EMERGING TRENDS IN INFORMATION AND COMMUNICATION TECHNOLOGIES FOR SMART HEALTHCARE SYSTEM

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Abstract: Currently, Technology is transforming the entire world into a sophisticated scientific arena, and the healthcare sector is no exception. With the implementation of information technology, hospitals can improve the quality of healthcare and lower their operational costs. Also, with the use of technology, the healthcare industry has been able to bridge the gap between rural and urban areas. With the right tools, Medical Profession can ensure providing better and more efficient care to their patients. The healthcare sector faces various challenges such as storing medical records of patients, maintaining hospital information systems, maintaining medical equipment, records of any medication errors, and related. Now, hospitals rely on ICT in transforming the entire healthcare revamping process. If the medical profession has the right communication channels, it is easy for them to provide treatment and care to patients wherever they are and in whichever part of the world. ICT technology helps physicians continuously monitor patient medical history, diagnostic reports, and track current health status. Doctors can also interact with patients and recommend physical exams and prescriptions from a distance. In this paper, the latest trends in information and communication technology in healthcare are being discussed.

Keywords: Artificial Intelligence, Blockchain, Cyber Security, Healthcare, ICT, IoT

INTRODUCTION

The application of ICT in health care can be divided into 4 mainstreams, such as health and education, hospital management system, health research, and health data management. ICT helps hospital management to run more efficiently and successfully. ICT facilitates the management to overcome the challenges faced by the hospital. ICT helps management improve patient safety and satisfaction, updating the latest technology, knowledge on population health and statistics, and keep a note on the stipulations of the government mandates. Primarily the workplace can be further strengthened.

ICTs in health research help to find possible preventive measures to eradicate and reduce the spread of diseases. We can find new technologies in diagnosis, thus reducing time and costs. This has saved many lives by providing treatment in advance. Through information and communication technology, the traditional health system can be eliminated and a new model of effective quality care can be formulated.

The basic application of IT in hospitals is to store electronic medical data. This makes it easy to retrieve the needed information. Thanks to ICT, data can be transferred to patients or doctors for consultation. Patients can have medical records ready with them, which can be used anytime, anywhere.

Information and communication technologies offer various ways of improvising the healthcare system. The health sector needs to use IT in a smarter way to bring about more welcome change and raise healthcare to a higher standard, which is very vital for the development of the country.

In an increasingly digital world, it is much recognized that the use of information and communication technologies (ICT) is essential in the health sector. ICTs are indispensable for ensuring the cost-effectiveness of health services and improving the efficiency of the health system. As demarcated by the World Health Organization (WHO), the term "eHealth" describes the use of all forms of ICT in health. The proper use of e-health ensures the integrity of an individual's health information, which is necessary for providing appropriate care and services to patients.

With safeguards in place and ensuring the protection of individual privacy, the analysis of e-health data also contributes to health research and education. The implementation of the eHealth strategy also improves the capacity of health systems to plan, budget, and deliver health care services, and supports the decentralization of health systems. Governments recognize the importance of e-health and are taking action to develop national policies, strategies, and regulatory frameworks for e-health. This is in line with the WHO position that the prevalence of e-health will promote and support universal health coverage.

RELATED LITERATURE

The usage of ICT has marked a turnaround in the health sector. According to Adeleke et al. (2014), ICT has become the cornerstone upon which efficient and effective healthcare delivery flourishes. Computer technology has a critical role in the transformation of healthcare services. ICT is valuable in data gathering, as well as the administration of healthcare services, and has the potential of improving the quality and consistency of healthcare data and services. Links with other healthcare providers have become conceivable through dedicated communication lines enabled by Information communication & Technology, and electronic medical records and knowledge-based healthcare services are achievable with the use of ICT. Clinical research, health information, and related resources are made readily available through the Internet, which has become a feasible means of communication, training, and education. One can also buy healthcare products using the available online stores.

Expert systems have been established to predict health states and prescribe drugs to treat cases of health challenges. Telemedicine – healthcare at a distance – is an aspect of ICT application that has been in usage in developed economies for years. With telemedicine, healthcare is delivered in real-time, or asynchronously, and may include the use of a video link. Numerous online applications have now evolved, making healthcare readily available and ICT penetration into the healthcare field has grownup exponentially in the twenty-first century (National Health ICT Strategic Framework 2015–2020 2015). This growth is due to the development of new and reasonable ICT tools to assist healthcare practitioners in the provision of health services. The literature is complete with materials on ICT and healthcare.

