DICOM

Digital imaging and communications in medicine (DICOM) is a standard developed by the American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA). DICOM defines the format of medical images obtained with computerized tomography (CT), magnetic resonance imaging (MRI), or computed radiography (CR), etc., and also defines the communication protocol between the medical imaging devices that handle these images. The ACR and NEMA organizations established ACR-NEMA Ver.1 in 1985. A standard format for radiological images was established, enabling the exchange of images between different vendors. However, the image format standard alone was not enough and it was necessary to establish communication between different devices. In 1988, a standard that included a communication standard called ACR-NEMA Ver. 2 was established. By that time, communication between devices via a network had also become possible, and the procedures in ACR-NEMA Ver. 2, which assumed communication only between local devices, had become outdated. The DICOM standard was established based on ACR-NEMA Ver. 2 and included communication between multiple devices on a network.

HL7

HL7 was established in the United States in 1987 and is a set of standards for exchanging electronic health information between software applications used by healthcare organizations. HL7 handles various information exchange types, including information concerning patient management, orders, inquiries, finances, laboratory reports, master files, reservations, patient referrals, patient care, laboratory automation and application/personnel management. HL7 is derived from OSI layer 7 protocol for exchanging information in healthcare systems. HL7 defines a protocol for data exchange. It also defines the format and the content of the messages that applications must use when exchanging data in various circumstances.

Continua Health Alliance

The Continua Health Alliance was established in the United States by Intel with the goal of promoting the digitalization of health and medical devices and of standardizing communication standards in order to improve the quality of personal healthcare. Companies from a wide spectrum of fields have joined the organization, ranging from medical device vendors such as Hitachi and Toshiba, to technology vendors such as Panasonic and Omron. Computing companies such as IBM, Dell, Texas Instruments, General Electric, Cisco, Google and Oracle also participate, and currently more than 240 companies worldwide are involved. Continua Health Alliance has established design guidelines that enable the interchangeability of data between different vendors. In recent years, blood pressure monitors and body composition monitors labelled Continua compliant have been commercially available to the public, and personal health data can now be sent from these devices to a health management database on the network, via a smartphone or other device.

openEHR

openEHR is an open-source software based on lifelong electronic health record (EHR) technology that provides the implementation standard behind the ISO 13606-1 standard. Essentially, openEHR is a virtual community that aims to achieve interoperability and compatibility in e-health.

ISO/TR 20514 describes a pragmatic classification of electronic health records, provides simple definitions for the main categories of EHR and provides supporting descriptions of the characteristics of electronic health records and record systems. The openEHR software complies with the integrated care EHR system that allows care givers, care delivery organizations, medical research and public health authorities access, under rules defined by the patient, to a patient's lifelong health information which is stored in a cloud of information sites. The integrated care EHR system:

- accumulates health information in a computer-processable format;
- securely transmits and stores it, and allows access by multiple authenticated users;
- is generally recognized as a logical information model independent of the EHR system; and
- provides continuous high-quality support to improve the efficiency of integrated health and medical care that accumulates past, present and future information. Currently, Ocean Informatics is in charge of the platform based on openEHR.

Standards related to medical record reports

Established standards related to medical record reports include:

- **Standardized structured medical record information exchange (SS-MIX)** was originally known as the medical record, image, text, information exchange (MERIT-9). MERIT-9 was established as an operational guideline for various standards for the exchange of patient information between medical facilities and has been implemented in medical record reports, outsourced test requests/result reports, etc.
- **J-MIX** is a Japanese set of identifiers for medical record information exchange (MIX).
- **Medical markup language (MML)** is a standard designed to ensure the correct exchange of medical data between different medical institutions with electronic medical record systems. Discussions on the formulation of MML standards began in 1995 and led to the launch of the MedXML Consortium. The MedXML Consortium works to maintain and disseminate the MML standard.

International telecommunication standards relative to e-health

Numerous e-health standards exist today. For more information, please refer to the Final Report on ITU-D Study Group 2 Question 2/2 for the study period 2018-2021.[30]

4.1 E-health standardization in ITU-T

Standardization related to e-health is carried out by the ITU Telecommunication Standardization Sector (ITU-T), which conducts studies and issues Recommendations. Currently, e-health standardization is considered in ITU-T SG21 Question 2 (Question 2/21: Multimedia framework for digital health applications), and e-health standardization was previously discussed in ITU-T SG16 Q28. The aim is to develop e-health applications in fields such as telemedicine using information and communication technology (ICT). ITU-T focuses on the standardization of ICT multimedia systems that support e-health applications and specifically on the realization of interoperability between devices and cost reductions.

Applications linked to multimedia systems, standardization of sleep monitoring and standardization of voice transmission were some of the e-health technologies presented in Q2/2 workshops.[31]

Machine-to-machine (M2M) communication is considered to be a key enabler of applications and services across a broad range of vertical markets including that of healthcare. The Focus Group on the M2M service layer (FG M2M) was established and focused initially on the healthcare market and on application programming interfaces (APIs) and protocols supporting e-health applications and services. FG M2M drafted technical reports in these areas and issues related to e-health were organized.[32]

30 ITU. Final Report on ITU-D Study Group 2 Question 2/2 for the study period 2018-2021. Telecommunications/information and communication technologies for e-health. 2021.
31 ITU-D SG2 Documents (workshop presentations) Q2/2-2023-05 from the Republic of Korea, and Q2/2-2024-02 from Keio University & ITU-T Q28/16.
32 ITU. Focus Group on M2M Service Layer. 2012-2013.

4.1.1 Recent ITU-T Recommendations for e-health

Standardization for e-health and digital health is conducted by Question 2 of ITU-T Study Group 21 (previously Question 28 of SG16). Study Group 21 is concerned with multimedia applications and services such as telemedicine, telehealth, e-health and digital health (See Annex 2 for more information on ITU-T publications related to the mandate of ITU-D Question 2/2).

As a foundational topic, frameworks for telemedicine and telehealth systems are continuously discussed. The experience of the COVID-19 pandemic has resulted in a number of ITU-T Recommendations on the use of e-health technologies for emergency situations. Other major topics among recent ITU-T Recommendations include artificial intelligence (AI) and machine learning (ML) for digital health, digital health data in occupational settings, and brain data exchange in the context of e-health. The use of ultra-high definition (UHD) imaging in telemedicine is also a recent trend and may lead to the future use of metaverse and immersive media in telemedicine.

ITU-T collaboration with the World Health Organization (WHO) focuses on digital health and preventive care. ITU-T has been working with WHO on developing standards on several topics in e-health and have also been collaborating on developing standards in preventive care and universal health coverage (UHC). Other recent joint work items concern the use of artificial intelligence (AI) in e-health and further collaboration between ITU-T and WHO is expected in the future.

Recommendations on e-health multimedia systems, services and applications are listed in the ITU-T H-series Recommendations H.800 through H.899.

This section provides a brief summary of recently approved Recommendations, organized into topical clauses for ease of understanding.

4.1.2 Digital health and preventive care: ITU-T collaboration with WHO

ITU-T has been working closely with WHO on developing evidence-based joint standards in the field of preventive care.

The aim if the 2015, WHO initiative "Making Listening Safe" is a world where people of all ages can enjoy recreational listening without risk to their hearing. ITU-T and WHO collaborated on Question 2 of ITU-T Study Group 21 and the first outcome of this collaboration was Recommendation ITU-T H.870 (2018) *Guidelines for safe listening devices/systems*. This Recommendation has since been superseded by ITU-T H.870 (V2) (2022).

A recent addition to the ITU-T H-series of Recommendations is ITU-T H.872 (2024), *Safe listening for video gameplay and esports*, which is aimed at reducing the risk of hearing loss among video game players.

Another product of ITU-T and WHO collaborative development is Recommendation ITU-T F.780.2 (V2) (2023), *Accessibility of telehealth services*, which defines accessibility requirements for technical features in telehealth services.

The scope of each of these ITU-T and WHO collaborative Recommendations is presented in this section.

ITU-T H.870 (V2) (2022), *Guidelines for safe listening devices/systems*

Recommendation ITU-T H.870 (V2) describes the requirements for safe listening devices and systems, called personal/portable audio systems, especially those for playing music, to protect people from hearing loss. It also gives a glossary for common understanding as well as background information on sound, hearing and hearing loss.

ITU-T H.870 (V2) recommends criteria for avoiding unsafe listening: one for adults and another for children, both based on the equal energy principle, which assumes that equal amounts of sound energy cause equal levels of permanent threshold shift, regardless of how the energy is distributed over time.

Importantly, the Recommendation provides guidelines on health communication for safe listening so that appropriate warning messages can be delivered effectively when necessary. Examples of such messages can be found in Appendix VII of the Recommendation.

Finally, the Recommendation also gives information about the implementation of dosimetry and related issues.

Communication devices and assistive devices are excluded from the scope of the Recommendation. Gaming devices are also for future study.

ITU-T H.872 (2024), *Safe listening for video gameplay and esports*

Recommendation ITU-T H.872 is aimed at reducing the risk of hearing loss among video game players. It is aligned with the principles of sound levels, exposure measurement and communication outlined in Recommendation ITU-T H.870.

ITU-T F.780.2 (V2) (2023), *Accessibility of telehealth services*

Recommendation ITU-T F.780.2 defines accessibility requirements for technical features to be used and implemented by governments, health-care providers and manufacturers of telehealth platforms, to facilitate the access and use of telehealth services by persons with disabilities and specific needs, including older persons with age-related disabilities. With the passage of the United Nations Convention on the Rights of Persons with Disabilities in 2006 and its ratification by numerous countries, people with disabilities have the right to enjoy the highest attainable standard of health without discrimination based on disability. Countries need to take all appropriate measures to ensure access to health services for people with disabilities.

During the COVID-19 pandemic, the use of telehealth services increased substantially in many countries and telehealth has become a basic need for the general population, especially for those in quarantine, enabling patients in real-time through contact with healthcare providers to access advice. However, due to the lack of global and comprehensive standards and guidelines for accessibility of telehealth services, many people with disabilities experience difficulties accessing and using such services and are often forgotten.

