Vol. 06, No. 2 (2024) 769-778, doi: 10.24874/PES06.02A.004

Proceedings on Engineering Sciences

www.pesjournal.net

TRANSFORMATIVE IMPACT OF TECHNOLOGY ON THE HEALTHCARE INDUSTRY: A SWOT ANALYSIS

Siya Bhatia
Mridul Dharwal
Sumeet Bhatia
Varun Mohan[1]

Received 08.09.2023.
Received in revised form 05.02.2024.
Accepted 04.03.2024.
UDC – 004.8

Keywords:

Innovations, Healthcare, Telemedicine, Artificial Intelligence, SWOT Analysis, Wearable devices

A B S T R A C T

The healthcare industry has witnessed a remarkable transformation driven by advancements in technology. This research paper aims to probe into the multifaceted impact of technology on the healthcare sector. By analyzing various technological innovations, such as artificial intelligence, telemedicine, electronic health records, remote healthcare, retail clinics and wearable devices, this study explores how technology has revolutionized healthcare delivery, improved patient outcomes, enhanced operational efficiency, and influenced healthcare professionals' roles. This paper has conducted a comprehensive SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis to examine the internal and external factors influencing the integration of technology in healthcare. The research evaluates the strengths and weaknesses of technology adoption, explores the opportunities for further advancements, and identifies the potential threats and challenges faced by the healthcare industry. By employing the SWOT framework, this paper offers valuable insights to stakeholders for strategic decision-making and effective utilization of technology in healthcare. The SWOT paragon provides significant insights to stakeholders for strategic decision-making and optimal technology utilization in healthcare.

1. INTRODUCTION

The world is a very distinct place than it was ten years ago. It is getting digitized by embracing modern technologies. Technology has left its imprint on everything from automated homes to automated aircraft. The repercussions of the covid-19 pandemic, the financial crunch and an expedition in the acquisition of digital technology have gravely swapped the landscape for everyone, provider or patients. An eminent field where the technology contributed significantly is healthcare industry. To fulfilling two main aims of healthcare industry-improving quality of care and controlling the cost, (Lee et al., 2020). New innovations and advancements are continuing growing in the world. Through the ages, medical advancements have improved our capacity to treat complex ailments. 21st century is bringing about even greater improvements

[1] Corresponding author: Varun Mohan
Email: varun0503ind39@gmail.com

with technology advancements, transforming the healthcare industry. The hospitals are becoming smarter with the acquisition of artificial intelligence (Rong et al., 2020) the internet of things (Jagadeeswari et al., 2018) and data management techniques. AI can greatly fulfil the goal of making healthcare more individualised, preventive, predictive and interactive.

The paper is organized in eight sections: Section 2 gives the Literature review; Section 3 presents the objectives; Section 4 defines the methodology adopted; In Section 5 we review the different technological advancements in the health sector that are used in medical diagnostics, surgery support and monitoring patient's condition from the remote places; Section 6 evaluates the internal strengths, analyses the internal weaknesses, explores the opportunities for further advancements and identifies the potential threats and challenges faced by the healthcare industry; Section 7 includes discussion; Section 8 provides our concluding remarks and future directions

2. LITERATURE REVIEW

Medical innovations and technological advancements are increasing our potentiality to treat the complex medical problems with the latest medical devices. Studies on innovation (Liaw, 2002) have revealed that survival and success of the health care sector depend on the efficiency and effectiveness of development of information technology and its implementation. (Rahmani et al., 2018) also identifies IoT technology is developing in the healthcare monitoring system for serving emergency services to patients. It is also employed as e-health application for various features such as early identification of medical issues, emergency alert and computer-assisted rehabilitation. Study by (Wu et al., 2017) confirms that today the smartphones that are connected with the sensor have become the essential part of the people's life Most intriguingly. Researchers working in the biomedical sciences (Rong et al., 2020) are making use of artificial intelligence to improve analysis and treatment outcomes, which will subsequently escalate the efficiency of the healthcare sector as a whole. Telemedicine (Heinzelmann et al., 2005) the domain where medicine, information and communication technology connect, is likely to be the part of this insurgence that could have the greatest influence on healthcare delivery system. The research done on wearable medical devices by (Fotiadis et al., 2006) also found that these devices help in monitoring vital signs including heart pulse, oxygen level in blood, breathing pattern, and body fat. These also help in supervising the treatment of chronic conditions like heart diseases, asthma, and diabetes. Another study by (Phares et al., 2021) on retail medical clinics also mark demand and supply matters by setting primary healthcare services in some retail shops so that the patients can easily access healthcare services conveniently**.**

