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ICT Trends

Digital Healthcare | Mobile Payment | Assistive Technologies | Internet of Things (IoT)

5th Generation Mobile Networks (5G) | Artificial Intelligence and Machine Learning

Blockchain and Shared Ledgers | 3D Printing

ICT Trends

Digital Healthcare

APCICT ASIAN AND PACIFIC TRAINING CENTRE FOR INFORMATION AND COMMUNICATION TECHNOLOGY FOR DEVELOPMENT

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ABOUT

The 2030 Agenda for Sustainable Development provides a plan of action for achieving an economically, socially and environmentally sustainable future. Information and communication technologies (ICTs) are recognized as enablers of the 2030 Agenda for Sustainable Development. Their diffusion and application in all sectors of society provide new solutions to persistent development challenges.

As new technologies, along with increased connectivity, spread rapidly and transform the ICT landscape around the world, it is important for policymakers and government officials to understand the current trends in order to fully leverage the potential benefits of ICT.

This publication aims to provide timely and relevant information on the major ICT trends and the implications of these trends. It serves as a knowledge resource for policymakers and government officials in Asia and the Pacific to increase their awareness and appreciation for the continuously evolving ICT landscape. It intends to present a broad understanding of how new and emerging ICT trends could be utilized to support sustainable and inclusive development.

This publication is a collection of brief write-ups on the following eight ICT trends:

1. Digital Healthcare
2. Mobile Payments
3. Assistive Technologies
4. Internet of Things
5. 5th Generation Mobile Networks
6. Artificial Intelligence and Machine Learning
7. Blockchain and Shared Ledgers
8. 3D Printing

This set of topics was selected based on their relevance to achieving the Sustainable Development Goals (SDGs). The topics selected also aim to provide a broadly representative sample covering a wide range of technology areas spanning hardware, networking, software and data, as well as application domains (i.e., healthcare, finance and disability).

Each write-up introduces the topic by first describing the technology features and components, and then proceeds to highlight potential application areas and use cases, with examples from the Asia-Pacific region and beyond. This is followed by a discussion on the policy implications involving regulatory aspects, standards and linkages to the SDGs. Each write-up may vary slightly to highlight relevant aspects.

The write-ups can be read independent of the other. Although the topics have been presented in a certain sequence, readers may start with any topic of interest and move on to any other topic that they find of relevance or interest. While going through the write-ups, readers may find multiple connections across application domains and technology areas. This has been intentional to foster

a better appreciation of the potential use of the new and emerging technologies for sustainable development. As these are brief descriptions, interested readers are advised to go through the references provided at the end of the write-ups for a more comprehensive understanding of the topics.

ACKNOWLEDGEMENTS

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Ⅰ. Digital Healthcare

Contents

List of Figures

1. Introduction

Throughout Asia and the Pacific, the demand for healthcare has increased significantly. However, the supply of healthcare has failed to catch up with the requirements of the population, largely because of limitations in infrastructure, human resources and financial resources.[1] While out-of-pocket expenditures on health have been on the rise, public health spending by governments has been more or less stagnant. According to World Health Organization (WHO) statistics, countries like Afghanistan, Cambodia, India, Myanmar and Pakistan spend over half of their total health expenditure on out-of-pocket expenses.[2] Moreover, around 44 per cent of WHO member countries have reported poor physician density of less than 1 per 1,000 population.[3] Given these trends in healthcare and the ever-growing and developing field of information and communication technology (ICT), innovations in digital healthcare can help to address the challenges facing the healthcare sector today.

1.1 Digital Healthcare and the SDGs

Sustainable Development Goal (SDG) 3 focuses specifically on good health and well-being. The targets for this goal cover prevention of deaths due to HIV/AIDS, ending various epidemics and communicable diseases, and improving access to medicines and vaccines.[4] To achieve these targets, as well as ensure universal health coverage (which has been emphasized by WHO), countries have been formulating policies and implementing initiatives to improve healthcare access. A key strategy in this direction has been the use of ICT in healthcare. In fact, a WHO report positions electronic health (e-health) as a means of moving towards the goal of universal health coverage and achieving the SDGs.[5]

1 PricewaterhouseCoopers, "The Digital Healthcare Leap", February 2017. Available from https://www.pwc.com/gx/en/issues/high-growth-markets/publications/the-digital-healthcare-leap.html.

2 Out-of-pocket expenditure is any direct outlay by households, including gratuities and in-kind payments, to health practitioners and suppliers of pharmaceuticals, therapeutic appliances, and other goods and services whose primary intent is to contribute to the restoration or enhancement of the health status of individuals or population groups. It is a part of private health expenditure. World Health Organization, "Global Health Observatory (GHO) data". Available from http://www.who.int/gho/en/.

3 Ibid.

4 World Health Organization, "SDG 3: Ensure healthy lives and promote wellbeing for all at all ages". Available from http://www.who.int/sdg/targets/en/.

5 World Health Organization, *Global Diffusion of eHealth: Making Universal Health Coverage Achievable – Report of the Third Global Survey on eHealth* (Geneva, 2016). Available from http://www.who.int/goe/publications/global_diffusion/en/.

