European Economic Letters
ISSN 2323-5233
Vol 14, Issue 2 (2024)
http://eelet.org.uk

Customer Attractiveness of Medical Service Robots in the Indian Healthcare Industry

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ABSTRACT
This paper explored the potential of medical robots in the Indian healthcare sector by understanding the attractiveness of medical robots to patients. The current state of the Indian healthcare sector has been discussed, including the shortage of medical personnel and the need for improved access to medical services. An extensive literature review was followed by data collection from Indian patients using online and offline survey methods. Exploratory factor analysis was conducted to analyze the data. Based on the results, a framework has been proposed constituting three factors: service alignment, automation support, and patient engagement, which contribute to the attractiveness of medical robots among patients, the successful implementation, and usage of medical robots. The service providers can use this framework to understand what the patients look for and what is the best they can provide them. However, challenges like cost and technological limitations must be handled well for successful integration.

Keywords: Medical Robots (MRs), Customer Attractiveness, Indian Healthcare Industry, Automation, Customer Engagement

INTRODUCTION

The utilization of robots in an industrial context has sparked a growing interest in exploring remote-controlled, semi-autonomous, and fully autonomous surface robots within healthcare. These robots could cover all aspects of the healthcare continuum, such as prevention, screening, diagnosis, treatment, and home care. Service robots could replace industrial robots when managing mundane or laborious chores like supply chain management, stocking and inventory control, back-end assistance, and patient care. For example, consider the delivery of medication or supplies.

Robots such as autonomous vehicles and drone fleets can simplify and standardize one-to-one deliveries, making high-priority urgent deliveries during acute care events possible and automating community-based delivery for an entire region. Robots can also assist healthcare professionals such as nurses, physicians, imaging technicians, and more in healthcare settings, allowing them to engage in direct patient interaction roles. From a patient-centric perspective, service robots could provide comfort and care and act as personal helpers for the patient to move around, eat, and conduct everyday activities.

India produces only about 50,000 doctors yearly, which is insufficient to meet minimum standards. To reach the World Health Organization's (WHO) recommended minimum doctor-patient ratio of 1:1000, India will need 2.3 million doctors by 2030. Early experiments by at least a dozen healthcare start-ups hold some answers to push healthcare in India into the future and ease the burden on India's healthcare system. One of the striking features of India's healthcare sector is the range of quality in available services. According to a report from the Indian Council of Medical Research (ICMR), Indian medical facilities are inadequate and unevenly distributed. The report states that while there are some pockets of excellence, most medical facilities are limited in capacity and access, with much of the care provided by untrained personnel. Additionally, the report notes that India's rural and remote areas are particularly underserved, with inadequate access to specialist care, medications, and diagnostic services. The report calls for more significant investment in healthcare infrastructure and personnel to ensure equity in access and quality of care (Indian Council of Medical Research, 2013).

LITERATURE REVIEW

Medical Robots (MRs):

According to Ginoya et al. (2021), robots can be instructed to execute a designated range of simple or intricate tasks. They can operate autonomously or with human interaction. These definitions describe that the robots perform complex and precise tasks, relieving physicians and medical staff of some of their workload and increasing the overall efficiency of healthcare facilities (Tang et al., 2019) in jobs ranging from surgery to rehabilitation. While they provide several benefits in healthcare, such as higher precision, improved outcomes, and decreased human error, MRs are becoming more widespread worldwide. Surgery, rehabilitation, and diagnosis are just a few healthcare applications for MRs.

Utilizing robotic assistance offers the benefit of programming tasks that demand high-speed motion and a concentrated emphasis on precision and accuracy. Furthermore, robots can execute tasks that involve applying force without experiencing fatigue. However, employing robotic systems comes with certain drawbacks. These include their elevated cost, substantial spatial requirements for operation, the necessity for regular maintenance, and the prerequisite for comprehensive training of operators, including medical professionals and clinical staff, before implementation (Ginoya et al., 2021).

Notwithstanding these disadvantages, the positive influence of medical robotic systems is evident in surgery. Here, attaining noteworthy enhancements in precision and accuracy has led to refining procedures like tissue manipulation.

Types of Robots:

- *Surgical Robots*
  Among the most frequently utilized MRs worldwide are surgical robots. These robots can be utilized in minimally invasive surgery, which calls for creating small incisions and using tiny equipment. Surgical robots can boost surgical results by giving surgeons better visual and tactile feedback, enabling more accurate motions, and lowering the risk of complications. The performance of surgical robots is equivalent to that of a skilled human surgeon, with little room for error since they have several degrees of freedom, flexibility, precision, and dependability (Ozturkcan & Merdin-Uygr, 2022).