3. OBJECTIVE

The paper aims to study present emerging developments (figure 3) in the healthcare sector in terms of technology and analyze how these technological developments helping the patients and practitioners in handling complex health problems. We have conducted SWOT analysis (figure 4) to evaluate the strengths and weaknesses of technology adoption, explores the opportunities for further advancements, and identifies the potential threats and challenges faced by the healthcare industry.

4. METHODOLOGY

By categorizing technological impact on healthcare into strengths, weaknesses, opportunities, and threats, SWOT analysis is one of the apex techniques used in strategic planning (Glaister & Falshaw, 1999). By listing internal and external factors affecting the industry in the four quadrants of SWOT analysis, healthcare industry can understand better how strengths can be capitalized, take up novel opportunities, acknowledge the weaknesses and how it can be improved and identify the threats in the future. By applying SWOT analysis, it is possible to apply strategic thinking in using technology in the health sector. Specifically with the application of technology in health sector strengths indicate the areas where efficiency, accessibility and diagnosis are becoming easy with the help of artificial intelligence. Weaknesses display the areas where technology or healthcare requires improvement. The threats and opportunities identified during the analysis requires some strategic planning inclusive of both healthcare and technological issues (Helms et al., 2008).

5. ENHANCEMENT OF HEALTHCARE USING TECHNOLOGICAL ADVANCEMENT

The survival and success of the healthcare sector depend on the efficiency and effectiveness of development of information technology and its implementation (Liaw, 2002). In case of COVID-19 pandemic technology has played a vital role in controlling the spread and making people aware to take necessary steps. (Jagadeeswari et al., 2018).

5.1 Artificial Intelligence in healthcare

Artificial Intelligence-the intelligence of machines or intelligent agents that can grasp and evaluate its environment and take pertinent actions to enhance its chances of attaining its objectives (Rong et al., 2020**).** AI is reinstating traditional, time-consuming and labor - intensive healthcare processes with fast, accessible from distance, and real-time solutions for diagnosis, treatment, and prevention of illness. 'Roam Analytics' (StartUs Insights, 2023) The US-based startup develops

AI programs for the healthcare sector that uses Natural Language Processing (NLP) to strengthen the structure and content of patients' electronic medical records and other artificial intelligence tools for storage and data analysis. Faster than a human expert Indian company Atreus creates an AI-powered system that can diagnose diabetic retinopathy (DR) with high accuracy in three minutes. The startup also works on early lung, breast and TB cancer diagnosis (StartUs Insights, 2023). "RUDO"- the "ambient intelligent system" can accommodate blind persons in living and working along with sighted people in specific industries like informatics and electronics (Hudec & Smutny, 2017) During complicated pregnancy stages, an artificial-intelligence based "smart assistant" can furnish pregnant women with dietary and other crucial advices. (Tumpa et al., 2017).