1.2 Digital Healthcare Definitions and Scope

According to the Economist Intelligence Unit, digital health is, "the convergence of technologies to support healthy living around the world".[6] There are various terms used when referring to digital healthcare such as e-health, health information technology, health 2.0, telemedicine, telehealth and connected care. All these terms, while pointing out their various components, tend to overlap in terms of their scope. The term e-health emerged around the year 2000 and has been widely used since then. However, the concept has been prevalent much before that. For example, between the 1980s and 1990s, studies on electronic health records revealed their potential in improving quality and efficiency in the delivery of healthcare.[7]

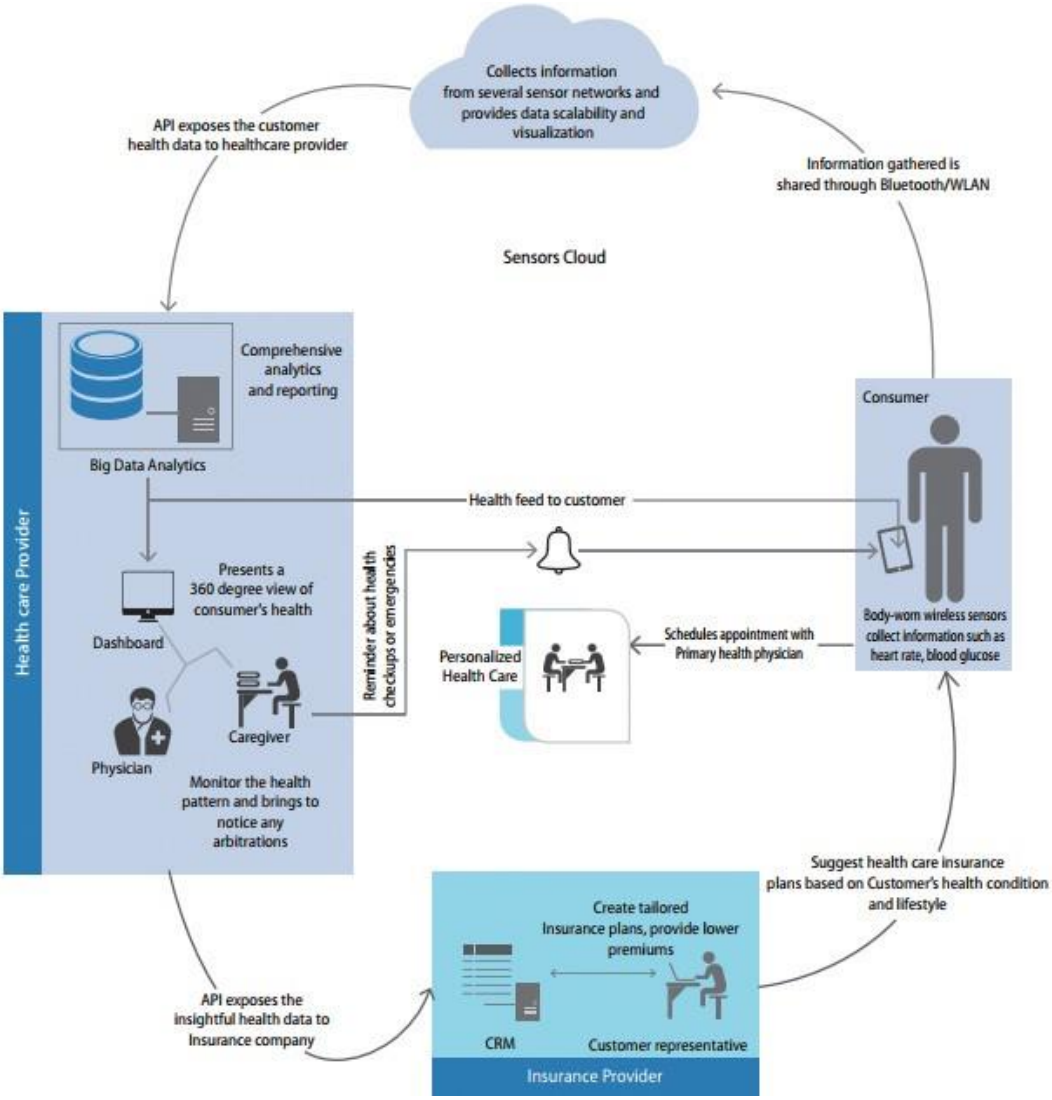
Over the past decades, ICTs have been expected to play an important role in, "health and health-related fields, including healthcare services, health surveillance, health literature, and health education, knowledge and research".[8] While most of the efforts in this area have been on improving existing systems of healthcare service delivery, there have also been efforts towards developing technologies that could provide stand-alone healthcare services. These developments have implications on the way the three main players in the health system, namely the providers, patients and payers, interact with each other.

6 The Economist Intelligence Unit, *Digital Health: Total Convergence Integrating Technology to Solve the World's Healthcare Challenges* (2017). Available from http://www.eiu.com/digital-health.

7 Hossein Riazi, Maryam Jafarpour and Ehsan Bitaraf, "Towards National eHealth Implementation: A Comparative Study on WHO/ITU National eHealth Strategy Toolkit in Iran", *Studies in Health Technology and Informatics* (September 2014), pp. 246-250. Available from https://www.ncbi.nlm.nih.gov/pubmed/25160183.

8 World Health Assembly, "Resolution WHA58.28: eHealth", 2005. Available from http://www.who.int/healthacademy/media/WHA58-28-en.pdf.

Figure 1: Intersection of Various Stakeholders in the Digital Healthcare Ecosystem



Source: Uday Kiran Kotla and Ginni Jain, "Digital Healthcare Ecosystem", Infosys Whitepaper, 2017.