Additionally, health information managers now have databases such as the Health Information Management System (HIMS) to manage patient health information. National HIMS databases are available through dependable networks to healthcare providers on demand to assist healthcare practitioners in the treatment of patients. The status of IT tools cannot be overemphasized in the dissemination of health information throughout and socially isolated landscapes (Ducut and Fontelo 2008; Quy 2000; Tamrat and Kachnowski 2012). These social networks have become platforms to make awareness in cases of an epidemic. Social inclusiveness and civic engagement are made possible using IT tools.

Electronic health is one of the most widespread applications of information and communication technologies and it has contributed hugely to health delivery through the provision of quality health service and ubiquitous access at a lower cost. Even though this model of health service is gradually becoming known or used in developing nations, these countries are faced with countless challenges when implementing and deploying e-health services on both small and large scales [1].

A pandemic is an outbreak that happens over a large geographic area touching a greater portion of the people as new pathogens appear for which people have less immune and no vaccines are available. It can spread from person to person in a very short time, and in fact, the health workers are at a bigger risk of infection because of the patients who carry the disease. In the 21st century, where everyone is linked through digital technologies, Information and Communication Technology (ICT) plays a critical role in improving health care for individuals and larger communities. ICT has presently been severed in a variety of application domains which signifies its importance as a main technological paradigm, and it has drawn higher attention for its potential to alleviate the burden on healthcare systems triggered by a rise in chronic diseases, aging, and increased population and pandemic situations [2].

Existing studies have established that people with disabilities (PwD) face a range of technological and behavioural barriers to successful acceptance of information and communication technology (ICT)-enabled health services. However, there has been little examination and no learned consensus on the relative impact of each factor. This study examines the determinants of ICT usage for health care among PwD. Applying national-level disability survey data in Australia, several multivariate hierarchical regression models are arranged to predict the relationship between ICT-enabled health service adoption and the descriptive variables. In addition, several measures of the overall goodness of fit are estimated for each model. The results specify that age, gender, income, level of education, language proficiency, and geographical remoteness are important predictors of ICT-enabled health care usage among PwD. It is also found that technological constraints have a sturdier moderating effect than behavioural factors [3].

Existing research shows that the adoption of information and communication technologies (ICTs) for healthcare development in emerging countries is largely dominated by the donor and international agencies, but the actual organizational-level decisions are often driven by commercial healthcare managers. The significances of the strategic-driven healthcare ICT adoption practices are that they fail to match clinician users' necessities and cause them to disuse ICTs for clinical practices and healthcare development. Prior attempts to bring local and globally distributed actors together to implement ICTs inventively for healthcare development have highlighted less on synthesizing the diverse information system approaches that inform our understanding of how to narrow down the 'manager-clinician' tensions in ICT adoption for development in emergent situations. To fill this gap, this article clarifies the process of shifting healthcare ICT adoption from top-down planning to collective user involvement to augment clinicians' acceptance of ICTs for clinical practices and development in a Ghanaian teaching hospital, applying the cohered emergent transformation model. Action research was applied to engage the hospital's corporate managers, clinician managers, and clinicians to express their views and experiences of the hospital's ICT adoption for healthcare delivery improvement. Together with observations and document analysis, the data was analysed to comprehend the hospital's information and communication technologies for development (ICT4D) adoption issues and identify ways of managing them. The outcomes offer alternative theoretical and practical ways of adopting healthcare technology systems that change the excessive use of managers' powers in ICT adoption towards clinicians' involvement, to permit technology acceptance for clinical practices and healthcare development [4].

Technological innovations have played a noteworthy role in the modern healthcare system. However, with the increasing rate of the human population relative to the accessible medical personnel and facilities, a sudden outbreak of epidemic diseases and its resultant spread into a pandemic may pose a threat to the wellbeing of the human populace. Thus, state-of-the-art innovations in communication engineering and technology can provide a support mechanism to the healthcare sphere. This paper dwelt the pillars and paradigms in information and communications technology (ICT) deployable in the healthcare domain and estimates a compliance index based on the subset in which the ICT pillars and paradigms are disintegrated. The analysis revealed that technological advances in the areas of robotics and the internet of things (IoT) paradigm presented a possible support mechanism for the healthcare domain [5].