- *Rehabilitation robots*
  Another form of MR that is becoming increasingly popular is the rehabilitation robot. These robots are made to provide specialized therapy and exercise to people recovering from illnesses or accidents. They can assist patients in regaining their strength and movement and give healthcare professionals helpful information to

help them customize treatment strategies.

- *Diagnostic robots*
  Diagnostic robots help with imaging and analysis in the medical field. These robots can capture medical photos, spot problems in those images, and even do biopsies. Healthcare professionals may detect illnesses and ailments more quickly and precisely using diagnostic robots, improving patient outcomes.

Medical Robots in COVID-19

The COVID-19 pandemic has propelled the global trend toward using service robots in healthcare (Ozturkcan & Merdin-Uygr, 2022). Here are a few instances of service robots being employed in medical settings worldwide:

- Telepresence robots enable distant physicians to communicate with patients in clinics or hospitals. With the robot's screen and camera, the doctor may interact with the patient and conduct virtual examinations and consultations.
- Delivery robots: Hospitals and clinics are adopting delivery robots to transfer medications, lab samples, and other supplies to various parts of the institution. This eliminates the need for workers to move around and spread illnesses.
- Robots that perform disinfection using UV-C light or other technologies are becoming increasingly frequent in hospital rooms and settings. These robots are beneficial in the fight against COVID-19 and can sterilize a room in minutes.
- Robotic surgery: Robots let surgeons perform surgical procedures more precisely and accurately, lowering the likelihood of human error. As this technology develops, it becomes possible to execute more intricate surgery.
- Elderly Care Robots: To support and assist seniors in nations with aging populations, elderly care robots are being developed. These machines can help with prescription reminders, mobility aids, and companionship (Dilip et al., 2022).
- Robots that can support and treat a patient’s mental health are being developed. These robots can converse with patients, assist them in learning relaxation techniques, and remind them of their appointments and medication.

Technology helped in controlling COVID-19

The healthcare sector in India faced significant challenges due to the COVID-19 pandemic, with hospitals struggling to cope with the high demand for treatment. However, technology offers a potential solution to combat this issue. By utilizing tools such as artificial intelligence, machine learning, blockchain, robotics, and nanotechnology, hospitals can better track and diagnose COVID-19 patients, reduce physical contact between doctors and patients, monitor the supply and demand of medical resources, and accelerate the development and delivery of vaccines.

Artificial intelligence and machine learning can help doctors track and diagnose COVID-19 patients and predict future health issues, providing accurate predictions based on patient data. These tools can combat rumors and misinformation, helping to improve public awareness of the pandemic. Robotics also offers solutions to the issue of doctors becoming infected with COVID-19. Doctors can minimize direct physical contact by using robots to deliver patient treatments, reducing the risk of infection.

Similarly, blockchain technology can track the distribution of medical resources, ensuring they are allocated where they are most needed. Open-source analytical tools can provide doctors with collective decision-making support, providing information on vital topics such as protein dynamics and ventilators. This software can improve decision-making, especially in countries facing a shortage of medical equipment. Finally, surveillance of containment zones poses a significant challenge to the Indian government, with many police officers becoming infected with COVID-19. However, drone cameras can provide a potential solution, helping to monitor these areas effectively while reducing human contact. The technology could also be a game-changer in accelerating the development and delivery of COVID-19 vaccines. Nanotechnology has formerly played a vital part in the medication of COVID-19 vaccines, and scientists are developing nanotechnology-grounded patches to produce further vaccines (Javaid et al., 2020). Containment zones are primarily affected by COVID-19 in India, and their surveillance challenges the government.

Factors Enhancing Attractiveness Among Users

The advancement and interactivity of robots are on the rise, with the potential to bring about revolutionary change in various industries, notably in healthcare. Despite this, whether robots are accepted by the public and implemented in society depends on how people perceive them. This study explored the question, “How have people's attitudes towards service robots, which could potentially be utilized in healthcare or hospital settings, been gauged and assessed?" While there is limited literature specifically focused on the attractiveness factors that attract users to MRs, some general factors can influence user acceptance and adoption of robotic technology in healthcare. These factors are based on studies examining technology acceptance and human-robot interaction in various contexts (Esterwood & Robert, 2020). Factors such as usefulness, trust, familiarity, and efficiency can all affect the perception of services provided by MRs (Burton et al., 2020).