2. Various Components in the Digital Healthcare Space

2.1 M-health and Healthcare Applications

With the expansion of mobile technologies and the increase in global mobile data traffic over the years, there has been an increasing use of mobile computing and communication technologies in healthcare and public health.[9] Mobile health (m-health) has become a major component of digital healthcare as is evidenced by the wide range of m-health initiatives and implementations worldwide.

Text messaging features are the most commonly used while designing m-health solutions. Other features include add-ons (like a glucometer), voice, video, multimedia messaging services and native applications[10] that are generally used for communication between healthcare providers and the patients, for consultations, emergency management, health monitoring and surveillance, and information and education.[11]

While some of the m-health technologies and solutions have been successfully scaled up within the health system, many have run into roadblocks.

Case: Mobile Alliance for Maternal Action (MAMA)

MAMA was developed in partnership with mHealth Alliance, United Nations Foundation and BabyCenter, and funded by the United States Agency for International Development and Johnson & Johnson. This m-health solution uses text messages to create awareness among expectant and new mothers, with the aim to reduce maternal and new-born deaths due to various complications like bleeding, high-blood pressure and infections. MAMA has been implemented in Bangladesh, India and South Africa, taking advantage of the rapidly growing usage of mobile phones in these countries. The text messages sent seek to influence health behaviour like those regarding, "birth spacing, regular antenatal care, exclusive breastfeeding, hand washing, and the use of insecticide-treated bed nets to prevent malaria".[12]

9 Caroline Free and others, "The effectiveness of M-health technologies for improving health and health services: A systematic review protocol", *BMC Research Notes* (2010). Available from https://www.ncbi.nlm.nih.gov/pubmed/20925916.

10 Maddalena Fiordelli, Nicola Diviani and Peter J. Schulz , "Mapping mHealth research: A decade of evolution", *Journal of Medical Internet Research*, vol. 15, no. 5 (2013). Available from https://www.ncbi.nlm.nih.gov/pubmed/23697600.

11 World Health Organization, *Global Diffusion of eHealth: Making Universal Health Coverage Achievable – Report of the Third Global Survey on eHealth* (Geneva, 2016). Available from http://www.who.int/goe/publications/global_diffusion/en/.

12 mHealth Alliance, *Five Years of Mobilizing for Health Impact: Key Achievements & Future Opportunities* (2013). Available from http://www.mhealthknowledge.org/resources/five-years-mobilizing-health-impact-key-achievements-and-future-opportunities.

Case: mSehat Mobile Platform, India

mSehat, which translates as m-health, is a mobile-based platform developed for frontline health workers in India, including the accredited social health activists, Anganwadi workers and auxiliary nurse midwives. mSehat was implemented by the Ministry of Health and Family Welfare as an integrated Android and web-based, multimedia-enabled m-health platform, which can be accessed via smartphones and tablets. The platform provides multimedia-based training and information on demand. It is also used for registration, tracking, counselling, reporting, screening and referral. Other features include automated report generation and the monitoring of medicine stocks.[13] This m-health platform is expected to support the Mother and Child Tracking System, which was launched by the Government of India to monitor the indicators related to pregnancy and child tracking, especially maternal and neonatal outcomes. The use of this mobile solution aims to make data entry and reporting more efficient and quicker, and reduces duplication of efforts that tends to happen in a paper-based data recording system.[14]

2.2 Telemedicine

Telemedicine refers to the use of telecommunications to provide healthcare services to people at a distance. This could include various forms of clinical diagnosis and monitoring of patients. Over time, the term has evolved to becoming synonymous with "telehealth" and it includes the use of ICT in non-clinical activities associated with the health system. The link between the healthcare provider and the patient may be established via telephone, email or a video link, which may be in real time or asynchronous (store and forward). According to WHO's third global survey on e-health, the different types of telehealth initiatives that were reported include teleradiology, teledermatology, telepathology, telepsychiatry and remote patient monitoring.[15]

Similar to m-health, telehealth also includes initiatives or programmes that seek to improve access to information and knowledge, provide a platform for networking and collaboration among stakeholders, support policymaking, health education and training, and improve public accountability in the health system.[16]

Case: Telemedicine in China

The rapid growth of telecommunications in China in recent years has given the required push for the development of major telemedicine networks in the country. Some examples are the Golden Health Network, the International MedioNet of China Network and the People's Liberation Army Telemedicine Network. In the 1980s, China had a system of telemedicine that was dependent on the store-and-forward model. With improved technologies, these telemedicine networks are

13 Government of Uttar Pradesh, India, "About mSehat". Available from http://msehat.in.

14 World Health Organization, *Global Diffusion of eHealth: Making Universal Health Coverage Achievable – Report of the Third Global Survey on eHealth* (Geneva, 2016). Available from http://www.who.int/goe/publications/global_diffusion/en/.

15 Ibid.

16 Ibid.

able to connect medical professionals and various equipment for teleconsultations in real time, and enable file sharing between patients and specialists. This is done via the Internet, wireless communication, satellite communication and Bluetooth.