Details concerning a person's wellbeing, such as prescription history, immunizations, allergies, and medical test records, should be held in an unvarying format. A systematic database of a person's healthcare records will help in assessing the appropriate treatment plan for someone who requires treatment at some point in their life. The majority of countries maintain their health-care-record-keeping scheme. The Ministry of Health and Family Welfare (Government of India) framed the rules for Electronic Health Records in our republic (India) in 2013, and changes were made by April 2016. The need for the removal of the traditional health record system is quantified in these guidelines [6].

With an elderly population, it is vital to maintain good health and autonomy for as long as possible. Instead of hospitalization or institutionalization, older people with enduring conditions can be assisted in their own homes with numerous "smart" devices that support them in their activities of daily living, accomplish their medical conditions, and prevent fall incidents. Information and Communication Technology (ICT) solutions enable the monitoring and management of older people's health to improve quality of life and physical activity with a decline in caregivers' load.

Method: This paper aimed to conduct a methodical literature review to analyse the state of the art of ICT solutions for older people with chronic conditions, and the influence of these solutions on their quality of life from a biomedical outlook. Results- By analysing the literature on the accessible ICT proposals, it is shown that different approaches have been deployed by noticing that the more cross-interventions are amalgamated then the better the results are, but there is still no evidence of the effects of ICT solutions on older people's health results. Furthermore, there are still unresolved ethical and legal issues [7].

The information and communication technology (ICT) in health will generate a distinct world of all told levels. The transformation of the health system has narrowly targeted the activity of diseases in hospitals by health professionals. There is a system aimed at keeping public health by providing them with data to require care of their health, whenever the need arises, and where they will be available. Hospital administrators and their staff need to appropriately manage ICT e-health skills with the mindset that it can improve quality, fortify processes and create its additional economy. The public health service of the government has bowed down and distorted. In the vast world, increasing population density, lack of transportation, and the resulting hardship, illiteracy, poverty, poor ecological pollution, poor health, lack of funding, and poor eating habits is all contributive factors to the decline in healthcare services [8].

Emergent and disruptive technologies have influenced human life. The Healthcare system has accepted ICT to improve the quality of life. Technologies like AI and IoT in healthcare have been used to bring efficient and affordable healthcare services. A smart city is a city that employs ICT to improvise citizen services and making citizens' life smarter. Smart healthcare uses and includes the latest digital and mobile technologies. Creating cost-effective and patient-focused healthcare systems is the chief concern of a smart city [9].

Renowned and Oscar award-winning American actor and film director Marlon Brando, says "privacy is not something that I am merely entitled to, it is an absolute prerequisite." Privacy threats and data breaches happen daily, and countries are mitigating the consequences caused by privacy and data breaches. The Indian healthcare industry is one of the major and rapidly developing industry. Overall, healthcare management is altering from disease-centric into patient-centric systems. Healthcare data analysis also plays a crucial role in healthcare management, and the privacy of patient records must have equal attention [10].

CHALLENGES AND OPPORTUNITIES

In our country, public health IT systems exist in silos. Several state health departments make their own IT solutions to achieve their program reporting needs. As a result, the systems do not help in united decision-making. Therefore, it results in a lack of standardization in architecture, data standards, illness, and service codes.

Noteworthy challenges and opportunities exist in India. These include the growing healthcare needs of an aging population, a swing towards community-based care, costly technologies, the need for better quality and accessibility, and the longing of people to be better and directly involved in decisions about their health. Information related to health plays a significant role in determining the ways of meeting these challenges. The Indian healthcare sector delivers ample opportunities for low-cost innovation and the application of technology to improve health outcomes. These openings exist due to brick-and-mortar infrastructure gaps, training of ICT-illiterate health professionals, capacity building, and deficiency of primary healthcare staff.

Hence, ICT can play a vital role to improve healthcare for individuals as well as communities. ICT can assist bridge the information gaps that have surfaced in the health sector in emerging countries like India by providing novel and efficient ways of accessing, communicating, and storing info. The gaps between health professionals and the communities served by them can be addressed by applying ICT in healthcare. Further, with the development of databases and similar applications, ICT has the probable outlook to improve health system efficiencies and thus prevent medical errors.

