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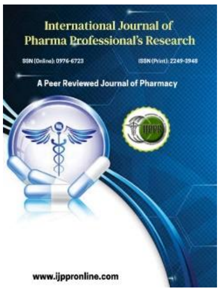

Impact of Digitalization on the Healthcare System

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Abstract: Digitalization is a pressing necessity with enormous potential to alter economic growth parameters, forging a mutually beneficial relationship with employment generation and long-term sustainability. The domain of healthcare has been moving into the digital world relatively late and only recently has started with digitalizing processes and services on a larger scale. Still, the potential for disruption in the healthcare industry is enormous. Healthcare digitization brings about many benefits to both patients and healthcare professionals throughout different stages in the patient journey. In this paper we review existing impact of digitalization in healthcare system. Digital health indeed needs to be seen as a broad concept whereby the purposes of healthcare are served through technologies that are combined for universal healthcare access, applications across various multi-disciplinary fields and ecosystems in healthcare and the health journey of people, as patients needing (access to) care and as citizens enabled to live healthier and prevent sickness. We conclude by outlining the implications and benefits of digitizing healthcare. There is a potential to improve healthcare by digitalization.

1. Introduction

Digitization (i.e., the process of converting analogue data into digital data sets) is the framework for digitalization, which is defined as the exploitation of digital opportunities. Digital transformation is then defined as the process that is used to restructure economies, institutions and society on a system level.[1,2] While the latter embraces changes on all societal levels, digitalization by means of combining different technologies (e.g., cloud technologies, sensors, big data, 3D printing) opens unforeseen possibilities and offers the potential to create radically new products, services and BM.[3] The world of companies is marked by high dynamic and complexity as well as globalization of competition and digitalization. Globalization, technological innovation as well as digitalization and increased products, capital and people circulation are the most important long term growth drivers. New digital systems bring huge advantages to the people. However, through digitalization and networking appear also new challenges like risk of perturbation in the delivery chain. The effects of digitalization and of developed new technologies will penetrate all aspects of economy and society; because the technology change will influence the economic growth more. New digital opportunities open up for continuous development and improvement of products, processes and services.[4] Digitalization is a pressing necessity with enormous potential to alter economic growth parameters, forging a mutually beneficial relationship with employment generation and long-term sustainability. Digitalization has stretched its wings over all aspects of existence in this era of technological growth, where everything revolves around the digital world. [5]

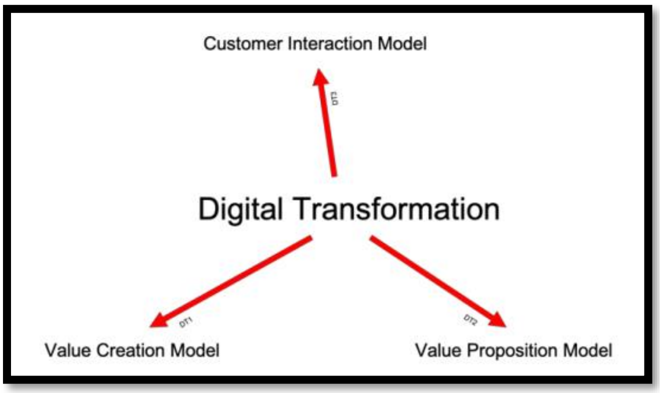

Figure 1: Dimensions of Digital Transformation

Digital transformation is based on direct and indirect effects of the application of digital technologies and techniques on organizational and economic conditions on the one hand and new products and services on the other. Besides constantly increasing computing power and miniaturization of classical IT components, the ubiquitous integration of these components into all types of technology has to be taken into account, especially in conjunction with: comprehensive use of sensors and actors including audio and video recordings, use of mobile communication technologies for networking and automated communication with very low latency (Internet of Things), elicitation, archiving and processing of very large data sets with the application of big data techniques, various techniques of machine learning, advanced forms of human-computer interaction. Particularly, the combination of these factors leads to new potentials for comprehensive automation of cognitive und mixed mechanical-cognitive tasks. [6] Digital inclusion also has a huge impact on job creation as a whole economy: 10 percent increase in digital integration reduces globalization the unemployment rate is 0.84 percent. From 2009 to 2010, digital usage has added an estimated 19 million jobs to the global economy, from an estimated 18 million jobs were added from 2007 to 2008. This is especially so critical detection of emerging markets, which will need to create hundreds of millions of jobs over the next ten years to ensure its prosperity The number of young people can contribute to their country's economy. Finally, the 10-point increase in digital input rises by 6 points at country points in the Global Innovation Index14 – mergers suggest that, as the world continues its digital development, there are also new names.[7] Digitization refers to creating a digital representation of physical objects or attributes. Digitalization refers to enabling or improving processes by leveraging digital technologies and digitized data. Digital Transformation is really business transformation enabled by digitalization. [8]