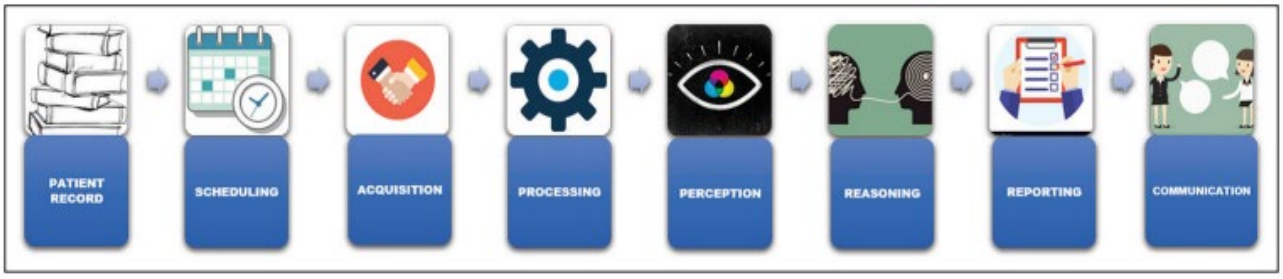

Figure 1. Flow of information in artificial intelligence
Source: (Mahajan et al., 2019)

5.2 Internet of things (IoT)-based healthcare system

The IoT is now broadly used in numerous practices, so its importance is increasing in daily life. For the purpose of effectively supplying patients with emergency services, IoT technology is developed in the healthcare monitoring system too. (Rahmani et al., 2018) it is used as an E-health application for the early identification of medical emergency alert computer-assisted rehabilitation (Selvaraj & Sundaravaradhan, 2020). In order to path a person's health, sensors are connected to smartphones that has become an indispensable part of peoples' daily lives (Wu et al., 2017) This sensor-based monitoring system gathers information from the wards and diagnostic tools, then uses that information to efficiently and autonomously manage healthcare. The IoT healthcare system offers effective tracking and monitoring, which enhances patient care. (Chen et al., 2018) The health care system based on Internet of things is much helpful in keeping the track of the wellbeing of heart patients and its efficiency can be increased for emergency medical alert by continuously monitoring the patient condition. (Selvaraj, S. & Sundaravaradhan, S., 2020). IoT can effectively monitor patients in remote locations and offer emergency care, particularly for people with cardiac conditions. The wearable IoT devices also play a major role in monitoring the patient's condition. (Elhoseny et al., 2018)

5.3 Remote health care

Remote care enables comfort while preserving high-quality care for patients by the use of video conferencing, wearable devices and big data without physically visiting the doctor. Remote care enables (StartUs Insights, 2023) comfort while preserving high-quality care for patients by relying on the IoT's ease of data transfer across devices. COVID-19 pandemic has increased the remote healthcare delivery significantly. By using wearable technology and IoT many healthcare problems are being resolved by remote patient care. A doctor may retrieve information from a patient's watch to learn about their caloric intake, heart rate, and other factors that help them to keep away serious health problems. For the purpose of an informed decision regarding medication or surgery, doctors can monitor and check patients from far away while speaking with them about their syndrome and even observing medical issues without physically present in patient's room. Remote care can reduce costs for everyone by reducing hospital visits, making free the hospital rooms for those who need them, and rearranging healthcare personnel' schedules, With the promise of real-time communication, enhancing quality of life, enhancing accessibility to healthcare, and reducing costs, remote care will only continue to improve. Pandemic has increased the remote healthcare delivery significantly Even now it is normally safe to resume regular in-person appointments, many healthcare professionals and patients have perceived that remote care is frequently more effectively and affordably provided for many ailments.

5.4 Retail Clinics-Nurse in a box

Retail clinics, a new health care model provides accessibility, realization and affordability. Unlike an emergency department, an urgent care center, or a doctor's office, RMCs are walk-in clinics housed inside retail establishments and offer a variety of healthcare services at cheaper prices. (Godman, 2016). Recently nontraditional Retail medical clinics like Walmart Health, Amazon, Kroger's The Little Clinic (Phares et al., 2021) are assisting in a new way to connect

healthcare demand with supply, the quality of care is similar with traditional healthcare providers with lower costs. More than 200 of Kroger's stores are home to The Little Clinic, which offers dietician services and primary care to both its clients and staff. (Boyle, 2020) By lowering the troubles of unanticipated costs and improving clarity for the treatments that patients often require, transparent pricing can help stimulate access and awareness. (Phares, J et al., 2021)