Case: Tele-ophthalmology by Aravind Eye Care Systems, India

The vision centres set up by Aravind Eye Care Systems especially in the rural communities of India seek to provide primary eye care services. These centres are equipped with wireless and broadband connections, and videoconferencing capabilities that enable specialists to provide basic consultation to patients living in the rural areas. At the same time, this reduces the need for the rural population to travel long distances to consult specialists at the main hospital.[17]

2.3 Health Information Systems

Health information systems of any country are designed to perform the following functions—"data generation, compilation, analysis and synthesis, and communication and use".[18] The objective of health information systems is to aid decision-making at different levels of the health system—individual, facility and country. The establishment of effective and efficient health information systems is expected to enable better monitoring and evaluation, management of diseases and epidemics, management of patients and health facilities, and support research and planning.[19]

Case: Health Information Systems Programme (HISP)

HISP, established by the Department of Informatics at the University of Oslo, is a global network that includes implementing partners like HISP India and HISP South Africa, as well as universities, ministries of health, and international agencies like WHO and the Norwegian Agency for Development Cooperation. HISP was established with the mission to support the design and implementation of sustainable health information systems. It involves the use of participatory approaches that aim to better understand the local health information flows and healthcare delivery systems. Free and open source software solutions guide the design, development and implementation of these local systems. The District Health Information Software or DHIS is the software used for implementing the health information system for online data management, capturing, validation and analytics. It can be adapted to a variety of use cases based on the local conditions and has been implemented in over 50 countries.[20]

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17 Aravind Eye Care System, "Case Studies on Aravind Eye Care System". Available from http://www.aravind.org/default/aboutuscontent/casestudiesOnAravind.

18 World Health Organization, "Health Information Systems: Toolkit on monitoring health systems strengthening", June 2008. Available from http://www.who.int/healthinfo/statistics/toolkit_hss/EN_PDF_Toolkit_HSS_InformationSystems.pdf.

19 Ibid.

20 PATH, "An Interim Review of the Health Information Systems Programme—University of Oslo—with Recommendations for Future Action", 15 June 2016. Available from https://www.mn.uio.no/ifi/english/research/networks/hisp/hisp-assessment-report.pdf.

2.4 Electronic Medical Records and Medical Practice Management Software

An electronic medical record (EMR) consists of a patient's medical history from a particular health facility. Many healthcare providers, both in the private and public sectors, are gradually moving from a paper-based health records system to a digital records system. Ease in storage and retrieval are cited as the main reasons for this shift. Medical practice management software enables medical professionals and other healthcare staff to keep track of the patients that visit their facility, and provides a platform to share relevant details with patients. Practo Ray is an example of such software, which, in addition to managing patient records, includes features like appointment reminders for patients, along with billing and accounts management for administration and finance.[21]

2.5 Electronic Health Records

An electronic health record (EHR) consists of a more comprehensive record of the patient's medical history than an EMR as it includes other providers that are involved in providing care. Authorized medical professionals are able to update and exchange patient records, which may consist of doctors' notes, diagnostic results and medications.

A well-designed EHR system ensures easy accessibility of relevant elements of patient records for both patients and doctors at different facilities. By following appropriate interoperability standards, EHR systems enable patients to move from one medical facility to another by equipping them with the relevant medical records of their former interactions within the health system. This avoids unnecessary duplication of efforts by the doctors and medical professionals when they chart out appropriate treatment plans for the patients, and thus enhances the efficiency of healthcare provision. Furthermore, doctors, other healthcare professionals and the government can use aggregated patient data from the EHR system to better understand trends in diseases and health-related habits of patients for whom the data is available.

Some key concerns that arise from the use of EMRs and EHRs are related to the privacy and confidentiality of health data, ownership and access, security, and the legal implications of such records. There are also challenges related to rolling out the systems, which requires changing the behaviour and practices of medical professionals. Other barriers include the lack of standardization and interoperability of systems, along with high costs of implementation and maintenance. All these challenges prompted WHO to publish a manual on the implementation of EHRs for developing countries.[22]

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21 Yourstory, "Practo Online Patient Care", 23 June 2011. Available from https://yourstory.com/2011/06/practo-online-patient-care/.

22 World Health Organization, *Electronic Health Records: Manual for Developing Countries* (Geneva, 2006). Available from http://www.wpro.who.int/publications/docs/EHRmanual.pdf.

Case: Singapore's National Electronic Health Record (NEHR)

The Singapore Ministry of Health along with Accenture designed and launched the NEHR, a nationwide patient data exchange system that aims at achieving its vision of, "One Patient, One Health Record". The project started in 2009, but it was only in 2013 that the system was made available to public health institutions and some private ones. It provides a consolidated view of a patient's medical history to healthcare professionals who are part of the network. According to the NEHR brochure, the information in the NEHR includes the following: admission and visit history, hospital inpatient discharge summaries, laboratory results, radiology results, medication history, past operations details, allergies and adverse drug reactions, and immunizations.[23] Figure 2 gives the stated objectives of the project.

One of the challenges that the NEHR system is trying to overcome is the lack of uptake among the private healthcare practitioners. This adversely affects the comprehensiveness and continuity in EHR data and may hamper effective decision-making. Issues like privacy and confidentiality and patient autonomy with regard to records are also being discussed by the Ministry of Health and the Singapore Medical Association (the national association for medical practitioners).[24]

Figure 2: Objectives of Singapore's National Electronic Health Record System

Stakeholder	Definition	EHR Objective
Clinician	Doctors, nurses, pharmacists, diagnostic clinicians, allied health and clinical support staff who provide services to patients in care delivery settings	To transform the way clinicians make decisions and deliver care through better information and cognitive support
Health Administrator	Ministry of Health, health statutory boards, hospital executives/management and health insurance companies	To gather information that will aid future resource allocations through deeper understanding of healthcare needs
Patient	Individuals who receive care from the Singapore healthcare system, including citizens, permanent residents, work permit holders and others	To improve the overall health of the population through better targeted interventions and confidence that clinicians have immediate critical information available to deliver high-quality care

Source: Accenture, *Singapore's Journey to Build a National Electronic Health Record System* (2012).