Recommendation ITU-T F.780.2 (V2) summarizes and defines those requirements and features that industries can implement to ensure accessible provision of telehealth services. Technical requirements defined in the Recommendation are based on comprehensive feedback collected from civil society on barriers that persons with disabilities experience when accessing and using telehealth services, as well as on the feedback from industry.

4.2 Artificial intelligence and machine learning in digital health: ITU–T collaboration with WHO

Artificial intelligence (AI) and machine learning (ML) in digital health is another area where ITU-T and WHO have been working collaboratively to produce Recommendations.

ITU-T F.781.2 (2024), *General framework of quality control of medical images for machine learning applications*

Recommendation ITU-T F.781.1 sets up the initial framework for quality control on medical imaging for machine learning applications, including specifying the workflow of data quality control for machine learning applications, the requirements for medical input images, medical image integration, medical image annotation and criteria on data quality for machine learning applications.

ITU-T F.781.2 (2024), *Quality assessment requirements for artificial intelligence/machine learning-based software as a medical device*

With the advent of artificial intelligence/machine learning (AI/ML) and its strength in faster and more accurate disease detection and diagnosis, a more timely and widespread adoption of decision-making assistant (DMA) software as a medical device (SaMD) could improve health for people. However, this does not mean the AI/ML-based DMA-SaMD for decision-making is ready for the clinic. AI/ML technology can only be used with complete confidence if it has been quality controlled through a rigorous evaluation in a standardized way. Performance and usability shall be assessed under a reliable and rigorous evaluation with a robust method to substantiate AI/ML-based DMA-SaMD quality.

Recommendation ITU-T F.781.2 provides a requirement framework for the quality assessment with a perspective of lifecycle management for AI/ML-based DMA-SaMD. It describes the quality assessment principles and process in the life cycle of AI/ML-based DMA-SaMD, including requirement analysis, data collection, algorithm design, verification and validation, change control and other stages when using AI/ML technology to assist medical staff in making clinical decisions by providing suggestions on diagnostic and treatment activities.

4.3 Digital health data

ITU-T H.862.8 (2025), *Requirements and framework of the occupational health service platform*

Recommendation ITU-T H.862.8 outlines the framework and requirements for the occupational health service platform. This framework aims to enhance data collection, processing, privacy protection and interoperability among data sources and users. The platform supports various occupational health use cases, including monitoring workers' health, informing policy development, and implementing tailored health programmes for workers.

To monitor workers' health and occupational hazards effectively, various Internet of things (IoT) devices can be used to monitor health status and workplace environments. The collected data can be stored in the occupational health service platform to provide occupational health services such as health surveillance, mass immunization, injury management, and mental treatments. A key challenge for the occupational health service platform is providing standardized approaches to manage occupational health data from diverse sources and formats, such as personal health records, health devices, sensors and other platforms.

ITU-T H.861.0 (V2) (2024), *Requirements on communication platform for multimedia brain information*

Recommendation ITU-T H.861.0 (V2) describes a conceptual ecosystem intended to exchange brain data based on communication platform requirements and definitions. Starting from a background of brain data exchange in the context of e-health, a functional framework model for a multimedia brain information platform (MBI-PF) is outlined. This model is then developed into a set of communication platforms which enable both experts and non-experts to utilize brain data for monitoring and maintaining health status of the brain.

4.4 Digital health and telemedicine using ultra-high definition imaging

ITU-T F.780.1 (V3) (2023), *Framework for telemedicine systems using ultra-high definition imaging*

Recommendation ITU-T F.780.1 describes requirements for using ultra-high definition (UHD) imaging, such as 4K and 8K video, for telemedicine. The purpose of these requirements is to use UHD systems for medical practices that use endoscopes and/or microscopes. The Recommendation also describes a list of requirements for using a UHD-based "endoscopic video camera" as a medical device.

In addition, Annex A of the Recommendation describes the requirements for the use of this technology as a medical device.

ITU-T F.780.3 (2022), *Use cases and requirements for ultra-high-definition teleconsulting system*

Recommendation ITU-T F.780.3 describes use cases and technical requirements of an ultra-high-definition (UHD) teleconsulting system. The UHD teleconsulting system is an important application of UHD display technology and ICT in telemedicine and can be utilized to help realize an optimal allocation of medical resources and benefit people in areas with less developed medical resources.

The Recommendation presents the framework, functional requirements and performance requirements of the UHD teleconsulting system, which are the necessary hardware and software foundations for teleconsultation.

Appendix I of the Recommendation presents two applications of the UHD teleconsulting system, the roles of various teleconsulting participants and an outline of the teleconsulting process. The Recommendation is intended for the development, construction and evaluation of UHD teleconsulting systems in different countries and regions.

ITU-T F.780.6 (2025), *Requirements for colourimetry for telemedicine systems using ultra-high definition imaging*

Recommendation ITU-T F.780.6 describes the requirements for the use of colour and colourimetry for telemedicine systems using ultra-high definition imaging. It describes requirements for the light source and test object colours, the camera and transmission, the viewing conditions and display as well as the overall characteristics of the telemedicine system. The Recommendation includes annexes on test colours for medical imaging equipment, measurement methods for the colour capturing accuracy of cameras and a measurement method of the colour reproducibility of electronic displays.

4.5 E-health for emergencies

ITU-T F.760.1 (2022), *Requirements and reference framework for emergency rescue systems*

Recommendation ITU-T F.760.1 describes the application scenarios, functional requirements and reference architecture of pre-hospital emergency rescue and applies these to the planning and design of emergency rescue systems in emergency centres, hospitals and other medical institutions. The appendix to the Recommendation includes some use cases of the proposed reference system.

ITU-T F.780.5 (2024), *Requirements, reference framework and use cases for telemonitoring systems in rapid deployment hospitals*

Recommendation ITU-T F.780.5 describes the application scenarios, functional requirements and reference architecture of telemonitoring systems in rapid deployment hospitals (RDHs), and applies them to planning and design in RDHs. The appendix to the Recommendation includes use cases of the proposed reference system.

4.6 Frameworks for telemedicine systems

ITU-T F.780.4 (2023), *Reference framework, requirements and scenarios for telemedicine systems*

Recommendation ITU-T F.780.4 describes the reference framework, requirements and scenarios of telemedicine systems. A telemedicine system is an important application of ICT in the medical field, especially against a background of unbalanced medical resources, and can realize the optimal allocation of medical resources and benefit people in areas with less developed medical resources.

The Recommendation presents the framework, functional requirements and scenarios of telemedicine systems, which are the necessary hardware and software foundations for telemedicine.

The Recommendation is intended for the development, construction and evaluation of telemedicine systems in various countries and regions.

4.7 Global Initiative on AI for Health (GI-AI4H)

In 2018, the World Health Organization (WHO) partnered with the International Telecommunication Union (ITU), setting the stage for the Focus Group on Artificial Intelligence for Health (FG-AI4H), a dynamic platform designed to provide answers to the pressing questions surrounding AI in healthcare.

With increasing global interest and participation in AI advancements, the FG-AI4H recognized the need for a long-term institutional structure. The partnership between ITU and WHO led to the formation of the Global Initiative on AI for Health (GI-AI4H). Launched in July 2023 under WHO, ITU and the World Intellectual Property Organization (WIPO), the GI-AI4H stands as a resilient, long-term institutional structure, grounded in its mission to enable, facilitate and implement AI in healthcare.

Chapter 5 – Emerging technologies for e-services and applications

5.1 Use of generative AI in e-health and e-education

This section presents topics linking generative AI and ICT, which are useful in e-education and e-health. A key feature of generative AI is that it creates sentences from keywords and given conditions and the main functions of generative AI technologies, such as OpenAI's ChatGPT, are briefly described below.

Literature search

AI can be used to search academic journals with given keywords and conditions. For specialized academic papers, Elsevier is developing Scopus AI, which provides paper summaries. Scopus AI "Beta" is currently being tested by researchers around the world, and the final product is scheduled to be released in early 2024 and is expected to improve the efficiency of paper searches.

Web search

A web search function allows users to search for topics that are trending on the Internet and collect images in almost real time.

Points to keep in mind when generating text

Using AI tools can shorten work hours and improve work efficiency, but there are also some points to be aware of, including the authenticity of the generated content, leaking of confidential information, and infringement of copyright and ethics. The following list shows the points to keep in mind:

- Check for readability
- Are there any grammatical errors?
- Check for data, numerical errors and time series
- Point out sentences that are easily misunderstood
- Check from multiple perspectives

The following list suggests ways to improve the accuracy of AI generated content:

- Measures against hallucination (a perfect lie) resulting from flawed training data
- Clear presentation of evidence
- Introduction of explanations of reasoning processes (XAI, explainable AI)

It is also necessary to check the source of the search results and verify their authenticity, and it is important to remember to check the generated text from perspectives other than academic aspects such as legal systems, morals, ethics and religion.

Secondary use of data

Medical data is accumulated by medical institutions, and secondary use of this data can improve the level of medical diagnosis. The global response to COVID-19 was successful in overcoming the pandemic largely because specialists from different countries were able to share data on infected patients across borders, in near real time and at no cost. However, secondary use of medical data in normal circumstances should be carried out according to certain rules. For example, European Health Data Space (EHDS)[33] considers the promotion of secondary use of electronic health data and lists objectives as:

- the development of cross-border infrastructure,
- the development of metadata, and
- the assignment of labels (utility labels) regarding the quality and usefulness of data.

If certain conditions are met, it may be possible in the future to use patients' past data across borders for secondary use.

It is important to note that just because a large amount of information is collected does not necessarily mean that the collected information will be effective for AI diagnosis. If the collected information comprises a lot of incorrect diagnoses by doctors, then AI will also make similar incorrect diagnoses and the original data and the diagnoses for related patients will be blurred.

Creating metadata using generative AI

Metadata plays a very important role when using data assets to make data-driven decisions. Until recently, generating metadata for data assets was a manual and time-consuming process. Generative AI can be used to automate the generation of comprehensive metadata for document-based data assets, enhancing data discovery, data understanding and overall data governance within a cloud computing environment, such as for instance the AWS Cloud environment. This approach involves leveraging foundational models and data documents to enhance the AWS Glue Data Catalogue with dynamic metadata.

