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Factors of adoption of artificial intelligence and internet of medical things amongst healthcare workers: a descriptive analysis

Tarika Singh Sikarwar[1], Seema Mehta[2], Sumit Yadav[3] and Drishti Arora [4]
[1]Professor, Prestige Institute of Management & Research, Gwalior
Corresponding author E-mail: singh.tarika@gmail.com, etc
[2] Professor, IIHMR University
[3]Student, Prestige Institute of Management &Research, etc
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Abstract

The technologies like Artificial Intelligence (AI) and the Internet of Medical Things (IoMT) have revolutionized the healthcare system. The Covid-19 pandemic has been a major force behind this revolutionary technology usage. This study finds the challenges in the adoption of this new knowledge i.e. in the adoption of AI and IoMT by the healthcare workforce based on self-designed questionnaires having questions on an interval scale to identify the challenges in the adoption of these technologies. This research was conducted from July 2020 to April 2021, taking a sample of 350 healthcare workers inclusive of doctors and paramedical staff however only three hundred respondents filled the questionnaire. Different challenges have been found for adopting AI and IoMT via an absence of a regulatory Framework; unexplained return on investment in absence of research with low funding, and Huge Data and Operational Mediocrity with all-time processing requirements are challenges for the adoption of these technologies. The finding of the study suggests better equipped and technologically aware healthcare workers for the betterment of services, especially in tough times like the Covid-19 pandemic.

Keywords: Artificial Intelligence (AI), Internet of Medical Things (IoMT), Workforce, healthcare ecosystem, Challenges

1. Introduction

With the rapid growth of medical science, it is difficult to meet all the medical requirements by using traditional methods. The Indian Healthcare sector has a projection of 372 billion by 2022. The global IoMT market stood at a value of $22.5 billion in the year 2016 and growth is anticipated to be $72.02 billion by 2021 (Nikhila, 2021), growing at an annual rate of 26.2 % (Frost & Sullivan. (2017). In this growth two technologies majorly contributes to Artificial Intelligence (AI) & Internet of medical things (IOMT). Furthermore, there is pressure on world healthcare systems owing to the escalations of chronic diseases and scarcity of resources (Lassalle et al., 2004). Artificial Intelligence simply represents the intelligence of machines and the separation of computer science that targets to generate it (Murali & S 2018). Medical Artificial intelligence is principally associated with the creation of AI Programs that execute identification and make therapy commendations, but working on only these areas was not enough, the AI scope in the healthcare system is much broader (Barrett, 1996). After that Artificial Intelligence in Medical (AIM) redefined its priorities and started a quiet revolution “evidence-based medicine”. The key problem area is a slower pace of system which transfers proofs to clinical practices and as result, clinical trial data keeps on mounting. A quick way is needed to access such guidelines and implement them to practice and come up with own experiences to help to make the system better. AI systems depend on the availability of large amounts of data. This poses a major impediment to building indigenous AI interventions in India.

Datasets for healthcare in India are fragmented, dispersed, and incomplete. Current AI experiments are dependent on historical data available from select hospitals or research institutes. The trouble with historical data, as has already been well documented in existing studies on AI, is that it will, by definition, reflect certain societal structures of discrimination (Gershgorn, 2018). Inadequacy of required data infrastructure is there in most healthcare organizations. IoMT provides connectivity between medical science and technology. Development and use of connected and distributed medical devices have brought the advent of IoMT which is bringing in both likely applications and abundant challenges (FernándezMaimó et al., 2019). IOMT is capable to provide more accurate results in the diagnosis. It has a low maintenance cost and makes the cure comfortable. Protection and security are more troublesome in the IoMT setting because clients, as well as unapproved articles, could get information (Miorandi et al., 2012). Real-time data of patients with the help of smartphones can be collected by doctors without visiting the patient physically (Venkatesh, 2019; Dash, 2020). It provides direct access to health reports over smartphone applications and provides an option to send them to the doctor. It prevents chronic illness. With this m- health service one can reach easily the standard of medical services and quality of medication as per patient needs (Dong, n.d.).