5.5 Wearable Medical devices

Splints, eyeglasses, bandages, and contact lenses, armband (figure 2) are examples of frequently used medical equipment that can be mentioned as wearable medical devices as they are both worn and having medical purpose. The 'heart holter' monitor (Fotiadis et al., 2006). Which typically track records of patient cardiac activity for a period of 24 hours, is the most well-known wearable monitoring equipment. The patients that are wearing electrodes positioned on their chest and connected to a tiny, battery-operated recording monitor are required to keep both a tape of the recordings and a log of their activities for their therapist. In this way patient's actions can then be connected with any abnormal heart activity at that time. (Fotiadis et al., 2006). Ambulatory health monitoring inside the healthcare environment is made possible by wireless connection devices that can immediately relay alarms to the healthcare professional. Sleep apnea monitors are the examples of medical monitoring and warning tools that can be used at home or at a hospital (Bowman & Schuck, 1995). Wearable clinical aids are intended to give patients with temporary or chronic disability long-term support.

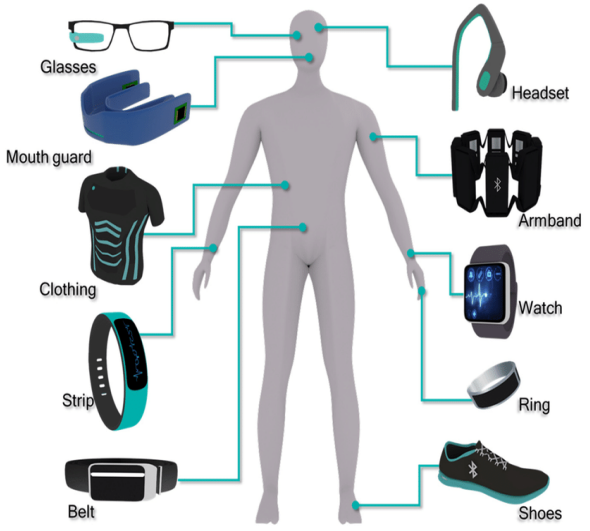

Figure 2-Portable medical and healthcare devices connected on body parts
Source: https://ww.w.researchgate.net/publication/333472144_Evolution_of_Wearable_Devices_with_Real-Time_Disease_Monitoring_for_Personalized_Healthcare/figures?lo=1

5.6 Unmanned aerial vehicles (UAV)

With the advent of telehealth and virtual care, it is now possible to make reasonable diagnoses and deliver healthcare solutions to patients who are difficult to reach. The biggest barriers to widespread use of telehealth include the supply of medicines, vaccinations, and other medical supplies to remote places, as well as the collection of biological samples for laboratory testing. Unmanned aerial vehicles (UAV) called drones have shown enormous promise in overcoming these challenges. It can also be used in life threatening conditions to transport automatic external defibrillators (AEDs) and save the lives of cardiac arrest outpatients, carry organs quickly and with great care. Ziplitne, (Dutta, 2023) the premier designer and operator of delivery drones based in the United States, recently secured multiple collaborations around Africa to transport vaccines, blood products, and other medical supplies to rural and isolated places.