5.1.1 Examples of using generative AI

5.1.1.1 Possibility of administering thrombolytic agents for a stroke victim in an ambulance

The most effective method in clinical research to verify the efficacy of a treatment is the randomized controlled trial. However, when judging the effectiveness of a drug in a specific population, problems arise such as the difficulty of homogenizing the treatment content, the difficulty of blinding subjects (meaning to conceal their group allocation) and the difficulty of random allocation, making it difficult to conduct a mathematically satisfactory randomized controlled trial.

Furthermore, while it is mathematically inappropriate to aggregate independently evaluated populations and then reassess overall effectiveness, in clinical practice, the results may closely align with the physician's intuitive assessment.

[33] HealthData@EU

In randomized controlled trials, patient eligibility criteria are often set strictly, and there are themes for which it is difficult to generalize randomized controlled trials. In these cases, observational research using actual clinical data is conducted.

Conversational AI can add weighting methods such as excluding groups that are not related to the population to improve the evaluation system, leading to high-quality observational research. In this case, it is necessary to verify the effectiveness in real clinical medicine. This means that it is necessary to evaluate whether the AI is correct and whether it deviates from the evaluations of actual medical practice.

The following example explains how conversational AI can compile multiple previously published medical papers, many of which are randomized controlled trials, and can then provide a new, comprehensive evaluation.

Specifically, generative AI was used to analyse the temporal effectiveness of thrombolytic agents for transporting stroke patients. The metadata obtained in advance are "thrombolytic agent tPA," "time of administration" and "patient prognosis." Searching for "thrombolytic agent tPA" in stroke papers available on the Internet suggests that tissue plasminogen activator (tPA) is effective even five hours after stroke onset, longer than the previously thought two hours.

In Republic of Cyprus, there are reports of tPA being administered during transport, and if it is effective up to five hours after onset instead of the previously thought two hours, then there will be more opportunities to administer tPA in an ambulance, which will result in more patients being saved. This treatment is administered under a doctor's supervision via a mobile connection and is effectively considered to be telemedicine during emergency transport. Situational needs such as this would apply to many developing countries.

5.1.1.2 Networking drug discovery

The chance that a drug will be selected from potential drug candidates is estimated to be only 1 in 30 000. Drug discovery is the process of developing a new drug and requires a huge amount of time, effort and cost. Connecting the simulation and evaluation work of the drug discovery process through a network will improve the efficiency of pharmaceutical industry and create significant business opportunities. Even drugs that are easily obtained at a pharmacy are thought to generally require more than 15 years of research and development and multiple JPY billions in investment before being made commercially available.

ICT is expected to help overcome some of these problems in drug discovery. It is important to build a network of multiple geographically dispersed research institutions that can work together in research and development. Working with a network shortens development time, improves efficiency and accuracy and helps to develop new drugs as quickly and effectively as possible, thereby speeding up their availability to patients.

AI matching technology can be used to create previously unknown compounds for the treatment of intractable diseases, meaning rare diseases with unidentified causes and/or lack of established treatments. This possibility of course creates huge business opportunities. Drug discovery development that is networked on a global scale will be able to identify sources of disease and find acting agents, enabling drug development groups around the world to share information and so shorten development time.

5.1.1.3 AI-based speech technologies for educational purposes (Republic of Kazakhstan)[34]

In Kazakhstan, Nazarbayev University created a large-scale speech corpus to develop text-to-speech systems (TTS) for the Kazakh language which presents several linguistic challenges. TTS, also known as speech synthesis, is the automatic process of converting written text into speech. Prior to the Nazarbayev University language corpus (collection), there were a limited number of linguistic databases for Kazakh and other Turkic languages. The language corpus will be used to facilitate the development of new speech technologies for these languages, such as a screen reader and voice assistant for visually impaired people, voice assistants for smart homes and cars and a voice narration application to create videos and books for educational purposes.

TTS has a wide range of applications in e-health, e-learning, telecommunications and automotive manufacturing. For instance, TTS is the basis of screen reader apps which enable sight-impaired people to use computers and smartphones. TTS can also be combined with optical character recognition to assist blind people with reading hard-copy documents, books and magazines. TTS-powered apps enhance overall quality of life by providing access to up-to-date information and knowledge.

In e-learning, TTS provides the opportunity to convert static content, such as e-books, PDFs and other training documents to audio. TTS is useful for converting long passages of text into playable audio. Instead of hiring a voice actor to read hours upon hours of technical materials, a text-to-speech voice can automatically render text into speech. TTS can also complement other important language and vision technologies, such as speech recognition, speech-to-speech translation, face-to-face translation and visual-to-sound. Considering all of these benefits, TTS is undoubtedly an essential speech-processing technology for e-health and e-education in any language.

In recent years, TTS research has progressed remarkably thanks to neural network-based architectures, regularly organized challenges and open-source datasets. In particular, impressive results have been achieved for commercially viable languages, such as English and Mandarin. However, there is still a lack of research into TTS technologies for low-resource languages, meaning languages that have relatively less data available for training TTS systems.

To address this problem, the first open-source Kazakh text-to-speech (KazakhTTS) corpus has been developed. This corpus is an expanded version of a previously released KazakhTTS synthesis corpus. The overall size is now more than 270 hours, the number of speakers has risen from two to five (three females and two males), and the topic coverage has been diversified with the help of new sources including books and Wikipedia articles. Kazakh speech corpus 2 (KSC2) subsumes the previously introduced two corpora: Kazakh speech corpus and Kazakh Text-To-Speech 2, and supplements additional data from other sources such as TV programmes, radio, senate discourses and podcasts. In total, KSC2 contains around 1 200 hours of high-quality transcribed data comprising over 600 000 utterances. This corpus is necessary for building high-quality TTS systems for Kazakh.

The corpus is expected to advance speech and language research for Kazakh and other Turkic languages, which are often classified as low resource due to the scarcity of freely available

34 ITU-D SG2 Document 2/49 from Nazarbayev University.

linguistic data. It can also serve as a foundation for developing various mobile applications, such as voice assistants, language learning tools and communication platforms.

5.2 Cloud computing network technology for e-applications

5.2.1 Cloud computing network at the national level

The cloud computing network is a system that uses data, software, computer resources, etc. through a network. The cloud computing network is a model that enables convenient, on-demand access to a shared pool of configurable computing resources such as networks, servers, storage, applications and services, which can be rapidly provisioned and released with minimal management effort or interaction with the service provider. In the past, a system called "on–premise" was common in which the space, facilities and equipment were prepared and used by each organization. Today, leveraging the cloud to use resources only as needed is becoming more widespread.

This topic is a continuation of SG1 Q3/1 of the previous study period and is an area that is expected to be exploited by many users in developing countries. There have been cases where national-level implementations have been carried out to collect data on COVID-19 and consequently, the perspectives of cloud network users are sought to serve as a basis for the next development.

In some developed countries, there are networks that report to local health centres via public telephone lines by fax or fax modem, but a zero-trust network system as an Internet cloud service is introduced here.

A **zero-trust network** is a network that assumes that all access is untrusted.

To avoid functional failures due to malicious attacks such as ransomware attacks, large companies and banks can widely deploy networks as virtual private networks (VPNs), but the medical sector has been hesitant to deploy VPNs to dispersed medical institutions for budgetary reasons.

As a remote access method to replace physical VPNs, the goal is to create a zero-trust network that checks safety on the Internet and provides a mechanism for communication that performs a number of security checks before connection and ensures safety.

5.2.2 Classification of cloud computing support programmes

Cloud computing services are a general term for services that allow companies and individuals to use various resources and applications via the Internet. The main feature of these services is their ability to be used in a flexible and scalable manner without the need to own physical hardware or infrastructure. In this section, three types of cloud services offered by service providers are introduced:

Infrastructure as a service (IaaS):

IaaS is a service that provides infrastructure parts such as servers and network devices over the Internet. IaaS has the advantage of being highly customizable compared to other cloud services and can be used in a variety of ways. Compared to setting up infrastructure in-house, it is a service that can be used as a backup by storing data in a remote location, which is also effective in disaster prevention.

Platform as a service (PaaS):

PaaS is a service that provides a platform for developing applications over the Internet. To develop an application, it is necessary to prepare an environment such as a backup server and the necessary operating system (OS). Normally, a large initial cost is required to build a high-performance environment. With PaaS, an advanced development environment built on the Internet at a low cost can be used immediately.

Software as a Service (SaaS):

SaaS refers to a system that allows users to access services over the Internet instead of installing software on a PC or other device. Traditionally, servers, middleware, software, networks, etc. for using software were built, operated and managed in-house. With SaaS, the task of building these systems is eliminated and various cloud services can be used immediately over the Internet.

5.2.3 Cloud computing in e-education

Efforts to drive digital transformation in schools through cloud technology are becoming increasingly widespread. Examples of schools' administration and communication tasks that are being facilitated by the use of cloud computing include the following:

- Staff meetings and document sharing can now be conducted online, allowing access and collaboration from outside the school.
- Meeting materials, approval documents and letters to parents are being digitized to reduce unnecessary paper use and manual stamping.
- Surveys for students and parents, as well as interview scheduling, are being digitized to streamline information collection and coordination.

In addition to streamlining teachers' administrative work and communications with stakeholders inside and outside the school, efforts are being made to create an environment in which various school affairs can be carried out remotely.

5.2.4 Cloud computing in healthcare

Some of the current challenges to operating an electronic medical record system on the cloud are listed below:

- Screens cannot be customized, making efficient input problematic.
- Operations cannot be customized, so for example, a user cannot assign a postal code to the F1 field on a PC.
- There are issues concerning what to do if/when the cloud network goes down, which would mean that the electronic medical records would not be available.
- There are issues concerning the availability of a 24/7 support system.

Another major aspect inhibiting the uptake of medical record systems on the cloud is that, when connected to the Internet, such systems become vulnerable to ransomware, phishing and other forms of cybersecurity attack. For this reason, many medical record administrators choose to use a secure intranet network within the hospital or group of affiliated hospitals.

Electronic medical record systems using cloud computing will become more widespread when these issues are resolved.