2. Digital Transformation

Digital transformation is "a series of deep and coordinated culture, workforce, and technology shifts that enable new educational and operating models and transform an institution's operations, strategic directions, and value proposition." Many people mistake digital transformation for other applications of information technology to work and personal life: digitization (of analog information) and digitalization (of processes)

(See Figure 2). But Dx is very different from either of these. It is more complex and more impactful. Our survey was careful to provide a definition and context for Dx to ensure that respondents were reporting on digital transformation rather than digitization or digitalization by defining all three and repeatedly clarifying whether we were asking about digital transformation, digitalization, or digitization. [9,10]

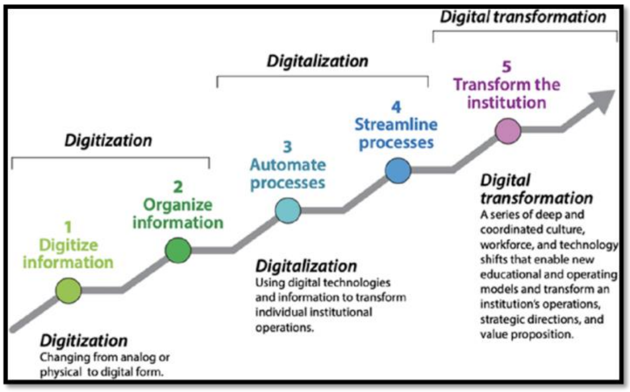

Figure 2: Digital transformation in context

3. Healthcare System

India has a mixed health-care system, inclusive of public and private health-care service providers.[11] However, most of the private healthcare providers are concentrated in urban India, providing secondary and tertiary care health-care services. The public health-care infrastructure in rural areas has been developed as a three-tier system based on the population norms.[12]

i. **Sub-centers:** A sub-center (SC) is established in a plain area with a population of 5000 people and in hilly/difficult to reach/tribal areas with a population of 3000, and it is the most peripheral and first contact point between the primary health-care system and the community. Each SC is required to be staffed by at least one auxiliary nurse midwife (ANM)/female health worker and one male health worker (for details see recommended staffing structure under the Indian Public Health Standards (IPHS)). Under National Rural Health Mission (NRHM), there is a provision for one additional ANM on a contract basis. SCs are assigned tasks relating to interpersonal communication to bring about behavioral change and provide services in relation to maternal and child health, family welfare, nutrition, immunization, diarrhea control and control of communicable diseases programs. The Ministry of Health & Family Welfare is providing 100% central assistance to all the SCs in the country since April 2002 in the form of salaries, rent and contingencies in addition to drugs and equipment.

ii. **Primary health centers:** A primary health center (PHC) is established in a plain area with a population of 30 000 people and in hilly/difficult to reach/tribal areas with a population of 20 000, and is the first contact point between the village community and the medical officer. PHCs were envisaged to provide integrated curative and preventive health care to the rural population with emphasis on the preventive and promotive aspects of health care. The PHCs are established and maintained by the State Governments under the Minimum Needs Program (MNP)/Basic Minimum Services (BMS) Program. As per minimum requirement, a PHC is to be staffed by a medical officer supported by 14 paramedical and other staff. Under NRHM, there is a provision for two additional staff nurses at PHCs on a contract basis. It acts as a referral unit for 5-6 SCs and has 4-6 beds for inpatients. The activities of PHCs involve health-care promotion and curative services.

iii. **Community health centers:** Community health centers (CHCs) are established and maintained by the State Government under the MNP/BMS program in an area with a population of 120 000 people and in hilly/difficult to reach/ tribal areas with a population of 80 000. As per minimum norms, a CHC is required to be staffed by four medical specialists, that is, surgeon, physician, gynecologist/obstetrician and pediatrician supported by 21 paramedical and other staff. It has 30 beds with an operating theater, X-ray, labor room and laboratory facilities. It serves as a referral center for PHCs within the block and also provides facilities for obstetric care and specialist consultations.