23 Ministry of Health, Singapore, "NEHR Singapore, Brochure – English". Available from https://www.moh.gov.sg/content/dam/moh_web/Publications/Educational%20Resources/Brochure_Eng.pdf.

24 SMA News, "SA's Letter to MOH on patient privacy and confidentiality under NEHR", June 2017.

2.6 Other Trends in Digital Healthcare

Virtual Reality

Virtual reality has been defined as technology that, "provides a computer-generated 3D environment that surrounds a user and responds to that individual's actions in a natural way, usually through immersive head-mounted displays".[25] It also involves technologies that enable head and hand tracking. A survey[26] on the applications of virtual reality-based technologies pointed out the benefits of using such technologies for improvements in quality and reduction of costs in healthcare. It revealed that virtual reality can be used in performing actual surgical procedures through remote surgery or telepresence, and augmented or enhanced surgery. Medical education and training is a major area for applying virtual reality as it can be used to perform computer-simulated surgeries and other procedures for training healthcare professionals. Some administrative uses of the technology include visualization of massive medical databases and architectural design for healthcare facilities. An individual patient can also use it for various kinds of medical therapy, for example, managing pain or fears/phobias, physical therapy and cognitive rehabilitation.[27]

Wearables, Sensors and the Internet of Things

"The Internet of Things (IoT) is a collective term for any one of the many networks of sensors, actuators, processors and computers connected to the Internet".[28] The development and use of wearable technologies, sensors and other connected devices for providing various healthcare services in the hospital, as well as at home, has been increasing over the past decade. In addition to tracking patients, it can also be used for tracking equipment and medicines.

For example, an IoT-enabled smart fridge was developed by Weka Solutions using Microsoft IoT to support supply chain management of vaccines. Each vaccine has an attached sensor that helps in storage at right temperature, dispensing of right dosage and automatic tracking of inventory. With sensors that collect real-time data, the IoT platform in the smart fridge also enables 24x7 monitoring and analysis.[29]

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25 Gartner, "IT Glossary: Virtual Reality (VR)". Available from http://www.gartner.com/it-glossary/vr-virtual-reality/.

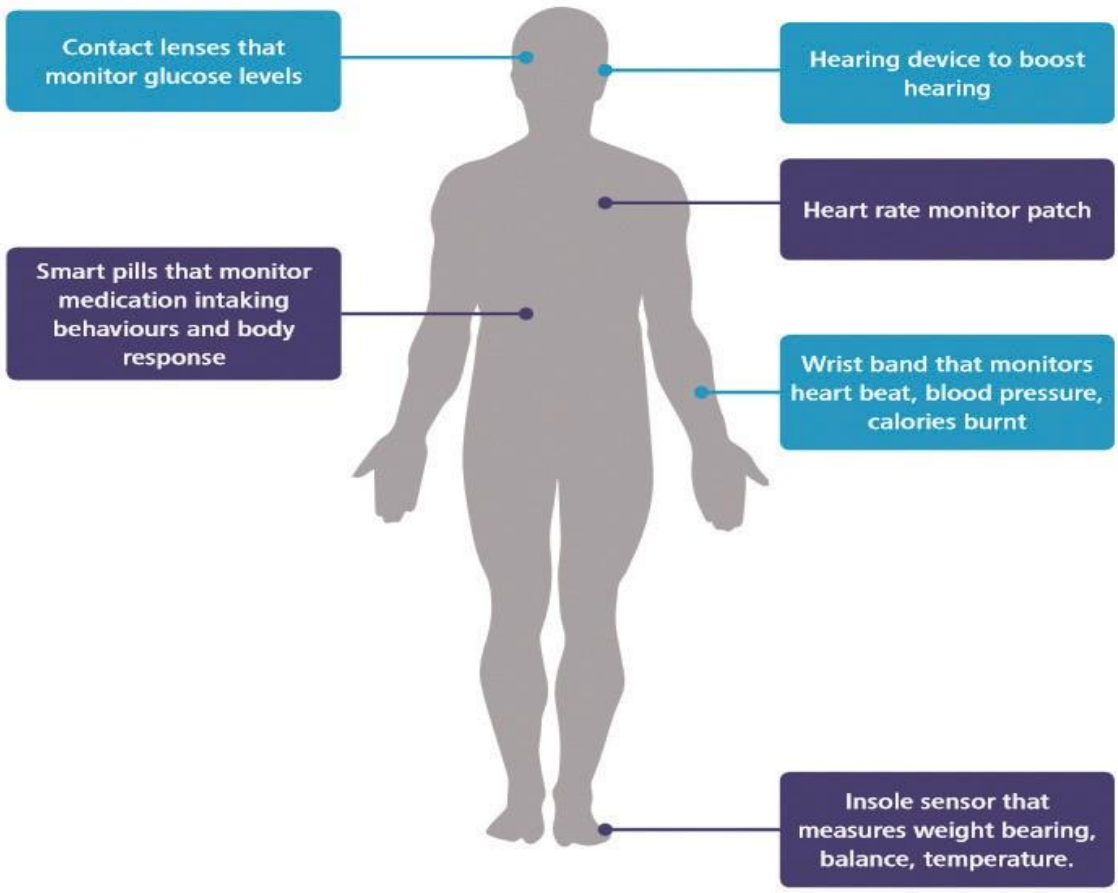
26 Judi Moline, "Virtual reality for health care: A survey", *Studies in Health Technology and Informatics* (1997), pp. 3-34. Available from https://www.ncbi.nlm.nih.gov/pubmed/10175341.