5.2.5 Case studies of cloud computing usage

5.2.5.1 Health centre real-time information-sharing system on COVID-19 (Japan[35])[36, 37]

In Japan, the health centre real-time information-sharing system on COVID-19 (HER-SYS) is an information input system allowing information on COVID-19 infected patients (e.g., patient symptoms, travel history, etc.) to be input digitally, controlled centrally and shared among relevant medical and administrative personnel.

Using the HER-SYS system, patients can input their basic health condition on smartphones, and medical personnel can quickly detect and respond to changes in the condition of infected patients and report 120 items to Government.[38]

Doctors who have examined patients with COVID-19 are legally obligated to report such cases to the local health centre and to the Ministry of Health, Labour and Welfare under Article 12 of the Infectious Diseases Act.

The HER-SYS system is based on software as a service (SaaS) that allows users to access services over the Internet instead of installing software directly on a PC, smartphone or other device. HER-SYS is the first nationwide **zero-trust network** instigated by the Government of Japan.

Issues related to external connection of medical record systems

Some of the issues experienced due to the external connection of electronic medical record systems included:

- A number of medical institutions in Japan were targeted by ransomware; in some hospitals, servers and terminals were blocked by viruses, causing long-term confusion by making it impossible to view medical records.
- The electronic medical records systems of many medical institutions were based on secure intranets and were therefore not connected to the external Internet.
- When outputting patient data, the information was transferred using media exclusive of the Internet such as paper printing, CD-ROM or fax.

These issues meant that it was not possible to directly connect to and operate HER-SYS. The situation reflected past experiences of unprotected electronic medical record networks being the target of ransomware attacks. As a result, patient data could not be extracted from the electronic medical record system online, and instead for cloud computing solutions, it became

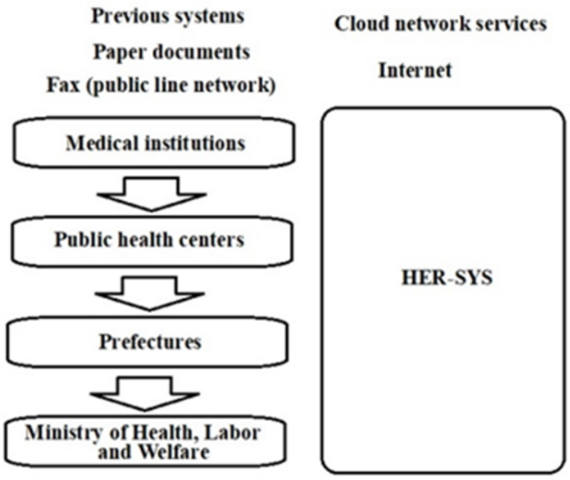
[35] Note: This section is not based on a contribution submitted by Japan, but developed by the authors of this report based on external sources available.
[36] Asami Hino. HER-SYS war chronicles - systems for countermeasures against COVID-19 (in Japanese). COVID-19 Expert Meeting. 2022.
[37] Ministry of Health, Labour and Welfare. https://www.mhlw.go.jp/content/10900000/000670376.pdf (in Japanese).
[38] https://www.mhlw.go.jp/content/10900000/000678061.pdf

necessary to manually input data from a terminal independent of the hospital's electronic medical record system.

Correlation of the fax-based system and HER-SYS

A conceptual diagram of the previous fax-based system and HER-SYS is shown in Figure 2. Previously, faxes were entered at the source (the input medical institution) to be shared among medical institutions and the public administration with the aim of achieving centralization without going through the local health centre. Although digital data sharing systems over the Internet can achieve real-time performance, if data collection takes time, such as when a patient needs to be monitored for several days before some medical information can be collected, and feedback to the user (the input medical institution) is delayed, the value of such systems is limited.

Figure 2: Conceptual diagram of the fax-based system and HER-SYS



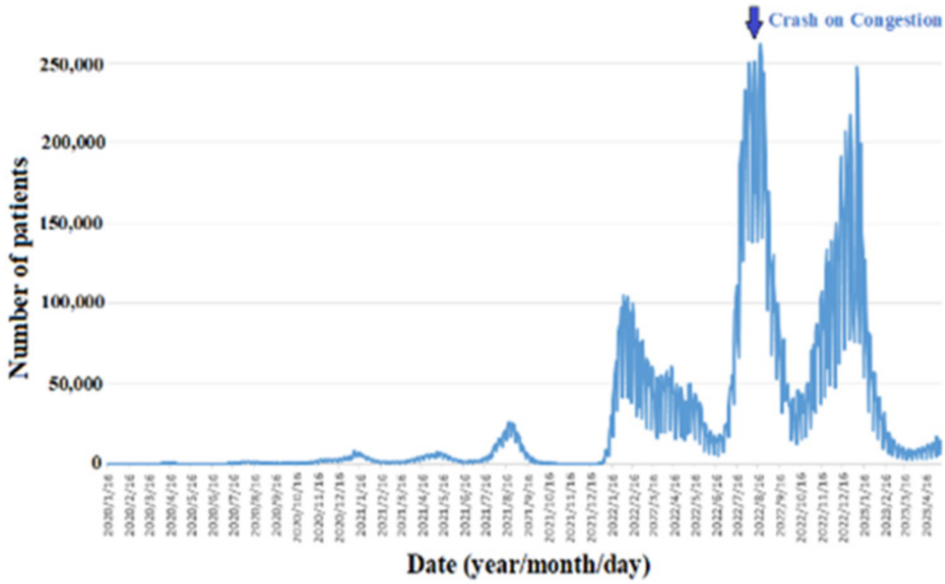
Main input items for HER-SYS

The 120 medical information input items (listed according to categories in Annex 1) that are required to be collected are divided into four categories. Among these, the third item category comprising items such as intensive care unit (ICU) admission and discharge, ventilator and ECMO usage status and outcome information on discharge/death are items that may take several days to collect and that cannot be answered immediately. Consequently, it is considered that responses will be incremented into for example item responses collected on day one, day three, day seven, etc.

HER-SYS traffic

Figure 3 shows a graph of COVID-19 patient numbers over time and the resultant crash of the system due to a sudden peaking in patient numbers. Prior to the sudden peak in COVID-19 patient numbers, authorities had been operating the system by requiring medical institutions to enter the entire 120 items of infection information. But when the number of coronavirus patients suddenly increased, the cloud network circuits suffered a crash due to congestion. The arrow in Figure 3 indicates a point on 26 July 2022 at which the reporting system was down because of congestion.

Figure 3: Changes in the numbers of patients with COVID-19



Inconsistent information and logistics topology

Local health centres print out the patient's personal data on paper before uploading, then black out the data, and fax it to the health centre to obtain permission to upload, and so avoid delays caused by the correction errors by affiliated medical institutions. For this reason, even though the HER-SYS was independent of the existing fax system, an intermediate gateway agency was required for collecting information, which resulted in double the work. In other words, the fax system that operated with the health centres that supported infectious disease management in Japan until now was built in a star-shaped network topology with the health centre as the focal point. This matched the logistical flow for tasks such as the transmission of patient samples to the health centre. However, the current HER-SYS is centralized and its network topology is not consistent with that of the actual real-world network topology.

Auxiliary functions to resolve functional deficiencies on the patient information input side

The input process at the terminal could be improved with the following auxiliary functions:

- an optical character recognition (OCR) function,
- a voice-to-text conversion function for the person entering data,
- a function to extract text data from the patient's personal electronic medical record.

Summary

The HER-SYS system crashed due to congestion, which demonstrates that the line design for the packet traffic was not adequate in the initial stages of the COVID-19 pandemic.

Information collection systems that include information networks (fax networks) centred on local health centres should also take into account the flow of patient samples.

The use of input assistance devices such as voice recognition devices, and of character recognition devices for extracting information from electronic medical records, is recommended.

5.2.5.2 National cloud computing policy (Syrian Arab Republic)[39]

The National Cloud Computing Policy (NCCP) of the Syrian Arab Republic is a comprehensive framework that aims to guide the development and adoption of cloud computing technologies across the country. It was developed by the Ministry of Communications and Technology of the Syrian Arab Republic in collaboration with various stakeholders, including government agencies, industry experts and academia. The NCCP outlines a vision for a secure, reliable and efficient cloud computing ecosystem in the country. It identifies key areas for development, including infrastructure, security, data protection and skills development. The policy also establishes a governance framework for cloud computing, including roles and responsibilities of various stakeholders, and mechanisms for monitoring and enforcement.

One of the key objectives of the NCCP is to promote the adoption of cloud computing technologies by businesses and organizations in the Syrian Arab Republic. The policy provides incentives and support mechanisms to encourage businesses to migrate their IT infrastructure to the cloud. It also aims to develop a skilled workforce in cloud computing through education and training programmes. The NCCP is an important step towards realizing the potential of cloud computing in the Syrian Arab Republic. It provides a clear roadmap for the development of a robust cloud computing ecosystem and it will contribute to the country's digital transformation and economic growth. When developing sectoral government policies in the field of digital transformation, it is necessary to benefit from government cloud computing services to ensure optimal investment (private and public) of available resources and to take advantage of the cloud computing infrastructure. The tasks of the Ministry of Communications and Technology within the implementation framework of the NCCP are as follows:

- Providing government cloud computing applications for the public sector, particularly the enterprise resource management system for the economic and administrative public sector, the customer relationship management (CRM) system for public sector services and the communication software such as government email systems;
- Working with public sector entities that own infrastructure, including equipment and data centres in order to further develop infrastructure;
- Determining the necessary governmental expansion of cloud computing infrastructure and how best to take advantage of all available resources;
- Strengthening the human resources capabilities of public sector workers to manage cloud services through training and qualifications in cloud computing skills;
- Taking the necessary measures to adopt the concept of "payment for service" among public sector entities and enabling them to do so.

The goal of this policy is to provide a unified centre for government data and services that operates 24/7.

5.3 Blockchain

Use of blockchain has gained immense popularity and traction and has revolutionized peer-to-peer information exchange by combining cryptographic principles with decentralization, immutability and transparency. From a network perspective, blockchain is a digital advanced database mechanism that records transactions and manages them across multiple computers through a peer-to-peer network. There are no role differences or hierarchical relationships

[39] ITU-D SG2 Document SG2RGQ/113 from Syrian Arab Republic.

between the computers, and all the computers of the network interact on an equal footing. Blockchain can also be defined more concisely as a digitally distributed, decentralised, public ledger that exists on a network of computers.