iv. **First referral units:** An existing facility (district hospital, sub-divisional hospital, CHC) can be declared a fully operational first referral unit (FRU) only if it is equipped to provide round-the-clock services for emergency obstetric and newborn care, in addition to all emergencies that any hospital is required to provide. It should be noted that there are three critical determinants of a facility being declared as an FRU: emergency obstetric care including surgical interventions such as caesarean sections; care for small and sick newborns; and blood storage facility on a 24-h basis. Schematic diagram of the Indian Public Health Standard (IPHS) norms, which decides the distribution of health-care infrastructure as well the resources needed at each level of care is shown in Figure 3. [13,14]

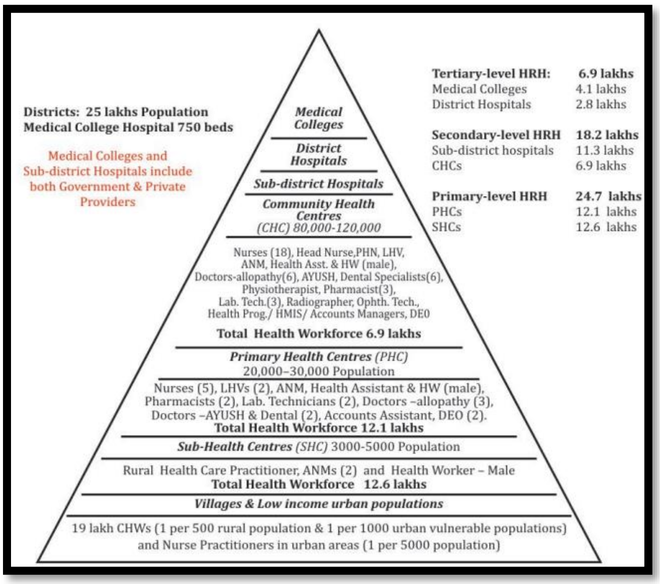

Figure 3: Norms at Primary, Secondary, and Tertiary Levels

3.1 Challenges of Healthcare System

Current healthcare issues could impact the patient experience, the efficiency of your operations, and your bottom line. To enact all the right changes, you must first explore all the biggest challenges physicians face today. Some of them are:

i. **Cybersecurity Threats:** Your patients trust you to securely hold onto all their most personal data, including personally identifiable info, medical records, and payment methods. Unfortunately, the rising risk of cybersecurity attacks endangers all that data – and the reputation of your healthcare center. In 2021, the rate of cyberattacks against healthcare centers tripled. Nearly 50 million people had their protected healthcare data breached as a result, resulting in costly shutdowns and the erosion of patients' trust.

ii. **Telehealth Implementation:** As evidenced by its rapid growth in 2020, telehealth was key in providing patient care while managing the risk of COVID-19 transmission. In response, virtual visits peaked in April 2020 at 78 times higher than their prior rate. Since that initial jump, telehealth visits have stabilized at 38 times higher than pre-pandemic levels, showing their popularity with patients. And that's a great thing. The improved accessibility to healthcare makes it easier for physicians to help patients manage their conditions. Plus, the virtual visits allow you to handcraft the ideal patient experience every time. More than 75% of patients show interest in telehealth, yet utilization rates remain in the 50% range.

iii. **Invoicing and Payments:** With all its medical jargon, complex coverage rules, and ever-changing approaches, the healthcare billing world doesn't make much sense to patients. Over 70% of patients find both the insurance explanation of benefits and their portion of the bills wholly confusing. On top of that, medical bill management portals rarely align with your patients' payment preferences. Late or altogether missing payments then occur as patients fail to find a way to manage their bills.