27 Wendy Powell, "Five ways virtual reality is improving healthcare", *Independent*, 26 June 2017. Available from http://www.independent.co.uk/life-style/health-and-families/five-ways-virtual-reality-is-improving-healthcare-a7801006.html.

28 Phillip A. Laplante and Nancy Laplante, "The Internet of Things in Healthcare: Potential Applications and Challenges", *IT Professional*, vol. 18, no. 3 (May-June 2016), pp. 2-4. Available from http://ieeexplore.ieee.org/document/7478533/.

29 Barb Edson, "IoT-enabled Smart Fridge helps manage vaccines and saves lives", *Microsoft*, 16 August 2016. Available from https://blogs.microsoft.com/iot/2016/08/16/iot-enabled-smart-fridge-helps-manage-vaccines-and-saves-lives/.

Figure 3: Innovations in Wearable and Sensor Technologies



Source: *Deloitte, Connected health: How digital technology is transforming human and social care* (2015). Available from https://www2.deloitte.com/content/dam/Deloitte/uk/Documents/life-sciences-health-care/deloitte-uk-connected-health.pdf.

Big Data, Artificial Intelligence and Machine Learning

Large amounts of health data are generated on a daily basis through the various modes of technologies that have permeated the healthcare industry. Artificial intelligence and machine learning play a huge role in providing meaning to the collected data, which tends to be largely unstructured. In health, artificial intelligence improves clinical diagnosis by analysing complex medical data.[30] This involves training machines with various kinds of health data in order to mirror the processes of human learning and cognition. IBM's Watson technology, which involves artificial intelligence or cognitive computing, has been used by multiple organizations for its potential application in storing and rapidly analysing vast amounts of data.[31]

30 ESCAP, *Artificial Intelligence and Broadband Divide: State of ICT Connectivity in Asia and the Pacific* (Bangkok, 2017). Available from http://www.unescap.org/resources/artificial-intelligence-and-broadband-divide-state-ict-connectivity-asia-and-pacific-2017.

31 PricewaterhouseCoopers, "What doctor? Why AI and robotics will define New Health", June 2017. Available from https://www.pwc.com/gx/en/industries/healthcare/publications/ai-robotics-new-health.html.

Robotics

The use of robotics in surgery has been prevalent for over 30 years, with the first known surgical robot being PUMA or programmable universal machine for surgery, which was used for urology surgery.[32] Robotics may be used to either assist the surgeon or may even be programmed to perform procedures on their own. For example, RoBear, a bear-shaped nursing care robot developed in Japan, is capable of taking care of elderly patients who may need to be lifted and assisted to sit on a wheelchair.[33]

3D Printing

3D printing or additive manufacturing technologies have been used in healthcare to create implants and prosthetics, as well as medical models and devices. The latest development is 3D bioprinting, which involves printing using cells. While the costs of printing generally depend on the materials used, 3D printing is considered a cost-effective technology because of the precision it brings to the process.

3D-printed skin has been used for treating burn victims in the past. Implants for babies as young as three months have been designed in such a manner that they grow along with the patient.[34] Researchers in Princeton University, USA have created a fully functional "bionic ear" that can surpass human hearing capabilities using 3D printing of cells and nanoparticles combined with a small coil antenna, thereby "merging electronics with tissue".[35]

32 Ibid.

33 Stuart Dredge, "Robear: The bear-shaped nursing robot who'll look after you when you get old", *The Guardian*, 27 February 2015. Available from https://www.theguardian.com/technology/2015/feb/27/robear-bear-shaped-nursing-care-robot.

34 Drew Hendricks, "3D Printing Is Already Changing Health Care", *Harvard Business Review*, 4 March 2016. Available from https://hbr.org/2016/03/3d-printing-is-already-changing-health-care.

35 John Sullivan, "Printable 'bionic' ear melds electronics and biology", *Princeton University*, 8 May 2013. Available from https://www.princeton.edu/news/2013/05/08/printable-bionic-ear-melds-electronics-and-biology.

3. Potential Benefits of ICT in Health

A systematic review of around 100 studies on telehealth revealed that a major impact of using ICTs in health has been improvements in the quality of healthcare. This was followed by improvements in access and cost effectiveness or minimization.[36]

From the perspective of healthcare providers, digital health technology has helped by reducing paperwork time, hospital admissions and bed days, and improving patient face time. A lot of these technologies have a focus on preventive care, promote patient independence and minimize use of healthcare services that can be avoided. All these have positive effect on patient outcomes. In such a scenario, patients are empowered through self-management, education and awareness, and supported with alternative communication platforms to interact with their healthcare providers. This implies a shift from a "paternalistic model of healthcare" to an "empowered patient sharing ownership" model.[37]

Figure 4 lists benefits of different types of digital healthcare technologies. As can be seen from the table, cost savings and better quality of healthcare are considered some of the main benefits of these technologies.