A good practice model from China that demonstrated the use of blockchain in a medical payment system was introduced in the previous study period.[40] Blockchain technology continues to grow and is being used in a variety of fields including supply chains, cybersecurity, voting, healthcare (especially medical payment services), web services, retail and Internet payment services. In particular, the benefits of a scalable central ledger which include enhanced traceability, increased efficiency and clarity, improved security and increased transaction speed, combine to make blockchain an increasingly attractive solution. In this context, blockchain technology, comprising multiple advanced features, has undergone numerous evolutions from blockchain 1.0 to next generation blockchain 4.0.

5.4 Biometric authentication technology for m-services

Mobile phones are increasingly serving as intelligent assistants that are used to store and manage ever larger volumes of high-quality information, and their value continues to rise with the expansion of applications across various services. Consequently, the demand for robust security features and biometric authentication in mobile devices continues to grow. In response to this demand, biometric authentication technology (including sensors and authentication algorithms) is steadily evolving and is increasingly being installed in mobile phones. Reliable verification is required for a number of m-services, including for example, health insurance payment services in the case of telemedicine. Biometric authentication technology can be used to authenticate the identity of a patient when consulting a doctor remotely via a mobile phone in a telemedicine scenario. Clearly the telemedicine payment system would not work if expenses paid through the patient's health insurance were not truly paid by the patient in question.

Recently, four trends have been attracting attention regarding the future of biometric authentication technology for mobile phones:

- **Realization of total security**: Traditionally, biometric authentication was considered as an application of pattern recognition technology. Today however, biometric authentication is more often considered as a security system and its level of security is measured by comprehensively analysing vulnerabilities and threats. Biometric authentication is essential for securing Internet of things (IoT) devices, yet the vulnerability of biometric data to breaches underscores the necessity for improved security measures. Cancellable biometrics systems, which convert original biometric data into non-reversible templates, offer a strong solution for user privacy and identity preservation. Template protection technology, as employed in the cancellable biometrics system, is essential to deal with the unique characteristic that biometric information cannot be replaced once it is leaked. In addition, focusing on the fact that the conventional error rate evaluation is the average value for many people and that a higher false acceptance rate (FAR) occurs for some users, authentication should be proposed that aims to guarantee the FAR for individual users by making a judgment based on the probability of false acceptance obtained from the occurrence probability of observed events when a certain sample is assumed to be uncorrelated.
- **Advances in sensor technology:** Due to the potential of the mobile phone market, adaptations of biometric authentication sensors targeting this market will continue to

[40] ITU-D SG2 Document 2/51 (2018-2022 study period) from China International Telecommunication Construction Corporation.

develop. Fingerprint sensors and other biometric technologies are expected to become even smaller and more affordable. These sensors will also be equipped with enhanced environmental resistance and liveness detection capabilities. Such sensors will also be integrated into device designs to create input systems that can be used easily.

- **Expansion of modalities.** With the advances in sensor technology mentioned above, it is believed that the options for operating modalities that can be used on mobile phones will expand in the future. Sensors that are currently too large or too expensive to be installed on mobile devices, and even those whose authentication algorithms are currently still in the exploration stage due to immature authentication algorithms, will be installed on mobile phones using various modalities that take advantage of their respective qualities. Users will then be able to choose the modality that suits their style on various devices. To address the challenge of "universal availability" and improve overall precision, multimodal authentication will be implemented. This approach combines multiple modalities, making the technology accessible to a wider range of users while enhancing its reliability.
- **Added value beyond authentication.** Biometric information, unique to individuals, has the potential to provide new added value beyond being simply a means of authentication. One example is the idea of using the results of "who put a finger on the interface" and also of "which finger", to determine the user interface to be displayed while also performing authentication. This is a trend that is expected to be further developed in the future for mobile phones, which are required to be smaller, have higher functionality and remain easy to use for everyone.

5.5 5G and satellite constellations

5.5.1 Remote robotic surgery using 5G (Japan)[41]

Remote robotic surgery is currently among the most technologically advanced developments in telemedicine. There are a number of surgical robot systems already on the market, and the da Vinci surgical system (Intuitive Surgical, Inc.) is the most widely used worldwide. However, there have also been significant developments in surgical robot systems in Japan which has long been associated with high-level industrial robotic technologies development. Japanese company NTT Docomo, Inc. provides an example of a remote robotic surgery support / remote robotic surgery system utilizing 5G technology in Japan.

In 2020, a commercial surgical robot system called hinotori™ was launched in Japan by the Medicaroid Corporation. The hinotori system comprises a surgical operation unit with compact robotic arms similar to human arms, an ergonomically designed surgeon cockpit, and a vision unit that produces high-definition 3D imagery. These elements, developed in collaboration with Kobe University, function together to carry out precise and advanced surgeries. Although robotic surgery is becoming more common, it is generally confined to urban areas and there are wide regional disparities concerning available medical care facilities. Associated with this issue, there are concerns about the reduced number of educational and experiential learning opportunities for young surgeons in rural areas, and also about the increased working hours of surgeons in urban areas.

Proposing a solution to these issues, Kobe University, NTT Docomo, Inc. and Medicaroid Corporation have been demonstrating cases of remote robotic surgery, including remote support via the 5G network since 2020, under the framework of the Healthcare of Tomorrow Initiative promoted by Kobe City. The hinotori system was connected between two locations via

[41] ITU-D SG2 Document SG2RGQ/62 (Rev.1) from Seisa University.

a commercial 5G network and cloud service (DoCoMo MECTM and MEC Direct), and a mock surgery was performed by a surgeon controlling the local operation unit, from a cockpit in a remote location far distant from the site of the surgery. High-definition surgical images and robot control information were successfully transmitted in real time, and surgical techniques such as blood vessel dissection, needle holding and needle handling, as well as basic gestures such as grasping were demonstrated. Surgeons experienced in robotic surgical techniques have positively evaluated remote robotic operations using 5G networks. These surgeons noted that the system shows great potential for performing remote surgeries effectively. The 5G wireless communication enabled improved flexibility during surgical procedures. Further advancements are anticipated as the technology progresses towards full-scale commercialization.

Figure 4: Long-distance 5G remote robotic surgery

5.5.2 Satellite constellations and remote robotics surgery

Starlink is a low earth orbit (LEO) satellite constellation system operated by Starlink Services, an international telecommunications provider that is a subsidiary of the American aerospace company SpaceX.

In satellite technology, a constellation refers to a system where multiple artificial satellites are launched into an orbital plane and operate together as a single unit. In recent years, large-scale satellite systems have been attracting increasing attention, with dozens, and in some cases hundreds or even thousands of satellites launched into low earth orbit (LEO) at about 200 km to 2 000 km above the Earth, and linked together to cover the entire Earth. Until recently, satellites used for television broadcasting were launched into geostationary orbit at an altitude of 36 000 km above the equator and with a delay experienced of about 0.12 seconds. The delay time for LEO satellite constellation systems is one order of magnitude lower than that of geostationary orbit satellite system. Another system is also being planned comprising a constellation of from just a few to several thousand medium earth orbit (MEO) satellites at a minimum altitude 2 000 km.

Starlink plans to launch 12 000 artificial satellites at an altitude of approximately 550 km, enabling broadband Internet connection anywhere on the planet.

By 2020, the Starlink service had already started in some regions such as the United States, and as of the end of July 2023, approximately 5 000 satellites have been launched, making Starlink available in 61 countries around the world. In the future, there are plans to launch more than 40 000 satellites.

In the United Kingdom, OneWeb is planning a constellation of 6 372 satellites at an altitude of 1 200 km, and as of the end of March 2023, 618 satellites have been launched and service has already started in some regions, with the aim of expanding the scope to cover the entire world by the end of 2023. In addition, China has established a state-owned company, China Satellite Network Group, and has announced plans to launch up to 13 000 satellites for the purpose of providing global Internet services.

Frequency resources related to this topic are not covered here as they are handled separately in the ITU-R Sector. Ground use varies from country to country, and it goes without saying that there are regions and countries where licences are not available.

Early stages of LEO and e-health association

An experimental satellite was developed by the University of Surrey in the United Kingdom and launched in January 1990. The satellite was given three names during its development: UoSAT-3, VITASAT and HealthSat-1, and after launch it became UO-14 (AMSAT-Oscar-14).

For the first 18 weeks in orbit, it functioned as a packet communication (store and forward) satellite in the 145 MHz amateur band, then quit the 145 MHz band and was utilized by the Volunteers In Technical Assistance (VITA) organization as part of an electronic messaging network for Africa, mainly for medical-related business communications. In this role, if for example a medical institution requested a large amount of Sulfadiazine Silver for burn treatment, it could be inferred that there had been a sustained conflict in that area. Overcoming a launch failure in 1995, VITASAT has since been operating as GemStar1 satellite.

Robotic surgery using satellite constellations in non-geostationary low earth orbit (LEO) is extremely effective in providing solutions in countries and regions with poor infrastructure, such as remote islands and developing countries. The future market for robotic surgical systems, such as the Da Vinci surgical system, is expected to experience significant growth in developing countries.

Using AI reinforcement learning to train in robotic surgical system operation sequences, supports remote surgery, improves operability and accuracy, and even compensates for momentary communication failures.

5.5.3 Strategy utilizing low latency

Robotic surgery applications require high-resolution 4K-level video images and low latency to control medical equipment such as scalpels, forceps, etc.

In Japan, 5G lines from NTT DoCoMo, Inc. are already being used for verification operations at close to a practical level. Furthermore, in recent years, verifications using LEO satellites have been conducted taking advantage of low latency, and two examples of this will be briefly introduced here.

On 4 September 2024, a television programme aired on FBS Fukuoka Broadcasting reported on a groundbreaking medical procedure. A specialist at the university hospital in Fukuoka had successfully performed a remote surgery operation on a patient in a medical institution 1 000 km away in Fukushima. The procedure utilized a 220 Mbit/s Starlink connection to transmit real-time video images and to control surgical instruments inserted through the patient's chest wall. This demonstrated the potential of high-speed satellite Internet in enabling advanced telemedicine and remote surgical procedures across long distances. It was reported that the operation was facilitated by the fact that the latency delay was small at all times.