Your revenue cycle management abilities decline in response, leaving you trying to find a way to keep your clinic afloat.

iv. **Price Transparency Mandate:** In response to patient complaints about surprise billing issues, the Centers for Medicare & Medicaid Services created the Hospital Price Transparency mandate. Although enacted in early 2021, only 5% of hospitals have achieved full compliance. Worse yet, more than 50% still don't publish the rates negotiated with insurance companies. Patients remain completely in the dark about their healthcare costs – and many are not standing for it. While the mandate only affects hospitals, healthcare centers of all sizes, including solo practices, are feeling hurt as a result. In the coming years, you can expect to see patients looking into the price of your healthcare services before deciding where to get care.

v. **IT Healthcare Investments:** Alongside the push for healthcare pricing transparency, patients want healthcare centers to eliminate wasteful spending. With up to 25% of health spending deemed wasteful, there's the potential for big savings over the years. Although the waste factors are numerous, administrative complexity, poor care coordination, and low-value care add up to a stunning $444 billion in excess spending every year.

vi. **Patient Experience:** A positive patient experience is a must if you want to boost care outcomes, retention rates, and profitability. When given favorable care experiences, your patients are more likely to adhere to medical advice. Better healthcare outcomes follow, boosting patient retention rates and lowering malpractice risk.

vii. **Effective Payment Models**: In the past, healthcare centers solely relied on the fee-for-service payment model for reimbursement. If you're using that model, your profitability largely depends on getting more patients through the doors and completing key procedures. Within that model, your physicians are not incentivized to promote preventative care and work within a coordinated care team. In recent years, the value-based payment model has started to take hold instead. This model largely aligns reimbursement rates with patient outcomes. Although only 15% of physicians have made the switch, the results speak for themselves. Patients seeing physicians using the value-based model get a higher quality of care, including better management of all their chronic conditions.

viii. **Healthcare Staffing Shortages:** Healthcare staffing shortages started in earnest during the pandemic and they're not likely to end any time soon. A recent study by the Association of American Medical Colleges forecasts a shortage of up to 104,900 physicians by 2030. As your physicians retire at rapid rates, your patient population will continue to age and grow. Their healthcare demands will steadily outpace the number of primary care and specialty providers as that occurs. Keeping up with the increasing demand will likely become one of the biggest challenges physicians face while serving their patient populations. [15]

3.2 Implications for Healthcare System

The implications of the direct-to-consumer approach as presented by Wu et al. would be profound and fundamentally change the healthcare industry as it exists in most countries. Whilst in the UK and most of Scandinavia healthcare is mainly financed by the government or its agencies through taxation and implies a single-payer system, in countries such as France, Germany, Belgium, Netherlands and Japan, healthcare is partly paid for by the government through taxes and employers' and citizens' insurance and involves a multiplayer system. [16] Providers of market priced health services would probably encounter widespread reluctance or inability of patients to pay for digital health services. While startups are hoping to compete on cost and choice, market-based financial considerations or choice may have a limited place in healthcare. If people are beset by a sudden health problem, they usually do not act like consumers. Even in a more market–based healthcare system as can be found in the US, where healthcare is paid for by employers and citizens, a different approach is currently pursued. In 2018, the Centers for Medicare and Medicaid Services introduced changes to the 2018 Medicare Physician Fee schedule which allows practitioners to seek separate reimbursement for certain digital health services such as remote monitoring. [17]

3.3 Digital Healthcare Services

Digital health is a broad umbrella term that includes eHealth and the use of emerging and advanced technologies in the field of, among others, big data, genomics and artificial intelligence per the World Health Organization (more below). mHealth (mobile health) is a subset of eHealth while digital health is defined as the use of digital technologies for health, a field of practice for employing routine and innovative forms of information and communications technology to address health needs. [18] Digitalization is playing an increasingly significant role in practically all areas of society. The domain of healthcare has been moving into the digital world relatively late and only recently has started with digitalizing processes and services on a larger scale. Still, the potential for disruption in the healthcare industry is enormous. Although approaches to healthcare financing and regulatory schemes differ greatly between countries, it is generally recognized that current healthcare systems are characterized by lack of transparency and inefficiencies and that digitalization of healthcare services can lead to improvements in quality, efficiency and accessibility of care. We use the term “digital health” as an umbrella concept which subsumes eHealth, mobile or mHealth, telehealth or telemedicine, among others. Digital health can be defined as “an improvement in the way healthcare provision is conceived and delivered by healthcare providers through the use of information and communication technologies to monitor and improve the wellbeing and health of patients and to empower patients in the management of their health and that of their families”.[19] The three dimensions of digitalization of healthcare services include the following: the significant domain of the new technologies and what is their potential and bottlenecks [20]; the domain of the working processes as continuous improvement organizational cycles (e.g., comprehensive use of management tools like LEAN systems [21] and clinical governance guidelines); and, last but not the least, the existence of a digitally qualified workforce. [22]