Patients find robots helpful if they can perform complex tasks, enhance accuracy, speed up procedures, or provide specialized care, making them attractive to users. Perceived usefulness is a well-established factor in technology acceptance models, such as the Technology Acceptance Model (TAM) developed by Davis (1989). Further, the desire to belong and feel connected to something can explain why people form relationships with robots. People are naturally inclined to build relationships with others; once created the desire to preserve things applies to humans and robots. Once individuals develop a connection with a robot, they frequently feel compelled to maintain it (Park & Del Pobil, 2013).

People view robots not only as machines but also as workers. Suppose nursing assistants can efficiently gather supplies in five minutes, and nurses are accustomed to seeing this. In contrast, suppose a robot clumsily collects the same collections, which takes 10 minutes. In this case, the nurses are unlikely to excuse the robot's subpar performance simply because it is a machine. Instead, it will be judged as an inadequate employee, thus leading workers to refrain from using it (Hancock et al., 2011). Evidence from existing human-robot interaction (HRI) research suggests that trust plays a significant role in people's perceptions of robots.

A robot's success largely depends on the trust humans are willing to place in it (Esterwood & Robert, 2020; Oksanen et al., 2020). People's attitude towards the robot was found to vary depending on the environment (accepted in calm settings, seen as a distraction in stressful ones) and their perception of their abilities when interacting with it, which impacted their trust. (Ljungblad et al., 2012). Due to safety reasons, service robots often move more slowly and consistently than humans, which some people may find irritating when they desire a quicker response. This observation reinforces the commonly held belief (Hancock et al., 2011). The patient has become attracted to using robots if they are easy to use and interact with. Intuitive user interfaces, clear instructions, and minimal training requirements contribute to the perceived ease of use. Also, delivering precise results with minimal errors and mitigating risk increases patients’ trust and confidence in its capabilities. This contributes to the attractiveness of MRs. The social acceptance of MRs among healthcare professionals and patients is essential to their adoption. Positive attitudes and perceptions of robotic technology within the healthcare community can influence users to consider and embrace MRs. The perception that healthcare professionals accept and endorse MRs can positively impact their attractiveness.

Further, MRs must consider the aging patient and workforce populations. This means that special considerations must be made to ensure that service robots benefit aging groups (Goher et al., 2017). Some older adults, such as healthcare workers and patients, may be apprehensive about having robots provide care, preferring to have a human touch instead (Hebesberger et al., 2017). If older adults encounter difficulty using robots, they may hold a negative attitude toward them. However, with effective communication and user-friendly performance boundaries, they develop a positive attitude and express interest in incorporating them into their daily tasks (Stuck and Rogers, 2018). Notably, the acceptance of robots has increased over time (Hebesberger et al., 2017; Ljungblad et al., 2012; Ozturkcan & Merdin-Uygr, 2022). The evidence suggests that the acceptance of robots can be transferred between different social connections.

The following select list of studies (Table 1) reflects the various studies conducted in the context of MRs.

Table 1: Selected List of Studies (2023-2000)

S. No.	**Authors (Year)**	**Purpose of the Study**	**Limitations/Future Scope of the Study**
1.	Dwivedi (2023)	Using diagnostics, medication discovery, patient monitoring, predictive analytics, and customized medicine, AI can improve patient outcomes, lower costs, and enhance healthcare quality. However, patient privacy, accuracy, and ethical considerations must be resolved. The objective is to maximize AI's advantages while addressing its problems.	AI can benefit healthcare through computer-assisted surgeries to calculate risk and fatality. Disease spread simulations using media data and administrative tasks like patient record updates and payment information management for healthcare workers.
2.	Dilip et al., (2022)	The objective is to deploy an uncomplicated robotic companion equipped with a headband that can monitor the health status of elderly individuals. These comrade robots can carry out tasks such as home automation for senior citizens, managing household equipment, sensing safety and well-being, and performing essential functions like outdoor navigation during emergencies.	Future research may increasingly use big data analysis, image processing, and statistical analysis to compare and evaluate machine learning approaches.
3.	Singla and Nguan (2022)	This book chapter examines several applications of healthcare-oriented robots in acute, ambulatory, and at-home settings.	-
4.	Sony et al., (2022)	The purpose of this study is to critically examine the impact of MCPS (Medical Cyber-physical system) on the quality of healthcare service delivery.	Future studies should explore stakeholders' perceptions through a qualitative study regarding the lived-in experience of the usage of MCPS. The prominent stakeholders who should be considered in this study are patients, doctors, paramedics, nurses, and other stakeholders directly or indirectly connected with the patient or service provider.”