An enormous number of medical care experts and service providers recognize the significance of specialized medical services technology advancements. Contemporary medication cannot proceed in the earlier era any longer. The unbelievable transferal in the innovation area has stunned everybody out of their astuteness. A few quickly developing advances are merging to impact the direction of IoT in medical services. There are a few difficulties in advance improvement, healthcare delivery just as issues identified with protection of information, advanced gap, the job of government and different partners, conduct and selection by clinical specialists and emergency clinics.

In this research paper, researchers have examined mainly the challenges of Artificial intelligence and Internet of Medical Things (IoMT) adoption in the Indian healthcare ecosystem by the healthcare workforce.

2. Healthcare workforce & emerging technologies (artificial intelligence (ai) &the internet of medical things (iomt) in healthcare system

As per a report published by WHO in 2006, “This report defines health workers to be all people engaged in actions whose primary intent is to enhance health” (The World Health Report, 2006). A healthcare worker, either directly or indirectly, deliver care and services to the sickening and ailing. They do it straight as nurses &doctors or incidentally as assistants, helpers, laboratory technicians, or even medical waste handlers (Joseph and Joseph, 2016). The international classification of HCWs includes: “generalized medical practitioners, specialist medical practitioners, professionals in nursing, professionals in midwifery, professionals in traditional and complementary medicine, practitioners in paramedical, professionals like dentists, pharmacists, professionals in environmental and occupational health, and professionals in hygiene, professionals in physiotherapists, dieticians and nutritionists, audiologists, and speech therapists, optometrists and ophthalmic opticians, medical and pathology laboratory technicians, paramedical technicians and assistants, medical and dental prosthetic technicians and their assistant or aides’ (Occupation group, (n.d.)in Mohanty, Kabi, and Mohanty, 2019). jWan et al., (2019) defined AI: as “Computers which perform cognitive tasks, usually associated with human minds, particularly learning and problem-solving" (p.10). Medical artificial intelligence is primarily concerned with the construction of AI programs that perform diagnoses and make therapy recommendations. Medical AI is based on representative replicas of ailment units and their association with patient factors and clinical indicators (Clancey and Shortliffe, 1984). “AI is concerned with methods of achieving goals in situations in which the information available has a certain complex character (Haefner, Wincent, Parida, & Gassmann, 2021). The methods that have to be used are related to the problem presented by the situation and are similar whether the problem solver is human, a Martian, or a computer program” (McCarthy, 1998). AI is mainly based on algorithms and models as a technique that is designed based on scientific findings such as math, statists, and biology (Li et al., 2019.). Advancements leading to human-level AI can be estimated by the negligible portion of these positions that can be acceptably performed by machines (Nilsson et al., 2017; Uden and He, 2017).

"The Internet of Medical Things (IoMT) labels the interconnection of communication-enabled medical-grade devices and their incorporation to wider-scale health networks to improve patients' health" (Gatouillat et al., 2018; R. et al., 2020). The healthcare management system is simplified by the Internet of Medical Things making it more efficient and real (Islam, et al., 2015). It facilitates information transfer while transferring patients from one hospital to another (Joyia et al., 2017) ensuring timely and cost-efficient treatment to patients (Fischer & Lam, 2016). The Cloud computing process ensures this information sharing (Guo, Kyo&Sahama, 2012; Mell and Grance, 2011; Chang, Chiu, and Ramakrishnan, 2009). Wang and Tan (2010) and Lohr (1991, p. 21), proposed that healthcare quality is "the degree to which healthcare services for individuals and population increases". Guo, Kyo&Sahama, 2012) have considered a cloud-based platform to provide healthcare organizations with software services, a program development environment, and hardware and computational resources.