Figure 4: Summary of Benefits of Digitizing Healthcare for Patients, Providers and Payers

	Patients	Providers	Payers
EMR	Easier to read and understand	Easy storage and retrieval; improved efficiency and productivity	
EHR	Better diagnosis and treatment	Coordination and informed decision-making	Faster reimbursements
Personal Health Records	Personal wellness management	Consistency of information	Links to healthcare plans and lower claims
Remote Diagnostics	Reduces duplicated tests and referrals	Easy access	Lower cost
Remote Monitoring	Patient-centric integrated care	Reduce emergency and re-admissions	Lower cost
Telecare	Access to specialist care	Improves productivity and reduces burden of healthcare resources	Lower cost
mHealth applications	Greater patient engagement and saves time	Proactive and targeted care	
Big Data/Analytics	Accurate diagnosis, better treatment	Improves diagnostics and accuracy of treatment	Lower cost

* EMR – Electronic Medical Records; EHR – Electronic Health Records

Source: PricewaterhouseCoopers, "The Digital Healthcare Leap", February 2017. Available from https://www.pwc.com/gx/en/issues/high-growth-markets/publications/the-digital-healthcare-leap.html.

36 Hammad Durrani and Shariq Khoja, "A systematic review of the use of telehealth in Asian countries", *Journal of Telemedicine and Telecare*, vol. 15, no. 4 (2009), pp. 175–181. Available from https://www.ncbi.nlm.nih.gov/pubmed/19471028.

37 Deloitte, *Connected health: How digital technology is transforming human and social care* (2015).

4. Policies and Strategies for Digital Health

With the proliferation of different kinds of technologies in healthcare, there is an urgent need for well-articulated policy and regulatory frameworks regarding the various aspects of e-health. These policies are required not just within countries but also at a global level. At the same time, every country or region needs a policy framework that considers the context in which ICT is being implemented. This is important, especially for developing countries, wherein replicating or emulating successful ICT interventions from developed countries can be problematic if the context is ignored.[38]

Against this background, WHO and the International Telecommunication Union collaborated to develop the National eHealth Strategy Toolkit. Published in 2012, it details the components and processes that are to be considered while developing e-health strategies or refining existing ones. The toolkit provides guidelines for governments to formulate a national e-health vision document for the country along with an action plan and monitoring framework.[39] WHO has also published specialized manuals and guidelines for the implementation of health information systems and EHRs, with a special focus on developing countries.

In 2015, the Broadband Commission for Sustainable Development formed a Working Group on Digital Health. It launched a report in 2017 that highlighted the role of government leadership and cooperation for advancing the role of ICTs in healthcare by focusing on financing, governance and the setting up of national frameworks that takes into consideration issues like connectivity, interoperability and common standards.[40]

According to a survey by the WHO Global Observatory for eHealth, 73 out of the 125 responding member states (i.e., around 58 per cent) reported to have any form of e-health strategy in place. However, a higher percentage (around 66 per cent) reported to having a health information system policy in place. In the case of privacy legislations, around 78 per cent of these countries have reported having any policies that regulated personally identifiable information.[41]

38 Hammad Durrani and Shariq Khoja, "A systematic review of the use of telehealth in Asian countries", *Journal of Telemedicine and Telecare*, vol. 15, no. 4 (2009), pp. 175–181. Available from https://www.ncbi.nlm.nih.gov/pubmed/19471028.

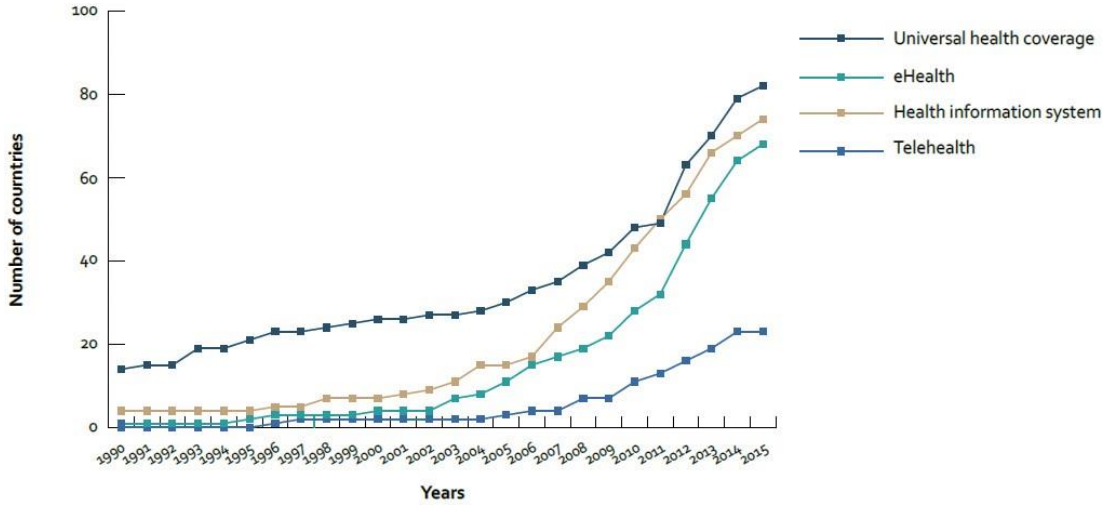
39 World Health Organization and International Telecommunication Union, *National eHealth Strategy Toolkit* (Geneva, 2012). Available from http://www.itu.int/pub/D-STR-E_HEALTH.05-2012.

40 Broadband Commission for Sustainable Development, "Working Group on Digital Health". Available from http://www.broadbandcommission.org/workinggroups/Pages/digitalhealth.aspx.

41 World Health Organization, *Global Diffusion of eHealth: Making Universal Health Coverage Achievable – Report of the Third Global Survey on eHealth* (Geneva, 2016). Available from http://www.who.int/goe/publications/global_diffusion/en/.