5.	Ozturkcan and Merdin-Uygr (2022)	The study provides an overview of robots' inclusion in healthcare in the pre- and intra-pandemic context and how humanoid service robots, with their shape, size, and mobility, are advantageous in using the physical spaces designed for humans.	Global healthcare faces challenges, such as demographic change, demands for increased quality, limited resources, and cost requirements. Robots, especially humanoid SR, offer opportunities to tackle some challenges. The next generation of humanoid SR could benefit from proactive policy-making and informed ethical human–humanoid interaction.
6.	Kumar et al., (2021)	The paper depicts the importance and growth of advanced technology in the medical care system and its rise with the administration and control of the spread of coronavirus.	Humanoid robots have many arrangements that can ease and minimize tremendous pressure and concern for workers and provide more ways for everyone to be cautious in vulnerable situations, with arrangements such as cover testing, watching, and telepresence.
7.	Sarker et al., (2021)	This paper investigates the use of robotics and artificial intelligence-based technologies and their applications in healthcare to combat the COVID-19 pandemic.	The AI and robotics technologies discussed in this paper are expected to significantly assist humankind in combating the COVID-19 pandemic and future disasters that may arise.
8.	Wisetsri and Vijai (2021)	The paper highlights the emergence and potential of artificial intelligence (AI) in the healthcare industry. It explains how AI predicts and diagnoses diseases, assists with medical procedures, and improves patient outcomes.	The information presented a potential research gap that could require a more in-depth analysis of AI's specific applications and limitations in healthcare.
9.	Burton et al. (2020)	The main objective of this concise literature review was to gain insight into how the public perceives service robots, especially in healthcare environments. A secondary aim was also to comprehend the typical approaches for collecting perception-related information.	As a "short review, " it should not be viewed as a systemic or completely inclusive examination of the topic. Additional work remains to develop valid survey measures of perceptions of service robots.

10.	Esterwoodand Robert (2020)	Robots in healthcare delivery have become essential, and their personalities are crucial in determining their effectiveness as healthcare providers. However, a comprehensive and systematic understanding of personality's impact on human-robot interaction in healthcare is currently needed.	Further investigation is required to advance our comprehension of personality in H-HRI. A subsequent review is necessary to explore whether the impact of personality differs when interacting with EPA robots compared to virtual agents/telepresence robots in the healthcare field.
11.	Khan et al., (2020)	The paper emphasizes the relevance of medical robotics in managing the spread of COVID-19 by minimizing person-to-person contact and ensuring sterilization. Korean and Chinese healthcare's success in controlling the pandemic was partly due to advanced medical technology, including robots.	Requirements of Robots in Healthcare, Classification of Robot Utilization in Healthcare.
12.	Sparrow (2016)	The authors proposed a dystopian future in which older people are exclusively cared for by robots, which we would be well advised to avoid if we can.	Interpersonal "relations of recognition and respect - which robots cannot provide - are essential to human welfare. The economics of aged care may lead to robots replacing human workers and reducing opportunities for these goods. Utopian future visions should consider the realities of aged care today."
13.	Roy et al. (2000)	This paper aims to provide an overview of a significant endeavor to create personal service robots for older people on a large scale, including developing a prototype robot. Moreover, it delineates the research plan for constructing these service robots for elderly individuals.	Currently, society faces a significant challenge in caring for the elderly and chronically ill individuals, who require varying levels of assistance ranging from support with basic tasks to helping those with dementia and cognitive impairment.

METHODOLOGY

The research methodology employed in this study involved several steps. Firstly, an in-depth literature review was conducted, identifying 24 items that contributed to the attractiveness of MRs from the patients' point of view. This is further reduced to 16 items based on applicability in the Indian context. This was followed by a questionnaire development comprising the following sections:

Section-1: Demographic profile of the respondents

Section 2: Three questions were designed, including one open-ended to understand the patient's point of view on the present status of the medical services available in India.