3. Role of disruptive technologies in delivering healthcare quality

Donabedian's (1988) theory stipulates that the interpersonal aspect of care plays a very important role in determining the satisfaction patients derive from health care. For a patient to be satisfied with health care delivery he should have a positive judgment towards every aspect of the quality of care delivered especially as it concerns the interpersonal side of health care. As per Donabedian (1980, p. 5), healthcare quality can be defined as "the application of medical science and technology in a manner that maximizes its benefit to health without correspondingly increasing the risk". Schuster, McGlynn& Brook (1998), p. 518) added that one of the features of decent healthcare quality is "providing patients with appropriate services in a technically competent manner, with good communication, shared decision making, and cultural sensitivity". It is the possibility of anticipated health results and is consistent with the present specialized information. Leebovand Scott, 2003), p.4) argued that healthcare quality means "doing the right things right and making continuous improvements, obtaining the best possible clinical outcome, satisfying all customers, retaining talented staff, and maintaining sound financial performance". Modern technology adoption is increasingly migrating to documenting patient interactions and information management. The term disruptive technologies was coined by Christensen (1997) and "refers to a new technology having lower cost and performance measured by traditional criteria, but having higher ancillary performance" (UTTERBACK and ACEE, 2005). "Das enable a larger population of less-skilled people or providers with less training to do things in a more convenient lower-cost setting, which historically could only be done by specialists in less convenient settings" (CN, 1996; Christensen, Bohmer, and Kenagy, 2000). Jonsson et al., (2002, p.218) have associated technology with healthcare as "broadly defined to include the drugs, devices, medical and surgical procedures used in health care, as well as measures for prevention and rehabilitation of disease, and the organizational and support systems in which health care is provided." Assen (2011) stated that operational excellence is the design and management to maximize operating profits through the constant operation of excellent production and delivery system that offers products and services to customers at the right value. Patient interaction and management of information are done via software-as-a-service (Saas) apps these days (Oh et al., 2015) enhancing the experience quality (Lemke, Clark, and Wilson, 2010). AI helps patients to move, communicate and decode neural activities on an individual basis AI utilized new technologies are showing excellent results in the calibration of mentally and emotionally fragile patients (Meghdari&Alemi, 2018). Further Istepanianet al., (2011) in their research introduced a unique concept of IoT in medical health as a highly beneficial tool for medical health. There is great optimism that the application of artificial intelligence (AI) can provide substantial improvements in all areas of healthcare from diagnostics to treatment. There is advancement in the healthcare industry like technology Internet of Medical Things (IoMT), Artificial Intelligence (AI), Machine Learning (ML), Big Data, Mobile Apps, and Advanced Sensors (Venkatesh, 2019; Laurenza et al., 2018). The foundations of technical revolution and their association with various types of healthcare services have been identified by Romeira et al. (2009). There is a digital disruption in healthcare service innovation (Ford et al, 2017) which is good for the future of healthcare (Thimbleby, 2013) but to realize efficiency gain, the costs aspects can't be neglected (Williams et al., 2008). It is generally believed that AI tools will facilitate and enhance human work and not replace the work of physicians and other healthcare staff as such. AI is ready to support healthcare personnel with a variety of tasks from administrative workflow to clinical documentation and patient outreach as well as specialized support such as in image analysis, medical device automation,

and patient monitoring (Bohr A, Memarzadeh K 2020). There is advancement in the healthcare industry like technology Internet of Medical Things (IoMT), Artificial Intelligence (AI), Machine Learning (ML), Big Data, Mobile Apps, and Advanced Sensors (Venkatesh, 2019; Laurenza et al., 2018). The foundations of technical revolution and their association with various types of healthcare services have been identified by Romeira et al. (2009). There is a digital disruption in healthcare service innovation (Ford et al, 2017) which is good for the future of healthcare (Thimbleby, 2013) but to realize efficiency gain, the costs aspects can't be neglected (Williams et al., 2008).