Smart, careful, and related integration of ICT in the delivery of healthcare service should be a prioritized strategy to aid the complex health needs of a republic with more than a billion people.

In India, public health computer systems are in loopholes. Many state health departments are creating their own IT solutions to meet their program reporting needs. As a result, systems do not support combined decision-making. Therefore, it is interpreted as a lack of architectural standardization, data standards, disease, and service codes. There are significant challenges and opportunities in India. These include the growing health needs of an aging population, the shift in community care, expensive technologies, the need to improve quality and accessibility, and people's desire to be better. and directly participate in decisions about one's health.

Health-related information plays an important role in determining how these challenges are being addressed. The healthcare sector in India offers many opportunities for innovation at low cost and the application of technology to improve health outcomes. Therefore, ICTs may play an important role in improving health care for individuals and communities. ICTs can help bridge the information gaps that have arisen in the health sector in developing countries like India by providing new and effective ways to access, communicate and store information. The differences between health professionals and the communities served can be addressed through the

implementation of healthcare ICTs. In addition, with the advancement of databases and similar applications, ICTs have the potential to improve the efficiency of the healthcare system and thus prevent medical errors. The intelligent, vigilant, and contextual integration of ICT in the delivery of health services should be a priority approach to address the complex health needs of a country with more than one billion people.

KEY BENEFITS OF USING ICT IN THE HEALTH CARE FIELD

New ICT, applied games such as the Serious Games or the wearables offer several options when improving the efficiency of the health care sector. The advantages of these new technologies can be abridged in the following main areas:

Increasing quality in the patient assistance- One of the most significant flaws of this sector is the fragmentation of health care and the difficulties for efficiently transmitting the information. ICT can help recover patient safety through direct access to the medical case history, checking the treatments online, keeping track of the patients' progress, and forestalling possible medical blunders. In universal terms, they are regarded as generally positive tools among professionals and users. Since they provide a way to enhance patient safety, their use is being promoted in many countries.

Pruning down the medical spending- Using ICT and Serious Games for Health help lessen these costs by reducing the time required to process data and manage paperwork. The system for image transmission and storage is indispensable to promote the development of the electronic therapeutic case story and telemedicine since it speeds up the tests and the gathering of results.

Cutting down the administrative costs- Invoicing brings about many options of saving due to the use of ICT and the new remote devices. Although the evidence of these data, electronic invoicing is not extensively used in most countries yet.

Option to carry on brand-new health models- ICT has been defined as a technology with high transformative potential since it presents new ways to carry out medicine and develop health care. They are certainly essential to renew primary health care since they contribute to a personalized following of chronic diseases; they progress the access to health care in rural populations, and they contribute to optimizing data measuring and supervision.

IoT IN HEALTHCARE

Before the Internet of Things, patients had no way of communicating with doctors about their health. The rise of the Internet of Things has enabled healthcare providers to monitor and communicate with their patients remotely. This has resulted in better care, lower costs, and increased patient satisfaction.

The Internet of Things (IoT) is transforming the healthcare industry by creating new opportunities and solutions that improve the quality of care.

Wearable devices like fitness bands and glucometers allow patients to receive personalized attention by monitoring their vital signs and keeping track of their activities. They can also be used to set alarms for various health conditions.

The Internet of Things has enabled people with special needs to monitor their health conditions. This has changed their lives as they no longer need to rely on medical facilities.

With the help of wearable devices and home monitoring equipment, healthcare professionals can keep track of their patients' health conditions more effectively. It allows them to provide better care and lower the risk of hospitalization.

Aside from monitoring patients, hospitals also benefit from the use of Internet of Things (IoT) devices. These include monitoring the locations of various medical equipment such as oxygen machines and wheelchairs.

The spread of infections in hospitals is a major concern. With the help of smart devices, hygiene monitoring devices can help prevent patients from getting infected. They can also help manage various aspects of a healthcare facility, such as inventory control.

With the help of the Internet of Things (IoT)-connected devices, health insurers can use data collected by these devices for their operations, such as claims processing and underwriting. This will enable them to detect fraud and improve their customer service.

Insurers can offer rewards to their customers who use and share their health data with their devices. This benefit will help them lower their claims and improve their customer's health.