5.7 Telemedicine

Major challenge, the humanity in the twenty-first century is facing is that of making high-quality healthcare accessible to everyone. The need of the presence of patient and the practitioner in the same location and at the same time has historically made it difficult to achieve fair access to health care. Telemedicine is the conveyance of medical assistance and the exchange of medical data over long distances. Subsequently, it covers the full gamut of medical operations, disease diagnosis, treatment, and prevention also ongoing training for and healthcare professionals and consumers, research and evaluation. Governments also accelerated the use of telemedicine by releasing guidelines as a response to the COVID-19 pandemic to lessen the pressure on healthcare institutions so that providers can communicate with their patients via telecommunication. This will reduce the burden on facilities and minimize the need for personal protective equipment (PPE). In real-time interactions like videoconferencing there is no delay between the collection, transmission and display of the information. Due to recent advancements in mobile phone and satellite communications mobile telemedicine is now possible. Some examples of these type of programs were the Alaska ATS-6 Satellite Biomedical Demonstration from 1971 to 1975 that evaluated the feasibility of boosting rural health care In Alaska using satellite moderated video consultation. (Elford, 1998) Telemedicine can lessen the geological diversity of diagnosis and clinical management by increasing access to medical knowledge. Teleconsultation has been demonstrated to alter diagnoses and treatment suggestions as well as shorten the drawn-out wait periods for specialty care that is in high demand. (Kedar et al., 2003).

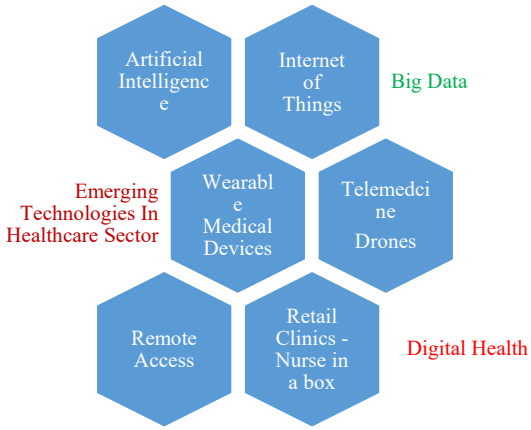

Figure 3. Emerging development in Healthcare Industry

6. A SWOT (STRENGTH, WEAKNESSES, OPPORTUNITIES, THREATS) ANALYSIS OF TECHNOLOGY ADOPTION ON HEALTHCARE INDUSTRY

We have presented a SWOT analysis (figure 4) of technology adoption to find out the strength and weaknesses and explore the opportunities and identify the threats. This pivotal management tool is used to kingpin the strengths, take the maximum advantage of opportunities and minimize the threats.

6.1 Strengths

Strengths are the areas where healthcare organization excels at, and technology has a positive impact on the flourishing healthcare sector.

- Enhanced patient care and outcomes- Advancement in information and communication technologies have paved the way for the delivery of low-cost e-health services to individuals all over the world. The IoT healthcare system offers effective tracking and monitoring, which enhances patient care. (Chen X. et al., 2018)
- Increased efficiency and cost savings - Remote care can reduce costs for everyone by reducing hospital visits, making free the hospital rooms for those who need them, and rearranging healthcare personnel' schedules, With the promise of real-time communication, enhancing quality of life, enhancing accessibility to healthcare, and reducing costs, remote care will only continue to improve.
- Improved accessibility and connivance Video conferencing allows clinicians/surgeons and physicians to contact with faraway patients in real time and provide expert advice as well as converse with the patient. Telemedicine (Heinzelmann et al., 2005) lessen the geographical differences and long waiting times associated with access to the healthcare facilities.
- Empowering patients through health information and education-Patient empowerment enables the patients to take charge of their own health care. It provides people with the knowledge, education, and information they need to use the data in their own best interests.
- Advanced diagnostics and treatment options Recent developments in information and communication technologies have generated new methods of diagnosing the diseases, the treatment options that care can be delivered in health care industry. Wearable devices help in supervising the treatment of chronic conditions like heart diseases, asthma, and diabetes. (Fotiadis et al., 2006). Over the previous two decades, rapid advancements in ICT as well as research and development efforts in the healthcare business, have resulted in substantial enhancements in the quality of medical services provided to patients.