In another case, a university hospital in Osaka conducted a trial verification experiment of remote robotic surgery via a LEO constellation satellite link with a medical institution on the remote island of Tokunoshima and obtained extremely good results. The results were submitted by the medical institutions to the Ministry of Health, Labour and Welfare, suggesting that in the future 5G and robotic surgery using LEO constellation satellites may be developed for medical procedures as well as for health insurance payment systems.

Conclusion

At WTDC 2022, Q2/2 was merged with Q3/1 on emerging technologies, including cloud computing, over-the-top (OTT) and m-services, and developed to comprise a wide range of e-services, including e-education and e-health.

Telemedicine and e-health have been ongoing issues for nearly 30 years, ever since ITU-D SG2 was first established (Q6/2, Q14/2). Until now, the report format has mainly been comprised of a presentation of good practice models that have been implemented. This report however focuses on topics, good practice models and also distinct national strategies implemented by various countries.

Mobile communications, including 5G, are spreading throughout the world, and global networks using constellations of orbiting satellites are becoming a reality, expanding the opportunities in developed and developing countries for advanced distance education, telemedicine and e-health.

This report introduced the concept of remote robotic surgery using 5G and orbiting satellites in constellations. This technology will enable for instance, specialists in New York to perform surgeries in the operating room of a medical institution in a distant developing country, significantly advancing the capabilities of remote medical care. The emergence of remotely operated surgical equipment is expected to create substantial business opportunities.

Cases of cloud computing network operation as a new technology were also introduced. A cloud computing network utilizing a zero-trust model would ensure that both the communication path and the communication partner are verified as trustworthy. Questions are raised concerning why achieving such trust is so inherently challenging. The issue presented in the Japan case study (section 5.2.5) not only concerns the basic design of a technology that ensures communication traffic, such as line design and the securing of line margins, but also discusses the difficulty of completely replacing existing technology networks, in this specific case, a public health centre star-shaped fax network. The challenge is comparable to suddenly stopping a system that functions as an integral part of society and switching to a new system. Building a fully developed zero-trust network is a future challenge not only for ITU, but also for Member States, telecommunications operators and users worldwide. It is hoped that perseverance and great technological advances will continue into the next study period.

Annexes

Annex 1: Input items for HER-SYS

Category	Input items
Category 1	– Active epidemiological research-related information – Personal basic information – Necessity of cooperation with the welfare department – Household composition
Category 2	– Medical interview-related information – Presence or absence of underlying diseases, etc. – Information about past hospitalizations – Inspection record – Incident notification information – Information on whereabouts – Reception date, first name (kanji), first name (furigana), date of birth, age group, sex, nationality, address, local public health centre, contact phone number, e-mail address, occupation, school/place of work, emergency contact information, close contact person's information. – Additional information such as disability / public assistance / securing child-care workers / securing caregivers / others (free description) – Status as older adults, those with underlying diseases, those with immunosuppression, those who are pregnant, and those who live with medical personnel – Date of medical interview, name of medical institution for diagnosis, medical insurance card number, symptoms – Respiratory disease (e.g., chronic obstructive pulmonary disease), diabetes, hypertension, dyslipidaemia, cerebrovascular disease, dementia, other underlying diseases (free description), drugs currently being taken (name of drug), use of immunosuppressants, use of anticancer drugs, classification of whether dialysis treatment is in progress, information related to pregnancy and smoking – Past hospitalization information related to COVID-19, date of sample collection, testing institution, scheduled date of contact, date of results, type of sample material, test method, test results, test results related to other bacteria/viruses (e.g., influenza, respiratory syncytial virus, adenovirus, pneumococcus, legionella, Human metapneumovirus, rhinovirus) – Information described in the occurrence report (e.g., type of person (corpse) diagnosed (examined), name, sex, date of birth, age at the time of diagnosis (0 years old is the age in months, occupation, address, location, name of guardian, address of guardian, symptoms, diagnostic method, date of first medical examination, date of diagnosis (autopsy), date of presumed infection, date of onset of illness, date of death, cause of infection, route of infection, area of infection, other matters deemed necessary by a doctor for the prevention of the spread of infectious diseases and medical care for the person concerned)

(continued)

Category	Input items
Category 3	– Date of admission/discharge, hospital/physician name, symptom-related information, chest X-ray findings, chest CT findings – Intensive care unit admission status, ventilator use, ECMO use – Outcome information on discharge/death (e.g., date of death, cause of death) – Category: home, medical institution, lodging facility, social welfare facility, other (free description) – Health observation information – Temperature, symptoms, doctor's findings – Contact information – Destination medical institution for emergency transport, family medical institution (local home doctor), follow-up institution – Waiting days (cancellation contact date severity) – Classification: mild, moderate, or severe
Category 4	– Active epidemiological information (mainly filled in by public health centres) – Behaviour history **(**for example, a salesperson who has many meetings**)** – History of activity (date/time/location/contact person) – Contact information – Name, contact information, presence or absence of a close contact – Presence or absence of infection links – Classification of confirmed/presumed/unknown infection route – Infection route information – Infected area (personally infected place, e.g., prefecture, ward, city, build-ings)

Source: Japan[42]

[42] Ministry of Health, Labor and Welfare: https://www.mhlw.go.jp/content/10900000/000670376.pdf (in Japanese).

Annex 2: List of ITU-T publications on issues of mutual interest in the scope of Question 2/2

The Inter-Sector Coordination Group on issues of mutual interest (ISCG) has been operating with considerable success throughout the last several periods of ITU Sectors. The Group is tasked with notifying the various working bodies of all ITU Sectors about the linkages between their Study Groups and Study Questions in order to avoid duplicating the existing and ongoing studies and ineffective use of financial and human resources.

To avoid duplication between the work of ITU-D on e-services, especially e-health, and the studies of ITU-R and ITU-T, it is crucial to understand what studies have already been done. In December 2022, the SG2 meeting, considered a document[43] from the ISCG, which contained a mapping of ITU-D Questions to ITU-T Questions. In addition to that document, which observes current work, it is also of interest to compile a list of relevant publications for each ITU-D Question. For this purpose, this annex presents a list of ITU-T publications on issues of mutual interest in the scope of the mandate of Question 2/2.

1. List of topics of ITU-D Question 2/2

	Description	Relationship
T1	Introduce good-practice models for e-services in developing countries, including e-health and e-education	in response to WTDC-22, Resolution 2
T2	Ways to promote an enabling environment among ICT stakeholders for the development and deployment of e-services and m-services	in response to WTDC-22, Resolution 2
T3	Study of new e-health technologies, including combating pandemic	in response to WTDC-22, Resolution 2
T4	Sharing e-health standardization with developing countries	in response to WTDC-22, Resolution 2
T5	Methods of development and deployment of cross-cutting m-services related to e-commerce, e-finance and e-governance, including money transfer, m-banking and m-commerce	in response to WTDC-22, Resolution 2
T6	Regulatory frameworks for the provision of OTTs	in response to PP-22 new resolution
T7	National case studies and experiences regarding legal frameworks and partnerships seeking to facilitate the development and deployment of e-services, m-services and OTTs	in response to WTDC-22, Resolution 2
T8	Impact of OTTs on end-user demand for the Internet	in response to WTDC-22, Resolution 2
T9	Strategies and policies to foster the emergence of a cloud-computing ecosystem in developing countries, taking into consideration relevant standards recognized or under study in the other two ITU Sectors	in response to WTDC-22, Resolution 2

[43] ITU-D SG2 Document 2/46 from the Inter-Sector Coordination Group (ISCG) on issues of mutual interest.

2. List of ITU-T publications on issues of mutual interest in the scope of Question 2/2

OTT

Recommendation ITU-T D.262. Collaborative framework for OTTs, Geneva, 2019.
https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13595

Recommendation ITU-T D.608 R. OTT voice bypass, Geneva, 2022.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14772

Recommendation ITU-T D.1101. Enabling environment for voluntary commercial arrangements between telecommunication network operators and OTT providers, Geneva, 2020.
https://www.itu.int/itu-t/recommendations/rec.aspx?rec=14269

Recommendation ITU-T D. 1102. Customer redress and consumer protection mechanisms for OTTs, Geneva, 2021.
https://www.itu.int/itu-t/recommendations/rec.aspx?rec=14730

ITU-T Technical Report. Economic impact of OTTs, Geneva, 2017.
https://www.itu.int/pub/T-TUT-ECOPO-2017

M-services

Recommendation ITU-T D.263 Costs, charges and competition for mobile financial services (MFSs), Geneva, 2019.
https://www.itu.int/itu-t/recommendations/rec.aspx?rec=13596

Recommendation ITU-T Suppl.4. D.263 Supplement on principles for increased adoption and use of mobile financial services (MFSs) through effective consumer protection mechanisms, Geneva, 2020.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14239

E-health

ITU-T T.78 (2022): Resolution 78 - Information and communication technology applications and standards for improved access to e-health services.
https://www.itu.int/pub/T-RES-T.78-2022

Recommendation ITU-T F.760.1 (12/2022): Requirements and reference framework for emergency rescue systems.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=15202&lang=en

Recommendation ITU-T H.627.3 (12/2022): Protocols for intelligent video surveillance systems.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=15204&lang=en

Recommendation ITU-T F.780.1 Framework for telemedicine systems using ultra-high definition imaging, Geneva, 2022.

https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14945

Recommendation ITU-T F.780.2. Accessibility of telehealth services, Geneva, 2022.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14967

Recommendation ITU-T F.780.3 (12/2022): Use cases and requirements for ultra-high-definition teleconsulting system.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=15203&lang=en

Recommendation ITU-T H.810. Interoperability design guidelines for personal connected health systems: Introduction, Geneva, 2019.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14113

Recommendation ITU-T H.811. Interoperability design guidelines for personal connected health systems: Personal Health Devices interface, Geneva, 2017.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13414