Section 3: Questions were designed on the 16 items identified using a 5-point Likert-type scale to understand the variables contributing to patients' attractiveness of MRs.

Data was collected from Indian patients using online and offline survey methods. A total of 198 responses were collected. Then, the exploratory factor analysis (EFA) was conducted to propose a set of factors contributing to the attractiveness of MRs among Indian patients.

ANALYSIS

The questionnaire respondents were required to choose an option based on the 5-point Likert- type scale ranging from strongly disagree to strongly agree, which best describes their opinions, experiences, or perceptions. Most of the respondents belonged to the northern part of the country. No significant difference was identified in the online and offline responses. The collected data of EFA was conducted starting with reliability and sampling adequacy analysis. IBM SPSS-29 software was used to conduct the research mentioned above. The demographic profile of the respondents is given in the table-2 below:

Table 2: Demographic Profile of the Respondents

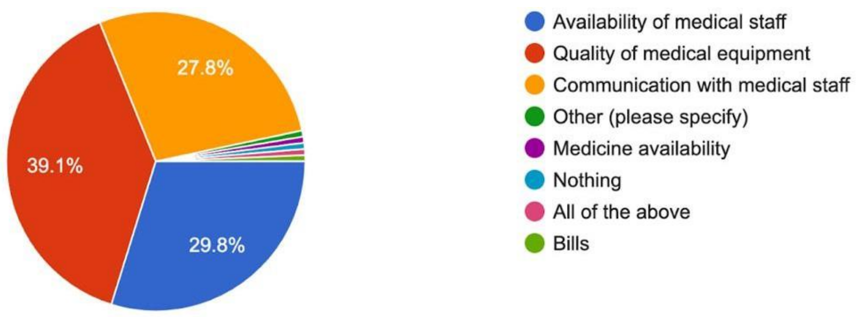
Gender		Age				Educational Level		
Male	Female	Between 16-25 years	Between 26-35 years	Between 36-45 years	Above 46 Years	Under Graduate	Graduate	Post Graduate and above
45.7%	53%	8.2%	61.9%	28.4%	1.5%	9.9%	25.9%	64.3%

In section 2, respondents were asked about the most significant challenge they might have experienced until now while taking medical services in India on the five options they were required to choose. The biggest challenge identified is the long waiting line, followed by a lack of necessary equipment availability and difficulty communicating with medical staff. The following figure-1 depicts the same:

Figure 1: Biggest Challenge experienced by the patients

Another question was about improving medical services in India. Most respondents focused on improving the quality of medical equipment, followed by the availability of medical staff and improved communication with medical staff. The following figure-2 reflects the same:

Figure 2: Ways to improve medical services in India



The last question in section-2 asked about the additional comments or suggestions on medical services and robots in India. Some suggested that MRs can be used to introduce a comprehensive program that combines awareness and primary nutrition education to enhance and maintain proper health for all stages of life. While some believe that robots have potential in the healthcare industry, it is essential to consider the sensitivity and empathy required in medical care, which should not be compromised. Therefore, any implementation of robots in the healthcare sector should be carefully evaluated to ensure they are beneficial and do not compromise the human touch necessary to provide quality healthcare services.

Data collected through section-2 of the questionnaire was analyzed by conducting EFA. Therefore, first, the reliability of the data was analyzed by calculating the value of Cronbach Alpha, which came out as 0.801, as shown in Table 3 below. The acceptable range of the Cronbach Alpha value is (>0.7) (Nunnally, 1978). This reflects that the calculated value lies in the range, and the data is reliable for further analysis.

Reliability Statistics

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.810	.801	16

Table-3: Reliability Statistics

To check the sampling adequacy of the data, Kaiser-Mayer-Oklin (KMO) statistics were calculated, where the value came out as 0.856, as shown in Table 4 below. Moreover, the acceptable range is (>0.5). Therefore, the data collected was found to be suitable for conducting EFA.

KMO Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	.856

Table-4: KMO Test

Based on the rotated component matrix below (Table-5), three factors were extracted, along with 12 indicators contributing 71.16% of the variance. IBM SPSS Version-26 was used to conduct exploratory factor analysis. Based on the analysis, a conceptual framework has been proposed reflecting on the attractiveness of MRs for patients.