These practical health care models are connected digitally leading to better delivery of value for patients and convenience to doctors. healthcare technologies will change the roles of healthcare workers and government (Mitchell &Kan, 2019) and a new framework for implementation of healthcare monitoring has to be worked upon Xu et al., (2015). Rong, (2020) has appreciated the tremendous potential of AI in biomedicine. Health care professionals, clients, managers, payers, policymakers, and certification staff's service-quality viewpoints in healthcare organizations have also been explored (Ali Mosadeghrad, 2014; Greco et al., 2020). Improvement in the safety of the patient by lesser errors in medication and minimization of adverse drug reactions as well as better practice guidelines acquiescence are the results of health information technology (Alotaibi and Federico, 2017). Even they can be reached through mobile phones, especially for those patients who stay out-station (Rajkumari, 2014) thus IoMT has been used in Better Dispersal of Health Care Methods and Improving Health Care Systems. A holistic approach is needed for the transformation of traditional healthcare to digitalized healthcare (Kraus et al., 2021).

4. Adoption of ai & iomt in healthcare: review of challenges

AI is a fundamentally Developing market in the field of healthcare and proven medical AI can play an important role in helping doctors and patients to deliver healthcare much more professionally in the 21st century (Murali& S, 2018; Vatandsoost&Litkouhi,2018). The variety of solicitations of AI and AI-mediated technologies in Medicine and Health Care is vast and rapidly increasing, with many powerful potential (positive and negative) results, which may affect the human being and society at all scales (van Hartskamp et al.,2019); Emilio Gómez-González et al., (2020). AI has a prominent perspective to encourage the shift of conventional healthcare into equitable cooperation among patients and health providers by investigating the immense quantities of data recorded by medical organizations and patients in each instant (Rayan, 2019).

AI systems enable decision-making in doctors (Mahapatra, Bozorgtabar, & Garnavi, 2019) In this research the author wrote about the overview impact of AI in the Indian healthcare system and wrote about the AI applications in stroke, in the three major areas of early detection and diagnosis, treatment, as well as outcome prediction and prognosis evaluation (Jiang et al., 2017). Research has resulted in the statement that explains the ability of the model's decision is an important component of AI systems, especially when it comes to healthcare since doctors have to be able to explain the rationale behind a decision. AI models use Blockchain technology as a friendly assistant for both patients and doctors to communicate with them during pre-surgery, surgery, and post-surgery (Le Nguyen and Do 2019). Research on the potential for artificial intelligence in healthcare discusses many instances in which AI can perform healthcare tasks as well or better than humans (Davenport&Kalakota, 2019). The satisfactory progress of AI tools in healthcare can be done for everyone by introducing a concerted effort among all those involved. It is thus time to also consider the opinion of patients and, together, address the remaining questions, such as that of responsibility (Reddy, 2020; Laï, Brian, & Mamzer, 2020)

There is a need for clinically validated and appropriately regulated AI systems that can benefit and are safe (Kelly et al., 2019; Wang, Kung, & Byrd, 2018). There are blockades to the espousal of artificial intelligence in the healthcare industry (Assadullah, 2019; Fish,2020) the technical challenge is to find solutions that address these ethical, legal, and societal issues. an effective framework of laws to govern privacy and data integrity, while dealing with issues of cultural acceptance, informed consent, liability, and explaining ability is needed in Artificial Intelligence in the Healthcare Industry (Yesha & Gangopadhyay, 2017). Models for customized hazard evaluations ought to be all around adjusted and productive, and powerful refreshing conventions ought to be executed. Cost, hazard, and vulnerability ought to be characterized for all