Recommendation ITU-T H.812. Interoperability design guidelines for personal connected health systems: Services interface, Geneva, 2017.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13415

Recommendation ITU-T H.812.1. Interoperability design guidelines for personal connected health systems: Services interface: Observation Upload capability, Geneva, 2017.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13416

Recommendation ITU-T H.812.2. Interoperability design guidelines for personal connected health systems: Services interface: Questionnaire capability, Geneva, 2017.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13417

Recommendation ITU-T H.812.3. Interoperability design guidelines for personal connected health systems: Services interface: Capability Exchange capability, Geneva, 2017.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13418

Recommendation ITU-T H.812.4. Interoperability design guidelines for personal connected health systems: Services interface: Authenticated Persistent Session capability, Geneva, 2017.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13419

Recommendation ITU-T H.813. Interoperability design guidelines for personal connected health systems: Healthcare Information System interface, Geneva, 2019.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14114

Recommendation ITU-T H.830.11 (04/2017): Conformance of ITU-T H.810 personal health system: Services interface Part 11: Questionnaires: Health & Fitness Service sender.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13206&lang=en

Recommendation ITU-T H.830.12 (04/2017): Conformance of ITU-T H.810 personal health system: Services interface Part 12: Questionnaires: Health & Fitness Service receiver .
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13207&lang=en

Recommendation ITU-T H.830.13 (08/2018): Conformance of ITU-T H.810 personal health system: Services interface Part 13: Capability Exchange: Health & Fitness Service sender.

https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13674&lang=en

Recommendation ITU-T H.830.14 (08/2018): Conformance of ITU-T H.810 personal health system: Services interface Part 14: Capability Exchange: Health & Fitness Service receiver.

https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13675&lang=en

Recommendation ITU-T H.830.15 (11/2019): Conformance of ITU-T H.810 personal health system: Services interface Part 15: FHIR Observation Upload: Health & Fitness Service sender.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14115&lang=en

Recommendation ITU-T H.830.16 (10/2019): Conformance of ITU-T H.810 personal health system: Services interface Part 16: FHIR Observation Upload: Health & Fitness Service receiver.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14097&lang=en

Recommendation ITU-T H.830.17 (06/2021): Conformance of ITU-T H.810 personal health system: Services interface Part 17: Personal Health Device Observation Upload (POU) Sender.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14687&lang=en

Recommendation ITU-T H.830.18 (06/2021): Conformance of ITU-T H.810 personal health system: Services interface Part 18: Personal Health Device Observation Upload (POU) Receiver.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14688&lang=en

Recommendation ITU-T H.840 (04/2017): Conformance of ITU-T H.810 personal health system: Personal Health Devices interface: USB host.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13214&lang=en

Recommendation ITU-T H.841 (08/2020): Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 1: Optimized Exchange Protocol: Personal Health Device.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14344&lang=en

Recommendation ITU-T H.842 (11/2019): Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 2: Optimized Exchange Protocol: Personal Health Gateway.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14116&lang=en

Recommendation ITU-T H.843 (08/2018): Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 3: Continua Design Guidelines: Personal Health Device.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13680&lang=en

Recommendation ITU-T H.844 (11/2019): Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 4: Continua Design Guidelines: Personal Health Gateway.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=14117&lang=en

Recommendation ITU-T H.845.1 (04/2017): Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5A: Weighing scales.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13219&lang=en

Recommendation ITU-T H.845.2 (08/2018): Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5B: Glucose meter.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13682&lang=en

Recommendation ITU-T H.845.3 (04/2017): Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5C: Pulse oximeter.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13221&lang=en

Recommendation ITU-T H.845.4 (04/2017): Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5D: Blood pressure monitor.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13222&lang=en

Recommendation ITU-T H.845.5 (04/2017): Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5E: Thermometer.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13223&lang=en

Recommendation ITU-T H.845.7 (04/2017): Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5G: Strength fitness equipment.
https://www.itu.int/ITU-T/recommendations/rec.aspx?rec=13225&lang=en

Recommendation ITU-T H.845.8 (04/2017): Conformance of ITU-T H.810 personal health system: Personal Health Devices interface Part 5H: Independent living activity hub.
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Annex 3: List of contributions and liaison statements received on Question 2/2

Contributions on Question 2/2

Web	Received	Source	Title
2/411	2025-05-01	BDT Focal Point for Question 2/2	Open-source RAG architectures for generative AI in the public sector: Building blocks to empower government services in the global south
2/407	2025-04-29	RIFEN	Cloud computing and access to educational resources between challenges and opportunities: the case of Bangambi in West Cameroon
2/404	2025-05-02	BDT	Extracted lessons learned from contributions to ITU-D Study Group 2 Questions (fourth meeting of ITU-D Study Group 2)
2/394	2025-04-22	Türkiye	Türkiye's comments on Question 2/2 Draft Output Report
2/371 (Rev.1)	2025-04-14	RIFEN	The impact of digital twins and big data on healthcare optimization: Challenges and Perspectives
2/369	2025-04-11	Chad	Strengthening distance learning and popularizing digital health in schools and health facilities
2/365	2025-03-16	State of Palestine	Online appointment booking system for government services
2/359 (Rev.1)	2025-05-07	Co-Rapporteurs for Question 2/2	Draft Output Report on Question 2/2
2/337	2024-11-08	BDT	Extracted lessons learned from contributions to ITU-D Study Group 2 Questions (third meeting of ITU-D Study Group 2)
2/336	2024-11-03	India	E-education initiatives of NCERT under the aegis of the Ministry of Education - Government of India
2/335	2024-11-01	BDT Focal Point for Question 2/2	Common functional requirements for open-source generative artificial intelligence applications for the public sector
2/330	2024-10-29	Egypt	Egypt IoT Forum
2/321	2024-10-29	State of Palestine	Palestinian interoperability framework "Zinnar"
2/318	2024-10-28	European Broadcasting Union	Kilkari: A maternal and child e-health service in India designed by BBC Media Action. Lessons learned and best practices for deployment at scale
2/311	2024-10-28	Republic of Korea	Standards for mental health services

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Web	Received	Source	Title
2/306	2024-10-23	Türkiye	The service of debt/credit inquiry and payment/refund transactions in electronic communications sector in Türkiye
2/295 (Rev.1) +Ann.1	2024-10-22	China	AI for Good, bridge the AI divide
2/293 +Ann.1-2	2024-10-21	GSM Association	2024 Mobile Industry Impact Report: Sustainable Development Goals
2/278	2024-10-31	Co-Rapporteurs for Question 2/2	Draft Output Report on ITU-D Question 2/2
2/272	2024-09-29	RIFEN	The impact of digital twins and big data on healthcare optimization: challenges and opportunities
2/261	2024-09-23	Syrian Arab Republic	Digital government procurement system in the Syrian Arab Republic
2/260	2024-09-19	Haiti	Electronic signature in Haiti
2/258	2024-09-21	RIFEN	STEM as enabling technologies for e-services and applications, including e health and e-education
2/248	2024-09-17	Bhutan	National digital strategy: Intelligent Bhutan
2/245	2024-09-15	India	Digital connectivity and use of new digital technologies for empowering the rural health system
2/243	2024-09-13	Madagascar	National interoperability framework for a unified, effective e-government system: Improving the quality of life of the Malagasy public through digital health, education and public security services
2/228	2024-10-02	Co-Rapporteurs for Question 2/2	Annual progress report for Question 2/2 for November 2024 meeting
RGQ2/207	2024-04-16	BDT Focal Point for Question 2/2	Open Source Ecosystem Enabler (OSEE) initiative for Digital Public Services
RGQ2/188 (Rev.1)	2024-04-15	United States	Engaging and providing digital skills for youth by piloting crowdsourced approaches to solve problems in the developing world
RGQ2/178	2024-04-11	Qualcomm, Inc.	Qualcomm Wireless Reach 5G Smart School in Italy (Update)
RGQ2/177	2024-04-11	Qualcomm, Inc.	Qualcomm Wireless Reach - vaccine cold chain monitoring
RGQ2/176	2024-04-11	Qualcomm, Inc.	Qualcomm Wireless Reach - program to address childhood chronic diseases

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Web	Received	Source	Title
RGQ2/169	2024-04-04	Russian Federation	"Digital Department" at the State Medical University
RGQ2/168	2024-04-04	Russian Federation	A single digital circuit in healthcare based on a unified state information system in the field of healthcare
RGQ2/163	2024-03-26	Syrian Arab Republic	A paper on digital development in Syria and the current reality
RGQ2/162	2024-04-02	Burundi	Online applications and e-services: case of e-learning from the Doctoral School of the University of Burundi, e-declaration, e-payment from the Burundian Revenue Office and e-administration from the Migration Commission
RGQ2/161 (Rev.1)	2024-03-28	GSM Association, Orange	Mobile operators' contribution to meaningful connectivity (with a focus on the African continent)
RGQ2/157	2024-03-26	RIFEN	E-health ecosystem in Côte d'Ivoire
RGQ2/153	2024-03-21	RIFEN	Use of Generative Artificial Intelligence Applications in the student environment in Cameroon
RGQ2/144	2024-03-14	State of Palestine	Inventorying government services and setting priorities
RGQ2/124	2024-02-29	Bhutan	Digital transformation in Bhutan: enhancing public service delivery through e-services
RGQ2/120	2024-02-29	Haiti	Challenges of digital transformation in health care
RGQ2/116	2024-02-28	Liberia	Digital Liberia and electronic government activity
RGQ2/113 +Ann.1	2024-02-22	Syrian Arab Republic	Implementing a cloud computing project in Syrian Arab Republic
RGQ2/108	2024-02-14	Chad	Strengthening e-health in the public health system of Chad
2/205	2023-10-25	BDT Focal Point for Question 2/2	Global Digital Health Business Case: Preliminary Results of a Cost-Benefit and a Return on Investment Analysis of Three Categories of Digital Health Interventions
2/204	2023-10-24	China	Brain-computer interface technology facilitates information accessibility for special populations
2/194	2023-10-22	Australia	Australia's experience in e-health in the COVID-19 pandemic