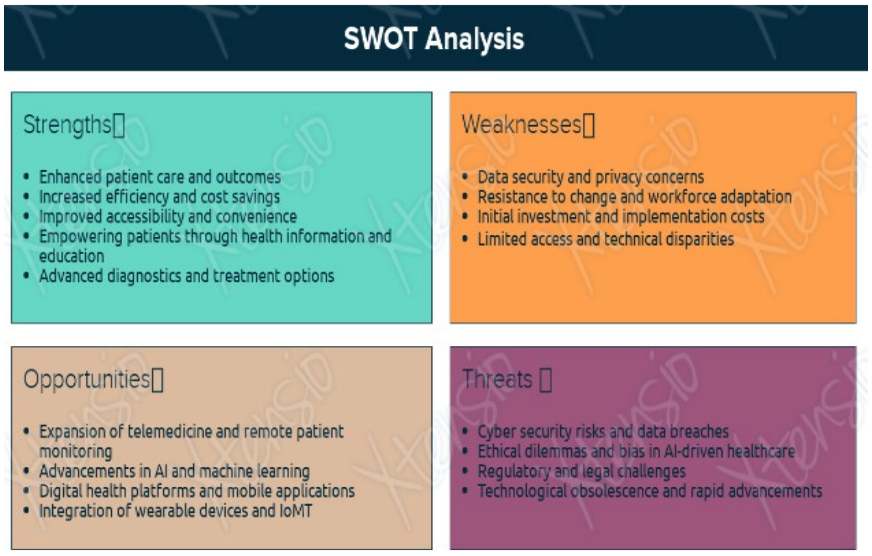

Figure 4. SWOT analysis

6.2 Weaknesses

Weaknesses are the areas that can be improved.

- Data security and privacy concerns-Another remarkable issue in the IoT is privacy, as devices are more prone to smack. These devices have limited resources and it is difficult to apply encryption algorithms to them. There is currently no suitable legislation in place to propound protection and privacy for personal medical records, particularly in developing nations; much work remains to be done in this regard.
- Resistance to change and workforce adaptation-Due to widely used AI some jobs may become obsolete and it is considered to be creating unemployment. Some organizations do not want to reduce their workforce and unwilling to implement the artificial intelligence.
- Initial investment and implementation costs-Information technology and other supporting technologies are significantly more extravagant than traditional ways and do not exactly be in the tune with the source of investment. Developing countries are facing financial crunch. Without external assistance, developing-countries governments cannot afford these technologies. For example, India's total expenditure on health is less than the developed countries. (Figure 5).
- Limited access and technological disparities

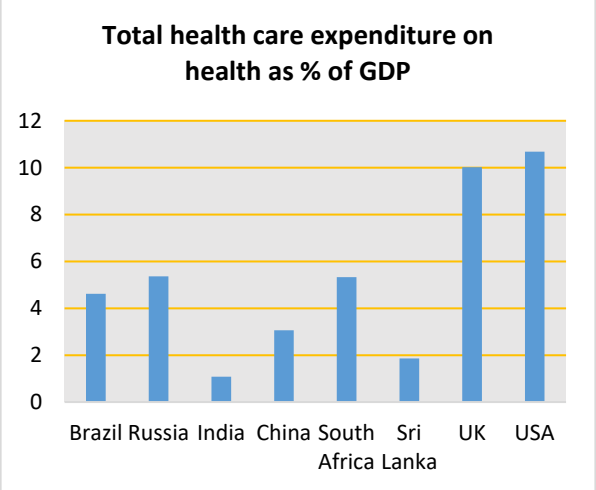

Figure 5. Total expenditure on health as a percentage of GDP in 2020
Source: WHO, Global Health Observatory (GHO) data repository.

In USA and developed countries AI is widely used in the healthcare sector, but in developing countries like India access to technology is limited. In rural areas people do not have mobile phones and access to internet for online consultation and diagnostics. Millions of people have retrieved the benefits of internet but billions are still left behind.

6.3 Opportunities

The competitive advantage of technology.