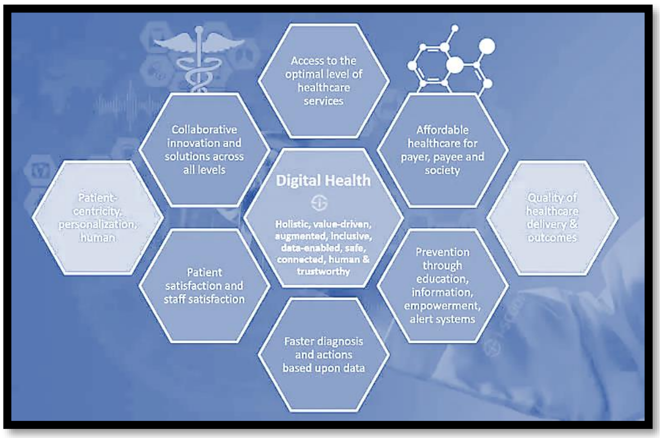

Figure 4: Digital health and healthcare priorities

This WHO definition of digital health is not universal yet it’s good that it’s broad and introduces a common narrative and understanding. Digital health indeed needs to be seen as a broad concept whereby the purposes of healthcare are served through technologies that are combined for universal healthcare access, applications across various multi-disciplinary fields and ecosystems in healthcare and the health journey of people, as patients needing (access to) care and as citizens enabled to live healthier and prevent sickness (and thus the need for care). [18]

3.4 Benefits of Digitizing Healthcare

Healthcare digitization brings about many benefits to both patients and healthcare professionals throughout different stages in the patient journey. In general, a patient's treatment journey consists of the following stages: Diagnosis, making a treatment decision, receiving treatment and monitoring.

i. **Digital transformation benefits:** Digital reinventions offer a plethora of benefits to enterprises. However, to achieve the same, creating a well-defined digital strategy is mandated. Let's take a peek at the benefits. [23]

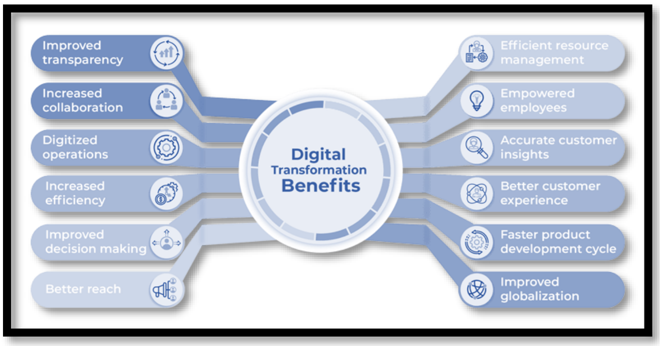

Figure 5: Benefits of Digital Transformation

ii. **Improves accuracy of diagnosis:** The use of digital health technologies has enabled industry professionals to diagnose patients' conditions remotely. Patient information such as their treatment history and list of medications can also be stored, accessed and shared between healthcare professionals in real-time. This helps to present a clearer and more accurate profile of the patient, thus improving the accuracy of diagnoses and facilitating clinical decisions.

iii. **Improves quality of healthcare:** The rise of digital health platforms has made it easier for patients to access medical data and healthcare services. It has also enabled them to monitor and track their conditions remotely, promoting a greater emphasis on self-care and giving them more control over their treatment. Through digital health platforms, healthcare providers can also offer care in a wide range of applications including therapeutics and acute and chronic diseases. They can detect changes in patients' condition earlier, allowing for a quicker response in the case of an emergency.

iv. **Improves access to healthcare:** In Asia, almost 80% of the population resides in rural areas with little to no access to healthcare services. For patients living in these areas, traveling to the city to receive medical care and treatment can be challenging and costly. Additionally, elderly patients or those with mobility issues may face difficulties accessing healthcare services. Patients who once faced challenges accessing medical services can now do so from their homes or communities. For example, diagnosis and patient monitoring can be carried out remotely or outside clinical settings.

v. **Reduces cost of healthcare:** According to the World Health Organization, approximately half of the world's population lack access to essential health services due to the costs involved. This includes medical treatment, rehabilitation and prevention. With the help of digital health technologies such as telemedicine, patients can better understand and monitor their health conditions remotely. This reduces unnecessary and often costly visits to emergency rooms, and even helps them save on transportation costs.