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Web	Received	Source	Title
2/172	2023-10-11	China	China's experience in NCD prevention and control - the first edition of challenge of typical digital products (services) for NCD prevention and control
2/171	2023-10-11	Uganda	Uganda's Universal Service Fund (UCUSAF) integration of ICT in education program
2/163	2023-10-09	Intel Corporation	Connect.post initiative to connect every post office to the Internet by 2030
2/162	2023-10-09	Intel Corporation	Updated Information on Wi-Fi Technology
2/161	2023-10-09	Vice-Chairs, ITU-D Study Group 1; Vice-Chair, ITU-D Study Group 2; Co-Rapporteur for Question 7/2	Implementation of Resolution 9 across ITU-D Study Groups' Questions
2/155	2023-10-05	International Chamber of Commerce	Digitalisation for people: digital skilling and services for the SDGs
2/149 +Ann.1	2023-09-29	Argentina	Recommendations for a trustworthy artificial intelligence
2/148	2023-09-29	Argentina	Accessibility in digital services for people with disabilities
2/146	2023-09-29	Argentina	Punto Digital Program and Virtual Learning Platform
2/143 (Rev.1)	2023-09-29	Argentina	Plan Conectar
2/142 (Rev.1)	2023-09-29	Argentina	Programme for the acquisition and distribution of robotics kits
2/135	2023-09-18	ATDI	Proposed draft liaison statement from ITU-D Study Group 2 Question 2/2 to ITU-T Study Groups 16 and 20, ITU-R Working Parties 5A and 5D
2/132	2023-09-14	State of Palestine	National data exchange - Unified eXchange Platform
2/122	2023-09-14	Co-Rapporteurs for Question 2/2	Annual progress report for Question 2/2 for October-November 2023 meeting
2/118	2023-09-07	Rwanda	Digital transformation of Rwanda's health and education sectors
2/116	2023-09-06	Kenya	Accessibility of e-government and other socially relevant digital services by the Government of Kenya

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Web	Received	Source	Title
2/110	2023-08-20	CAPDA	Development of a smart education-data management system in organizations in low-income countries
2/109	2023-08-17	Cameroon	Digital transformation of Cameroon's health sector
2/108	2023-08-18	India	Ayushman Bharat Digital Mission - an integrated digital health infrastructure
RGQ2/89	2023-05-25	Vice-Chair of ITU-D SG2; ITU-D SG2 coordinator for WTDC Resolution 9	Proposed draft liaison statement to ITU-T SGs 16 and 20, ITU-R SG1, WPs 1B, 5A, and 5D (copy to ITU-T SGs 2, 3, 5, 9, 13, and ITU-R WPs 1C, 4A, 5B, 5C, 6A, 7B) on questions of mutual interest and implementation of the WTDC Resolution 9 (Rev. Kigali, 2022) for e-services including e-health and e-education
RGQ2/75	2023-05-09	BDT Focal Point for Question 2/2	Global Digital Health Business Case: an ongoing analysis of clinical effectiveness of digital health interventions and projected economic benefits from scaled-up implementation of digital health services
RGQ2/71	2023-05-08	Co-Rapporteurs for Question 2/2	Proposed liaison statement from ITU-D Study Group 2 Question 2/2 to ITU-T Study Group 16 on contribution for consideration by ITU-T
RGQ2/70	2023-05-08	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 contribution for consideration by ITU-R
RGQ2/65	2023-05-06	Qualcomm Inc.	Qualcomm Wireless Reach 5G Smart School in Italy
RGQ2/64	2023-05-06	Qualcomm Inc.	Trends in education technology with accompanying cases studies
RGQ2/62 (Rev.1)	2023-05-03	Seisa University	Report on examples of efforts for 5G utilization in telemedicine, "Remote Robotic Surgery via 5G"
RGQ2/52	2023-04-25	Mexico	Reports on terms and conditions applicable to users in the use of e commerce platforms
RGQ2/50 +Ann.1	2023-04-25	Intel Corporation	WBA Whitepaper on Rural Wi-Fi Connectivity
RGQ2/47	2023-04-23	Vice-Rapporteur for Question 2/2	List of ITU-T publications on issues of mutual interest in the scope of Mandate of Question 2/2
RGQ2/46	2025-04-24	International Chamber of Commerce	Delivering universal meaningful connectivity to enable e-services and applications

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Web	Received	Source	Title
RGQ2/45	2023-04-02	Kenya; ATDI	Resolution 9 (Rev. Kigali, 2022) implementation, ITU-R and ITU-D collaboration - Participation of countries, particularly developing countries, in spectrum management
RGQ2/39	2023-04-14	Côte d'Ivoire	Digital management of COVID-19 in Côte d'Ivoire - Testing process
RGQ2/33	2023-04-05	Benin	Benin student e-learning platform
RGQ2/32	2023-04-05	Benin	MEDOM-Bénin: online health service
RGQ2/26	2023-03-30	Haiti	Benefits of AI to telemedicine
RGQ2/25	2023-03-28	State of Palestine	E-government services system "Hukumati" (My Government)
RGQ2/15	2023-03-15	Burundi	Skills development for students through use of ICTs at reduced rates
RGQ2/12 +Ann.1	2023-03-15	Kuwait	Cloud computing
RGQ2/11	2023-03-16	Intel Corporation	Updated information on global status of Wi-Fi 6
RGQ2/10	2023-03-16	Intel Corporation	Updated information on the Global status of 5G
RGQ2/9	2023-02-23	Liberia	Fibre cable deployment and Liberia Research and Education Network
2/TD/3	2022-12-06	Co-Rapporteurs for Question 2/2	Areas of responsibility - Question 2/2 Management Team
2/TD/2	2022-12-05	Co-Rapporteurs for Question 2/2	Proposed draft liaison statement to ITU-R WP5D
2/85	2022-12-01	Seisa University	Proposed work plan and table of contents for Question 2/2
2/76	2022-11-22	BDT Focal Point for Question 2/2	Leveraging mobile networks in Eastern Caribbean to mitigate COVID-19 'infodemic' and to improve access to evidence-based preventive health guidance and information
2/67	2022-11-16	Republic of Korea	Overview of e-education (e-learning) services in the Republic of Korea
2/58	2022-11-15	Intel Corporation	Importance of computer and broadband programs for households, students and education
2/53	2022-11-10	Seisa University	Study on e-health issues during COVID-19 pandemic supported by ICTs
2/49	2022-11-22	Nazarbayev University	AI-based speech technologies

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Web	Received	Source	Title
2/46	2022-10-17	Inter-Sector Coordination Group	Mapping of ITU-D Questions to ITU-T Questions and ITU-R Working Parties
2/43	2022-10-20	China International Telecommunication Construction Corporation	A case study of using information and communication technology to deal with difficulties in education during the COVID-19 pandemic
2/40	2022-12-03	Telecommunication Development Bureau	Connect2Recover research competition reports on digital inclusion and digital connectivity and resilient digital infrastructure: lessons learnt from COVID-19 pandemic
2/36	2022-10-12	Senegal	Promoting digital transformation: the 2nd Digital Forum and the 1st competition for the President of the Republic's Digital Innovation Grand Prize organized in Senegal in 2020

Incoming liaison statements for Question 2/2

Web	Received	Source	Title
2/239	2024-08-23	ITU-T Study Group 13	Liaison statement from ITU-T Study Group 13 new Technical Report ITU-T TR.SME.FRAMEWORK "Framework for Future Network Technology Integration for Small and Medium Scale Enterprises in Developing Countries"
2/226	2024-07-19	ITU-T Study Group 3	Liaison statement from ITU-T Study Group 3 to ITU-D Study Groups 1 and 2 on creation of new work item on economic and policy aspects of the provision of high-speed Internet connectivity by retail satellite operators
RGQ2/106	2024-02-09	ITU-R Working Party 5D	Reply liaison statement from ITU-R Working Party 5D to ITU-D Study Group 2 Question 2/2 on enabling technologies for e-services and applications, including e-health and e-education
2/156	2023-10-06	ITU-T Study Group 20	Liaison statement from ITU-T Study Group 20 to ITU-D Study Group 2 Question 2/2 on questions of mutual interest and implementation of the WTDC Resolution 9 (Rev. Kigali, 2022) for e-services, including e-health and e-education
2/153	2023-10-04	ITU-T Study Group 12	Liaison statement from ITU-T Study Group 12 to ITU-D Study Group 2 Question 2/2 on agreement of Supplement 30 (P.Suppl_DFS): "Considerations on the automation of Digital Financial Services testing"
2/101	2023-07-31	ITU-T Study Group 16	Liaison statement from ITU-T Study Group 16 to ITU-D Study Group 2 Question 2/2 on contribution for consideration by ITU-T
2/95	2023-07-03	ITU-R Working Party 5D	Liaison statement from ITU-R Working Party 5D to ITU-R Working Parties 5A, 5C and 6A, ITU-D Study Group 2 and ITU-T Study Group 20 on draft new Report ITU-R M.[IMT.APPLICATIONS]: Applications of the terrestrial component of IMT for specific societal, industrial and other usages
2/94	2023-07-03	ITU-R Working Party 5D	Reply liaison statement from ITU-R Working Party 5D to ITU-D Study Group 2 Question 2/2 on mutual interest and implementation of the WTDC Resolution 9 (Rev. Kigali, 2022) for e-services including e-health and e-education
RGQ2/13	2023-03-14	ITU-T Study Group 3	Liaison statement from ITU-T Study Group 3 to ITU-D Study Groups 1 and 2, Question 4/1 and Question 2/2 on revision of ITU-T Technical Report on Economic impact of OTTs and progress on work item Study_OTTs
RGQ2/7	2023-02-17	ITU-T Study Group 20	Liaison statement from ITU-T Study Group 20 to ITU-D Study Group 2 Question 2/2 (reply to ITU-D Q2/2-2/87)

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Web	Received	Source	Title
RGQ2/4	2023-02-14	ITU-R Working Party 5D	Liaison statement from ITU-R Working Party 5D to ITU-D Study Group 2 Question 2/2
2/13	2022-01-18	Telecommunication Standardization Advisory Group	Liaison statement from Telecommunication Standardization Advisory Group (TSAG) to ITU-D Study Groups 1 and 2 on the establishment of JCA on digital COVID-19 certificates (JCA-DCC)

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