potential applications (Ellahham, Ellahham & Simsekler, 2019.). The researcher expounded on the Strategies for the security of AI and ML in medical care that are advancing and are not yet completely created. Frameworks and applications with significant and ostensible security ought to be taken care of with a necessary convention. Models for customized risk evaluations should be very aligned and proficient, and compelling, refreshing conventions should be executed. Cost, hazard, and vulnerability ought to be characterized for all potential applications (Assadullah, 2019). Further Joyia et al., 2017) wrote about the future challenges of the internet of medical things in terms of medical services in healthcare and its contribution to the healthcare domain. IoMT enables the doctors as well as hospital staff to work more precisely and aggressively with less energy and intelligence. Hence recent efforts focus on IoMT integration frameworks (Rghioui and Oumnad, 2018; Gatouillat et al., 2018) like the Robust IoT-based nursing care support system which is a digital integration platform Chiang, Hsu, and Yeh, 2018). Similarly, Islam et al., (2015) proposed an intelligent model to decrease the risk of security and discusses the advancement of technology in the domain of IoT in the context of medical things, and also proposed e-health with IoT policies.

Jackson et al., (2003) dealt with the demonstrating procedures of IoMT-devices and summed up that the mix of devices is to a great extent concentrated according to a systems administration viewpoint. The IoMT comprises arranged associated clinical devices, unwavering quality, wellbeing, and security of organized network-connected devices. Alansari et al. (2018) in their work have distinguished different users of IoT in healthcare systems, as well as its function inclinations for the ongoing improvements in the domain of IoMT security. Azana et al., (2020) quoted that advanced technologies like blockchain can be used to minimize security threats to systems as well as humans. Health services, as well as commercial interactions by the government, can be improved with IoT (Chiuchisan, Costin, and Geman, 2014; Hossain, Muhammad, & Alamri, 2017). Dimitrov (2016) found that IoT is titivating healthcare services. Health requirements are now managed using IoT. There are security challenges and privacy concerns of IoMT(Zheng et al., 2020) like security-related issues because of the use of IoT-based healthcare application sensors (Nanayakkara, 2019) but blockchain technology can enhance security and guard the privacy of the IoMTsystem (Sun, 2019).

The review suggests AI approaches elicit medical and non-medical data in several categories and reconcile and incorporate information around communities with proof regarding the epidemiology and management of non-communicable conditions, Shaban-Nejad, Michalowski, & Buckeridge, (2020). Also according to the Mc Kinsey & Company report IoMT will host the economy with a manifold increase in its investments as it allows healthcare organizations to carry out this humongous feat relatively easily. The doctors can get access to the files quite readily without any problem (Ch. Venkateswarlu et al., 2016) but Venkatesh, (2019) brought about the way that the development of IoMT shows up when medical care delivery is by all accounts progressively costly. However, the ultimate goal for the usage of these technologies in this aspect is that the patients receive their treatment at the right time and at the right cost (Fischer & Lam, 2016). Further, the review also suggests In low-to-middle-income countries (LMICs), some of the challenges of integrating AI into healthcare systems relate to the hurdles of scaling digital health technologies(As per www.usaid.gov. 2018). This creates a barrier for AI tools for population health to scale at a national level. The reason for strengthened grounds for IoMT and AI in healthcare is the turmoil caused because of COVID-19 which acted as a Pivot for digital health to leap.

5. Objective

To analyze the factors of adoption of Artificial Intelligence (AI) and the Internet of Medical Things (IoMT) amongst healthcare workers.

6. Research methodology

A cross-sectional descriptive study was done wherein healthcare workers acted as the population. Using nonprobability purposive sampling a sample of 350 healthcare workers was considered for the study. Self-designed questionnaires on the challenges of Artificial Intelligence (AI) and Internet of Medical Things (IoMT) adoption in the Indian healthcare ecosystem were emailed to respondents between July 2020 to April 2021 including doctors and other healthcare staff was emailed as well as responses were taken by visiting the hospitals and clinics personally. In the end, the researcher was able to get three hundred filled questionnaires. Responses have been solicited on a Likert-

type scale from 1 to 5, where 1 stands for minimum agreement and 5 stands for maximum agreement. A reliability test has been applied to check the reliability of the questionnaires with the help of Cronbach's Alpha. Exploratory Factor analysis has been applied to find out the factors associated with challenges of Artificial Intelligence (AI) and Internet of Medical Things (IoMT) adoption in the Indian healthcare ecosystem, separately for doctors and other healthcare medical staff of hospitals.