vi. **Increases efficiency:** The World Health Organization estimates that the world will experience a shortage of 18 million skilled healthcare professionals by 2030. As such, the need for more efficient medical services is essential in easing the burden on existing healthcare providers. [24]

vii. **Enhanced data collection:** Most businesses are collecting mountains of customer data, but the real benefit is optimizing this data for analysis that can drive the business forward. Digital transformation creates a system for gathering the right data and incorporating it fully for business intelligence at a higher level. It creates a way that different functional units within an organization can translate raw data into insights across various touch points. By doing this, it produces a single view of the customer journey, operations, production, finance, and business opportunities.

viii. **Stronger resource management:** Digital transformation consolidates information and resources into a suite of tools for business. Rather than dispersed software and databases, it consolidates company resources and reduces vendor overlap. The average number of applications used in enterprise businesses in 2020 is 900. Digital transformation can integrate applications, databases, and software into a central repository for business intelligence.

ix. **Increased profits:** Companies that undergo digital transformation improve efficiency and profitability. Consider these results reported by the SAP Center for Business Insights and Oxford Economics: 80% of organizations that have completed digital transformation report increased profits, 85% say they have increased their market share, on average, leaders expect 23% higher revenue growth than competitors.

x. **Increased agility:** Digital transformation makes organizations more agile. Borrowing from the world of software development, businesses can increase their agility with digital transformation to improve speed-to-market and adopt Continuous Improvement (CI) strategies. This allows for faster innovation and adaptation while providing a pathway to improvement. [25]

xi. **Improved productivity:** Having the right tech tools that work together can streamline workflow and improve productivity. By automating many manual tasks and integrating data throughout the organization, it empowers team members to work more efficiently. [26]

3.6 Challenges of Digital Health

The digital transformation of healthcare has raised several challenges that affect patients, medical professionals, technology developers, policymakers and others. Due to the massive amounts of data collected from a variety of systems that store and code data differently, data interoperability is an ongoing challenge. Additional challenges relate to concerns ranging from digital literacy among patients and the resulting unequal access to healthcare to issues related to data storage, access, sharing and ownership. The increasing digitization of healthcare and the growth of mobile and IoT devices as data collection tools raises many ethical issues. In particular, such companies offer solutions for collecting, storing and analyzing health data which raises issues relating to privacy, data protection and informed consent. [27–29] The nature of health data is also changing; we are now collecting more private user-generated data, particularly data harvested from social media and through wearable technologies, than ever before. The growth of apps and technologies developed for a consumer market blurs the lines between what is medical and non-medical devices and raises ethical challenges relating to how to regularize such technologies [28,30]. This issue is exacerbated by the speed of advancements and increasing globalization of healthcare solutions. [27,30,31] In the United States, the Health Insurance Portability and Accountability Act (HIPAA) of 1996 was written to protect patients' personal data. HIPAA was amended in 2009 with the introduction of the Health Information Technology for Economic and Clinical Health (HITECH) Act, which was designed to make HIPAA compliance stricter. However, critics of those acts said they do not go far enough to limit access to patient data without consent and HIPAA regulations are often violated. In late 2020, the U.S. Department of Health and Human Services

(HHS) proposed changes to HIPAA concerning privacy and security standards that negatively affect a patient's ability to access personal health data and interfere with healthcare's transition to value-based care, a model focused on value and quality of care. [32]

3.7 Application of Digitalization in Healthcare System

The application of digitalization to provide digital health interventions to prevent disease and improve quality of life isn't a new concept. However, in the face of global concerns -- related to aging, child illness and mortality, epidemics and pandemics, high costs, and the effects of poverty and racial discrimination on access to healthcare -- digital health platforms, health systems and related technology continue to grow in importance and to evolve. [33]

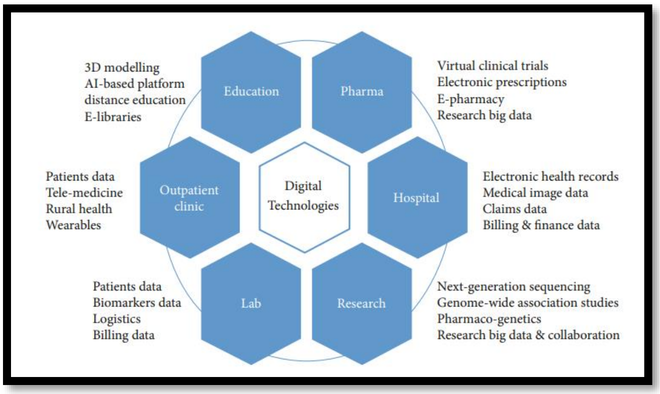

Figure 6: Scheme of main applications of digital technologies in healthcare

The health space is increasingly reliant on technology and the repurposing of health data by technology companies seeking health-related insights. The main uses of technology in the health sector include:

- Mobile health (applications used in detecting or preventing health issues)
- Health information technology (electronic medical records, electronic prescribing)
- Precision medicine (customized health care based on genetic information)
- Predictive analytics (use of data to predict health outcomes)
- Telehealth and telemedicine (remote access and use of health care services)
- Consumer tech used to monitor and manage health data (wearables)
- Connected devices used exclusively for medical purposes (e.g. connected pacemakers)
- AI-enabled check-ups
- Observatories that map and monitor disease spread/epidemics
- Biotechnology/bioinformatics (computatisation to study genetics and other biological data)
- Medical Robotics (precision machines aiding in surgery, nursing, blood services and many more)
- Advanced prosthetics (3D-printed prosthetics). [34]

The networking of man and machine – and digitization is nothing else – must take the middle course. Digitization must bring benefits, e.g., through:

- Customer information can be found more easily and used by salespeople.
- Acceleration of processes in companies, if all participants profit from it.
- More intuitive and more comfortable use of new IT solutions.
- Deep linking of electronic and individualized contacts to prospects and customers.

Digitalization is not an end in itself, but a means to an end. It is people who work with it and whose needs, wishes, and objectives must always be the focus of attention. This simple basic idea is, at the same time, a springboard for exciting further developments in the company's sphere of activity. [35,36]

Table 1: Application of digitalization in healthcare

Applications	Study aims	Outcomes	References
Ultrasound imaging	Development of deep learning detection network for ultrasonic equipment for real-time detection of breast cancer.	Method to realize the intelligence of the low-computation-power ultrasonic equipment, and real-time assistance for detection of breast lesions was developed.	37
CT imaging	To perform a quantitative and qualitative evaluation of a deep learning image reconstruction (DLIR) algorithm in contrast-enhanced oncologic CT of the abdomen.	DLIR improved CT evaluation of the abdomen in the portal venous phase. DLIR strength should be chosen to balance the degree of desired denoising for a clinical task relative to mild blurring.	38
MRI	To develop a deep learning algorithm for automated detection and localization of intracranial aneurysms on time-of-flight MR angiography and evaluate its diagnostic performance	A deep learning algorithm detected intracranial aneurysms with a high diagnostic performance which was validated using an external data set.	39
Cancer diagnosis	To conduct the breast cancer diagnosis by using principal component analysis-support vector machine (PCA-SVM) and principal component analysis-linear discriminant analysis-support vector machine (PCA-LDA-SVM) model classifier algorithms (LabVIEW).	The proposed method provides improvement especially for the polynomial kernel function. An increase in classification accuracy was observed in the test phase compared to PCA-SVM, along with improved classification.	40
Cancer diagnosis	To develop a computerized image analysis system using deep learning for the detection of esophageal and esophagogastric junctional (E/J) adenocarcinoma	AI system achieved high sensitivity and acceptable specificity for the detection of E/J cancers and may be a good supporting tool for the screening of E/J cancers.	41
Cancer diagnosis	To study whether an artificial intelligence (AI) system can increase the accuracy of characterizations of polyps by endoscopists of different skill levels.	The method significantly increased the accuracy of evaluation of diminutive colorectal polyps and reduced the time of diagnosis by endoscopists.	42
Drug development	To study whether recurrent neural networks can be trained as generative models for molecular structures, similar to statistical language models in	Recurrent neural networks based on the long shortterm memory (LSTM) can be applied to learn a statistical chemical language model.	43

	natural language processing.	The model can generate large sets of novel molecules with physicochemical properties that are similar to the training molecules ones.	
Genomics	To validate the ability of a computational approach based on deep neural networks (DeepCpG) to predict methylation states in single cells.	DeepCpG yields substantially more accurate predictions than old methods. It was shown that the model parameters can be interpreted, thereby providing insights into how sequence composition affects methylation variability	44