Health care monitoring devices are mainly used for monitoring various aspects of a person's health. Some of these include monitoring blood pressure, respiration rate, sleep hygiene, and mood monitoring.

ARTIFICIAL INTELLIGENCE IN HEALTHCARE

Artificial intelligence (AI) has altered industries around the world and has the potential to drastically alter the field of healthcare. Imagine being able to analyse data on patient visits to the clinic, medicines prescribed, lab tests, and procedures performed, as well as data outside the health system, such as social media, procurements made using credit cards, census records, Internet search activity logs that comprise valuable health information.

Artificial intelligence in the medical field relies on the analysis and clarification of huge amounts of data sets to help doctors make better decisions, manage patient data information effectively, create modified medicine plans from complex data sets and discover new drugs.

AI can be used in clinical decision support, Info Management (both physician and patient) also medical diagnostics: the use of Artificial Intelligence to identify patients with specific illnesses.

Drug discovery- There are dozens of health and pharma companies presently leveraging Artificial Intelligence to help with drug discovery and improve the lengthy timelines and processes tied to determining and taking drugs to market.

Clinical Trials- Clinical Trials are, inappropriately, a real mess. Most clinical trials are managed offline with no integrated solutions that can track progress, data collection, and drug trial results.

Pain management- This is still a developing focus area in healthcare. As it turns out, by leveraging cybernetic reality combined with artificial intelligence, one can create simulated realities that can distract patients from the existing source of their pain and even help with the opioid crisis.

Improving patient recoveries- Patient results can be enhanced through a wide variety of strategies and outcomes-driven by artificial intelligence.

MACHINE LEARNING IN HEALTHCARE

Machine learning can also benefit healthcare organizations to meet growing medical demands, improve operations and lower costs. At the bedside, machine learning inventions can help healthcare practitioners detect and treat disease more efficiently and with more precision and personalized care. Machine learning applications can improve the accurateness of treatment protocols and health outcomes through algorithmic processes.

For example, deep learning, a type of complex machine learning that mimics how the human brain functions, is progressively being used in radiology and medical imaging. Using neural networks that can learn from data without any supervision, deep learning applications can sense, recognize and analyse cancerous lesions from images. Faster processing speeds and cloud infrastructures permit machine learning applications to detect anomalies in images outside the purview of what the human eye can see, helping in diagnosing and treating illness.

Recordkeeping- Machine learning in health informatics can update recordkeeping, including electronic health records (EHRs). Using AI to expand EHR management can improve patient care, reduce healthcare and administrative costs, and enhance operations.

Data Integrity- Gaps in healthcare information can affect machine learning algorithms making inaccurate predictions, which can negatively influence decision-making in clinical settings. Since healthcare data is initially intended for EHRs, the data must be prepared before machine learning algorithms can efficiently use it.

Predictive Analytics-The combination of machine learning, health informatics, and predictive analytics propose opportunities to improve healthcare processes, alter clinical decision support tools and help improve patient results. The promise of machine learning's altering healthcare lies in its ability to leverage health informatics to forecast health outcomes through predictive analytics, leading to more accurate diagnosis and treatment and improving physician perceptions for personalized and cohort treatments.

BLOCKCHAIN APPLICATIONS IN HEALTHCARE

The term 'Blockchain' means an immutable common record, of a chain of transactions, each composed of a blockchain, with blocks joined by encryption keys. These keys or signatures are kept in common books, joined by a cycle of nodes or processes that know them. Each node has a copy of the whole chain, always synchronized and updated.

According to the National Institute of Standards and Technology (NIST), Blockchain technology includes its tamper-resistant nature, the decentralized nature of the digital ledgers, and the impossibility of changing a published transaction subsequently within the user community that shares the ledger which is the main benefits.

This technology is also called digital signal technology (DLT). The main issues on blockchain applications in healthcare include the security of the network infrastructure at all levels, identity and verification of all participants, uniform rights to access electronic healthcare information. Healthcare applications Blockchains in healthcare can be envisaged in five main areas such as eHealth Management. registry data (EMR), health data protection, management of personal health registry data, timely maintenance of genomic management, and electronic health records.

ROBOTIC UTILITY

Surgery is the most frequently discussed robotic application in healthcare, and perhaps the most successful so far. Though, it is not the only application. Other areas in healthcare that concentrate on the usage of robots are telepresence, rehabilitation, scientific transportation, sanitation, and prescription dispensation.