7. Factors affecting the adoption of artificial intelligence

Exploratory factor analysis is applied to know the factors indicating challenges in the adoption of Artificial intelligence Initially , a reliability test to check the reliability of questionnaires on the challenges of Artificial Intelligence (AI) was applied (table 1).

Table 1: Reliability statistics

Variables	Cronbach's _Alpha	No. of Items
AI (Medical Staff)	.777	8
IoMT (Medical Staff)	.856	8

The result is in line with the finding of Normally (1978) recommended that instruments used in basic research have a reliability of about 0.7 or better, therefore, all the items in the questionnaire are highly reliable.

Then the KMO test was applied (table 2) to check the normal distribution and sample adequacy whereas the Barlett test has been applied to check whether the responses matrix is the identity matrix and to find out whether the data is suitable for factor analysis not.

Table 2: Sample adequacy

Variables	No. of responses	KMO Value	Chi-square and Sig Level
AI (Medical Staff)	150	.776	280.036 @.000
IoMT (Medical Staff)	150	.889	425.539 @ .000

Table 2 shows data is good for applying exploratory factor Analysis.

Further two factors emerged indicating the challenges in adopting Artificial Intelligence (Table 3).

Table 3: Factors for challenges in adopting Artificial Intelligence

Variables	Factor 1	Factor 2	Cumulative Variance
challenges in adopting Artificial Intelligence	absence of a regulatory framework	unexplained return on investment in absence of research with low funding	54.079%

namely the absence of a regulatory framework and secondly unexplained return on investment in absence of research with low funding. These two factors explained a cumulative variance of 54.079 percent.

Factors affecting in adoption internet of medical things

Only one component namely the Internet of Medical Things was extracted in EFA performed to know the factors underlying challenges in the adoption of IoMT in medical staff. Huge Data and Operational Mediocrity with all-time processing requirements emerged as a challenge in the adoption of IoMT.

8. Study findings

The objective of the study was to find out challenges in the adoption of Artificial Intelligence (AI) and the Internet of Medical Things (IOMT) amongst healthcare workers as there is an evolving role of Artificial intelligence (AI) and the Internet of Medical Things (IOMT) due to market forces, growing millennial population, and technology adoption and patients are more aware than ever of their healthcare needs (KILIÇ, 2016). There is a major role of Doctors and medical staff in adopting these technologies and making fuller utilization (Parlakkılıç 2019). However, the study shows various challenges faced by Healthcare staff in adopting these technologies which include the non-existence of any healthcare regulatory body, unaffordability, and Low funding & returns. Further, there are other technology-based Adoption Challenges in terms of IoMT, like not being technically updated in understanding and interpreting the data obtained from

IoMT use. The research conducted showed that the efforts needed are from both healthcare workers as well as from the government to use this knowledge regarding challenges and provide the required legitimate preparation in form of training and better coordination among the healthcare workforce & arrangement (Oborn, 2008) in the organization to acknowledge productivity gains. These technologies can empower the health staff to take care of their job even more absolutely and effectively provided attention is paid to the factors giving challenges in the adoption of AI and IoMT.

9. Implications

The challenges found in the adoption of AI and IoMT in the research will help in understanding the improvements required in healthcare delivery making the healthcare system digitally ready for any such crises. There are other opportunities like starting new technology ventures, healthcare centers, and coming up with a public-private partnership (PPP) if the challenges identified are met. The study can be conducted even among the patients to know about their knowledge as well as perception about challenges in the adoption of AI and IoMT in the Healthcare System. The challenges further can be classified based on demographic factors such as age and education. The challenge for regulatory Framework relates to government policymaking and Low funding and Returns have implications for the investment needed in the sector which can be through government funding or the PPP model. Further,The adoption challenges in AI and IoMT need the involvement and training of healthcare workers

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