However, such policies sometimes tend to be vague and nebulous as to what it wants to achieve. A few countries in Asia like China, India, Indonesia, Malaysia, Republic of Korea, Singapore and Thailand have some form of national e-health policy in place. However, it has only been a few years since their implementation and hence, it is still quite early to assess their impact. Figure 4 gives the timeline of adoption of e-health strategies by countries during 1990-2015.

Figure 5: Number of Countries with Universal Health Coverage, E-health, Health Information System and Telehealth Policies or Strategies, Cumulatively by Year of Adoption, 1990-2015



Source: World Health Organization, *Global Diffusion of eHealth: Making Universal Health Coverage Achievable – Report of the Third Global Survey on eHealth* (Geneva, 2016). Available from http://www.who.int/goe/publications/global_diffusion/en/.

Case: Malaysia's Telemedicine Act 1997

Malaysia is considered to have a, "proactive, moderately comprehensive, structured policy" when it comes to e-health.[42] The Telemedicine Act of 1997 along with the Digital Signature Act of 1997, Communication and Multimedia Act of 1998, and Personal Data Protection Act of 2003 provided the necessary environment for its e-health strategies to grow.[43] Telehealth was implemented as a flagship application by the Ministry of Health in Malaysia as part of the Multimedia Super Corridor Project. It included components on personalized health information and education for individuals, distance education and learning for medical professionals, teleconsultation, and EHR. The initiative introduced the concept of a Lifetime Health Plan for its citizens that includes activities such as health promotion, illness care plans for specific disease and conditions, alerts and reminders, and health status monitoring. The initiative was expanded in 2004 to include an online health portal for health promotion and call centre services.[44]

42 Richard E. Scott, Penny Jennett and Maryann Yeo, "Access and authorisation in a Global e-Health Policy context", *International Journal of Medical Informatics*, vol. 73, no. 3 (2004), pp. 259-266. Available from https://www.ncbi.nlm.nih.gov/pubmed/15066556.

43 Ibid.

44 M. H. Mat Som, A. N. Norali and M. S. A. Megat Ali, "Telehealth in Malaysia: An overview", *2010 IEEE Symposium on Industrial Electronics & Applications* (October 2010), pp. 660-664. Available from ieeexplore.ieee.org/abstract/document/5679384/.

Case: E-health Policies and Strategies in India

The Government of India proposed the establishment of a National eHealth Authority as the regulatory body to ensure the promotion and development of the e-health ecosystem in the country. This involves regulating EHRs, health information exchange and other digital health initiatives. Its functions also include policy formulation, development and release of standards, regulating privacy and security, and certification for e-health solutions and products.[45] In 2016, the e-health section of the Ministry of Health and Family Welfare formulated and released standards for implementing EHR systems across the country. These standards have been devised for disease classification, medicine and clinical terminology, laboratory data exchange, digital imaging and communication, and unique identifiers for patients for interoperability.[46] Other initiatives include an online registration system for managing appointments, the National Telemedicine Network Scheme for teleconsultation and tele-follow-up services at primary healthcare facilities in the public health system, and computerization of public health facilities to support implementation of health information systems.[47]

45 Ministry of Health and Family Welfare, India, "Concept Note: National eHealth Authority", no date.

46 Press Information Bureau, India, "Online Prescription", 2 December 2016. Available from http://pib.nic.in/newsite/PrintRelease.aspx?relid=154775.

47 Ibid.

5. Role of Standards in Digital Health

Policy frameworks should be supported by standards, architectures and solid partnerships among stakeholders.[48] Multiple organizations like the International Organization for Standardization, Standards Association of IEEE and Health Level Seven International have emphasized the importance of standards in the area of digital health. Interoperability is an important keyword when it comes to designing an e-health system, and standards play an important role in ensuring seamless exchange of information and better management of complex health data.[49] According to Health Level Seven International, standards provide, "a comprehensive framework for the exchange, integration, sharing and retrieval of electronic health information that supports clinical practice and the management, delivery and evaluation of health services". This can be achieved through an ongoing collaboration among various stakeholders associated with the health system and by establishing affiliate organizations that support the use of these standards at the local level.[50] The Standards Association of IEEE has developed relevant standards for, "the promotion and expansion of connectivity and communication between personal health and wellness devices". Through its studies it has tackled important issues, including ways that standards can help to mitigate technological risks, facilitate interoperability, help save costs and promote adoption in the marketplace.[51]

48 World Health Organization, *mHealth: New horizons for health through mobile technologies* (Geneva, 2011). Available from http://www.who.int/goe/publications/goe_mhealth_web.pdf.

49 International Organization for Standardization, "Strengthening national health systems through a capacity-based eHealth architecture", no date. Available from https://www.iso.org/iso/14639-brochureversionv7.pdf.

50 Health Level Seven International. Available from http://www.hl7.org/.

51 IEEE Standards Association, "eHealth". Available from http://standards.ieee.org/innovate/ehealth/.

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Glossary

E-health : The use of ICT for health.

Interoperability : The ability of different information technology systems and software applications to communicate, exchange data and use the information that has been exchanged.

Telemedicine : The practice of medicine when the doctor and patient are widely separated using two-way voice and visual communication (by satellite or computer).

Universal health coverage : Ensuring that all people have access to needed promotive, preventive, curative and rehabilitative health services, of sufficient quality to be effective, while also ensuring that people do not suffer financial hardship when paying for these services.

Acronyms

E-health	Electronic Health
EHR	Electronic Health Record
EMR	Electronic Medical Record
ICT	Information and Communication Technology
IoT	Internet of Things
M-health	Mobile Health
SDG	Sustainable Development Goal
WHO	World Health Organization

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