- Expansion of telemedicine and remote patient monitoring

Major challenge, the humanity in the twenty-first century is facing is that of making high-quality healthcare accessible to everyone. World Health Organization (WHO) has given this vision in its health-for all strategy in the 21st century. (WHO, 1997). By improving communication up and down the health care pyramid (figure 6) telemedicine can be expected to increase equity of access to health care, the quality of that care, and the efficiency with which it is given. Widespread use of telemedicine would allow for decentralization; for example, work previously done in the secondary sector might be undertaken in primary care, and work previously done in primary care could be transmitted to the community level

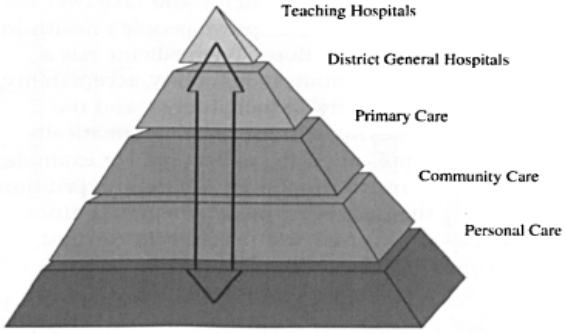

Figure 6. Telemedicine used as an improving communication up and down the health care pyramid
Source: (Craig & Petterson, 2005)

- Advancements in artificial intelligence and machine learning-

In USA and developed countries AI is widely used in healthcare sector. Advanced algorithms, vast data sets, and tremendous computing power are now being used to help patients. Real-time sophisticated data analysis and challenging cognitive activities are now a reality. (Mahajan et al., 2019) The hallmarks of AI include information gathering, processing, learning, and reasoning (Fomenko & Lozano, 2019). "RUDO"- the "ambient intelligent system" (Hudec et al., 2017) can accommodate blind persons in living and working along with sighted people in specific industries like informatics and electronics. During complicated pregnancy stages, an artificial-intelligence based "smart assistant" can furnish pregnant women with dietary and other crucial advices. (Tumpa, et al., 2017)

- Digital health platforms and mobile applications

The emergence of mobile-based applications has surfaced the road for directly accessing and probing patient information via sensors attached to users. Mobile healthcare applications allow speedier information

delivery at a lower cost, unlimited Internet-based services, and efficient battery backup (Jagadeeswari et al., 2018)

- Integration of wearable devices and Internet of Medical Things (IoMT)

The wearable IoT devices also play a major role in surveillance of the patient's condition. (Elhoseny et al., 2018) Many issues in healthcare are being resolved by remote patient care by using wearable technology and IoT. A doctor may retrieve information from a patient's watch to learn about their caloric intake, heart rate, and other factors that help them to keep away serious health problems. Ambulatory health monitoring inside the healthcare environment is made possible by wireless connection devices that can immediately relay alarms to the healthcare professional. Sleep apnea monitors (Bowman & Schuck, 1995) are the examples of medical monitoring and warning tools that can be used at home or at a hospital a variety of GPS-based navigation tools (Loomis et al., 2001) made for visually impaired people to help in finding the way, obstacle avoidance, and navigation.

6.4 Threats

Threats are the external factors that impede the strategies and harm the organization's ability to compete in the market.

- Cyber security risks and data breaches-

Transmission of patient's medical records including personal data, health conditions examination reports etc. passed through IoT devices can be misused by the hackers. (Elhoseny et al., 2018) Another significant issue in the IoT is privacy, as devices are more prone to assault. These devices have limited resources and it is difficult to apply encryption algorithms to them.

- Ethical dilemmas and bias in AI-driven healthcare-

Ethical problems with privacy and security (Char et al., 2018) such as the lack of explicit legislation regarding data anonymization, balancing privacy and accessibility of data, create significant ethical quandaries. It will be critical for governments to obtain and handle data today and in the future. It is difficult to strike the correct balance between privacy, ownership, and transparency.