4. Technologies That Will Change Healthcare

i. Smartphones and wearables: The technologies within these devices have improved iteratively and it is now possible to have access to computing power that could steer a spacecraft, GPS, a high-speed internet connection and high-quality imaging capabilities in the palm of our hands, alongside a host of sensors for health-relevant data (eg, movement and location tracking), plus a touch-screen interface. Wearable devices are in a newer category of technologies encompassing smartwatches (eg, an Apple Watch), activity trackers (eg, a Fitbit) and connected patches (eg, a smart bandage or smart plaster). These are generally in direct contact with the wearer for long durations, generating large quantities of data on specific biometrics or behaviours.

ii. At-home or portable diagnostics: Telemedicine allows healthcare providers to evaluate, diagnose, and treat patients in remote locations using telecommunication technologies. Advantages of telemedicine include the ability to collect, store, and exchange medical data. Moreover, telemedicine allows remote monitoring of patients, distance education, improving administration and management of healthcare, integration of health data systems, and patient movement tracking. [45–49]

iii. Smart or implantable drug delivery mechanisms: Between a third and a half of all medication prescribed to people with long-term conditions is not taken as recommended. Several technologies in development could enable patients and care professionals to monitor and improve adherence to a prescribed drug regime either through automation or providing better information about medication usage (using smartphone reminders and location information).

iv. Digital therapeutics and immersive technologies: Digital therapeutics are evidence-based health or social care interventions delivered either entirely or mostly through a device (a smartphone, tablet, virtual-reality or augmented-reality system, or a laptop). They effectively embed clinical practice and therapy into a digital form.

v. **Genome sequencing:** Advances in genome sequencing and the associated field of genomics will give us better understanding of how diseases and medications affect different individuals. With the genetic profile of a person's disease and knowledge of their response to treatment, it should be possible to find out more about the likely effectiveness of medical interventions, such as prescribing drugs to treat a disease (pharmacogenomics).

vi. **Artificial intelligence:** Artificial intelligence (AI) is an umbrella term encompassing a number of different approaches where software replicates functions that have until recently been synonymous with human intelligence. This includes a wide spectrum of abilities such as visually identifying and classifying objects, converting speech to text and text to speech, etc.

vii. **Robotics and automation:** The ongoing miniaturization of electronics and motors over several decades has enabled the creation of more complex and capable robotic systems. When combined with sophisticated sensing technologies, medical imaging data and safety mechanism they have the potential to be used in health and care settings. Robots have multiple unique benefits such as no fatigue, the ability to lift heavy loads smoothly, not being damaged by x-ray radiation, the ability to replicate tasks with high degrees of precision, and can be many different shapes and sizes. With these benefits and flexibility, there's potential for robots to be used to improve diagnosis, interventions and care provision in health and care settings. This could span simple tasks, such as helping porters move patients, to advanced applications involving surgical interventions.

viii. **The connected community:** Behind all technologies, there are people. The internet and the devices and technology it has enabled have facilitated the development of many communities, bringing together people around a common interest, shared identity, social movement, or even just a hashtag. [50]

4.1 New diagnostic methods using information technology

There is a potential to improve healthcare by adopting new technology, e.g., by use of Big Data or Artificial Intelligence (AI) [51] for analytics, leverage mobile applications and social platforms to make healthcare more available to patients. [52] New methods, supported by AI, are being developed for diagnosis of melanoma. The area of digital Clinical Decision Support Systems (CDSS) is developing, with potential to increase diagnostic accuracy and patient safety.[53,54] Previous studies have compared AI algorithms with the performance of dermatologists [52,55,56] and conclude that its usage can improve overall diagnostic accuracy.[57] However, the lack of understanding how AI comes to its decision [58], the need of additional training [59], new equipment [60], and other costs [59] constitute barriers for clinical adoption of AI based CDSS.

5. Conclusion

The view we outline in this paper carries forward a position that it is not only the technology itself that requires digitalization in healthcare system, but also the world into which it is implemented and that it, in turn, creates. In this respect, more insights could be gained in the future by conducting a study with more respondents or diversifying the sample, impact of digitalization in healthcare system. In general, further analyses are certainly needed to determine the importance and influence of digitalization concern. These findings inform a reconceptualization of the implications and benefits of digitizing healthcare. Future research and development are a potential to improve healthcare by digitalization and compassion.

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