Medical device packaging- Packaging is a perfect software for collaborative robots. clinical devices provide some thrilling challenges for packaging robots. for example, sterilization is important for devices that allow you to come into contact with humans. when human beings perform such packaging obligations, there is a high chance of infection which could jeopardize the integrity of the products.

Lab automation- Another robotic utility that has clean openings for healthcare is lab automation. Each day, a big wide variety of assessments are accomplished in clinical labs throughout the world. One lab in Copenhagen college health centre was inundated with blood samples and had to perform 3,000 tests per day. The team added two UR robots into their system which allowed them to achieve amazing productivity gains. Even though their workload augmented by 20%, they were still able to deliver 90% of their tests within 1 hour.

Also, robots can be used in Neurosurgery and Cutting Bone also

CYBER SECURITY IN HEALTHCARE

In the present-day electronic world, cybersecurity in healthcare and protecting information is vital for the normal functioning of organizations. Numerous healthcare organizations have various types of specialized hospital information systems such as EHR systems, e-prescribing systems, practice management support systems, clinical decision support systems, radiology information systems, and computerized physician order entry systems. Furthermore, thousands of devices that comprise the Internet of Things must be protected as well which include smart elevators, smart heating, ventilation, and air conditioning (HVAC) systems, infusion pumps, remote patient monitoring devices, and others.

Healthcare cyber security has changed dramatically in the last ten years with the advent of the Internet of Things (IoT) devices increasing on the medical network. IoT technologies are speedily becoming part of the high-tech medical arena. Medical devices are now linked to the network to help doctors, nurses, and support teams provide critical care services for patients. The innovative interconnected device types are not always managed in the same way as traditional IT systems. Which are often left unpatched and vulnerable to attack. This uncontrolled environment leaves hospitals and other medical service providers accepting great levels of risk to improve services.

Healthcare providers now need to secure connected medical devices more than ever, and there has been a proliferation of IoT devices in healthcare. The attack surface is growing and cybercriminals are developing more sophisticated tools and techniques to attack healthcare facilities, access data, hold data and networks for ransom.

Many common threats continue to be a problem in healthcare, including Malware and Ransomware. Cybercriminals use malware and ransomware to shut down devices, servers, or even the entire network. In some cases, a ransom is then required to fix the encryption.

Cloud threats- More and more protected health information is stored in the cloud. Without proper encryption, this can be a weakness for the security of healthcare organizations.

Deceptive Websites- Savvy cybercriminals have created websites with addresses similar to reputable ones. Some simply substitute .com for .gov, giving the careless user the illusion that the sites are all the same.

Phishing Attack- This strategy sends a large volume of emails from apparently reputable sources to obtain sensitive information from users. Encryption Blind Spots: While encryption is important for protecting health data, it can also create blind spots where hackers can hide from breach detection tools.

Employee error- Employees can make healthcare facilities vulnerable to attack through weak passwords, unencrypted devices, and other compliance failures.

Various healthcare organizations can improve their cybersecurity by implementing the following practices, such as

Establishing a safety culture-Continuous cybersecurity training and education emphasizes that every member of the organization has the responsibility to protect patient data and create a safety culture.

Maintain good computing habits-New entrants should get training on best practices for using computers, including software and operating system maintenance. Continuous updates are essential to ensure that the healthcare system is always optimally protected.

Control access to protected health information- Only those who need to view or use the data should be granted access to protected information.

Use strong passwords and change them regularly: According to a Verizon report, 63% of confirmed data breaches involve the exploitation of underlying weak or stolen passwords. Healthcare workers should not only use strong passwords but also change passwords regularly.

Restricting network access: Do not install software applications and other add-ons on existing systems without the prior consent of the appropriate organizational authorities.

Physical Access Control- There is also the possibility of data corruption if the physical device is stolen. Computers and other electronic equipment, including protected information, should be stored in a locked room in a safe place.

CONCLUSION

In the present age of technology, information systems have played an important role in problem-solving. One significant area in which information and communication technologies can play a role is health. The use of electronic means to provide or support people with health care could play a revolutionary role in improving the living conditions of mankind. ICT technologies such as IoT, artificial intelligence, robotics, blockchain, machine learning, and cybersecurity will certainly improve healthcare in India.

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