- Regulatory and legal challenge

It is well acknowledged that the law will never be able to keep up with the exponential rise of technology. No specific laws are made to deal with AI. It is difficult to develop regulatory requirements for deploying AI technology in healthcare in order to comply and adhere to an ever-changing future-ready evidence-based environment. (Asan et al., 2020) At the moment, Indian intellectual property rules do not recognize the patentability of algorithms, which form the foundation of an AI solution. (Ganapathy, 2021).

- Technological obsolescence and rapid advancements-

The rapid growth of information and telecommunications technology, which causes systematic and often costly evaluations to become obsolete in a short period of time.

7. DISCUSSION

There is no denying that technological advancements can be useful in some circumstances. AI and IoT have emerged as promising tools for transforming healthcare delivery, improving patient outcomes and enhancing operational efficiency. From the technological front we can forecast that future advancements in nanotechnology, wireless communication and sensor technology, will change provisions of healthcare and can prove to be strengths for the healthcare industry in the future. Smart gadgets and devices like smart phones will develop in size, cost, and power, as well as becoming more user-friendly and accessible at the point of care. (Heinzelmann, et al., 2005).

However, if health-care institutions and governments do not adopt policies to promote its advancement and development, the transition to a society where technology is utilized to the fullest extent will not be realized. With the growth and incorporation of information technology into healthcare delivery there will be bright prospects for patients, payers and providers in health systems in the near future can prove to be great opportunities for the healthcare sector. A proper regulatory system can enhance the prospects of technology in the healthcare as the United States Food and Drug Administration (FDA) has stated its authority and aim to regulate artificial intelligence (AI) in the healthcare sector. In 2019, the FDA established a digital health branch to develop new regulatory requirements for AI-based technologies (Mahajan et al., 2019). By applying this pivot management tool 'SWOT analyses' the developing country like India can also reap the benefits of technology in the healthcare sector as India is emerging as a hub of technology.

4. CONCLUSION

We are in a transition period as artificial intelligence (AI) is rapidly applied in healthcare around the world. Transitions present opportunities as well as challenges. Anytime whenever there is advent of a new technology in any sphere, it has to face a number of challenges. Common hitch of artificial intelligence in healthcare includes a regulatory compliance requirement, lack of data exchange, and provider and patient adoption. AI

has come across all of these issues, narrowing down the areas in which it can succeed.

Technological advancements require more investments that is a big constraint for the developing countries. As a result, medical practitioners, doctors, hospital administration, insurers, and other collaborators must work together to develop collaborative cost-benefit approaches that validate the blooming and deployment of new technologies. Large private-sector organizations should step ahead to assist hospitals in executing high-tech patient management systems. Governments of low-income countries should also increase the expenditure on the healthcare. The stored information (Data) might be readily corrupted by the hackers is another problem with healthcare monitoring. Therefore, it is essential to create an IoT-based healthcare system that provides safety to patient's privacy and must be fused with patients for effective data transfer. (Elhoseny et al., 2018) The study is limited to include few latest innovations in the healthcare sector. There is much scope of analyzing the more innovations like use of 3D printing, genomics, cloud computing and many more in healthcare sector. There is a need to address the issues of accessibility, affordability, scarcity, and inconsistency of healthcare to have the optimum utilization of technology.

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Siya Bhatia
Sharda School of Business Studies
Sharda University,
Greater Noida,
Uttar Pradesh
India 201310
siyabhatia5@gmail.com
ORCID 0009-0007-6373-8482

Mridul Dharwal
Sharda School of Business Studies
Sharda University,
Greater Noida,
Uttar Pradesh
India 201310
mridul.dharwal@sharda.ac.in
ORCID 0000-0002-7977-4062

Sumeet Bhatia
Jay Pee institute of Information and Technology,
Noida, Uttar Pradesh
India 201304
sumeetiitiim@gmail.com

Varun Mohan
Sharda School of Basic Sciences and Research, Sharda University, Greater Noida, Uttar Pradesh
India 201310
varun0503ind39@gmail.com
ORCID 0000-0003-0453-1610