Rotated Component Matrix[a]			
	Component		
	SA	AS	PE
AS1: Reduced medical expenses		0.642	
AS2: Real-time availability of medical resources		0.772	
AS3: Trustworthiness		0.638	
SA1: Policy support	0.863		
SA2: Transparency of services	0.876		
SA3: Effective resources	0.871		
PE1: Willingness to use			0.938
PE2: Participation			0.774
PE3: Familiarity			0.557
AS4: Automated Services		0.788	
SA4: Efficient Services	0.754		
PE4: Potential Benefits			0.643
Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. A			
a. Rotation converged in 7 iterations. SA: Service Alignment, AS: Automation Support, PE: Patient Engagement			

Table 5: Rotated Component Matrix

STRATEGIC IMPLICATIONS

Based on the data analysis, three factors (Figure 3), namely, service alignment, automation support, and patient engagement have emerged, contributing to the attractiveness of MRs among patients.

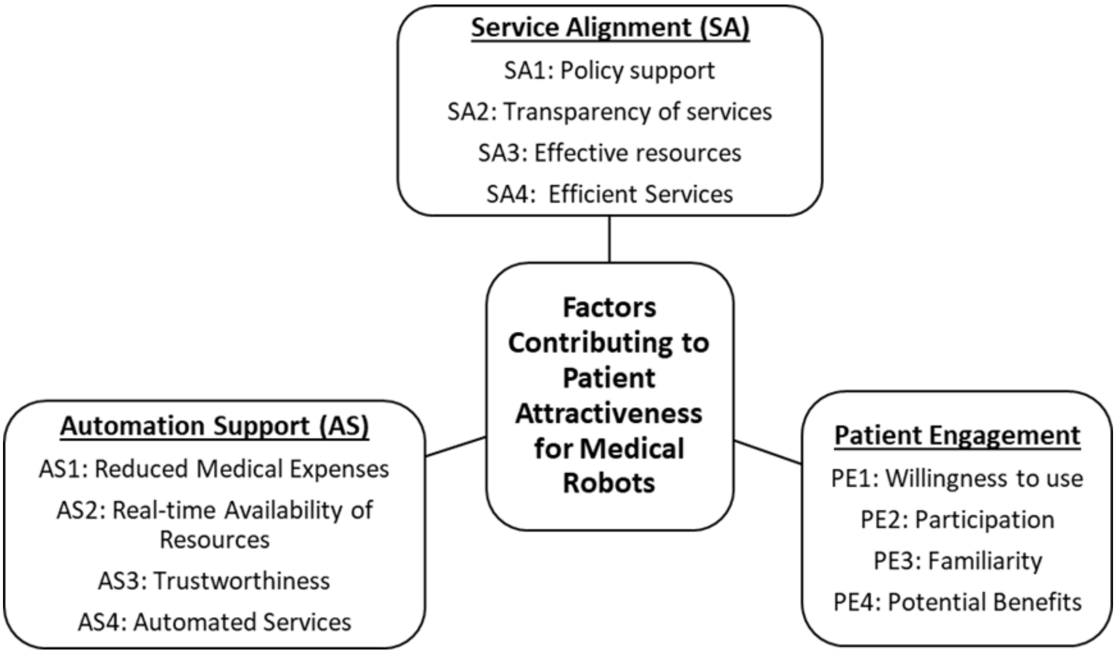


Figure 3: Factors contributing to the attractiveness of MRs among patients

For patients who prefer taking medical services from robots, it is evident that the service is aligned well with policy support, transparency of services, adequate resources, and efficiency. Policy support from healthcare service providers gives patients confidence that robots can assist them.

Transparency of services reflects a clear understanding of procedures used to deliver services by MRs. Adequate resources like drugs, biological products, medical devices, facilities, equipment, etc., make the patient more secure while receiving medical services. Efficient service delivery reflects the correct and accurate diagnosis and treatment of the medical problem.

Automation plays an important role, requiring more time in each sphere. Similarly, a patient may get attracted to medical services from robots to save time. Automation support has emerged as one factor that may attract users to take assistance from MRs. It comprises reduced medical expenses, real-time availability of resources, trustworthiness, and automated services. Using automated systems instead of manual human effort can save time and financial resources in the long run. Automation can facilitate the process and eliminate any delay in the real-time availability of resources. Human error is still possible compared to an automatic system that provides more accurate and efficient services and builds trustworthiness among medical users.

A medical user must be engaged with MRs to be attracted to them regularly. Patient engagement has emerged as a factor comprising willingness to use, participation, familiarity, and potential benefits. To build regular engagement between MRs and users, it is essential to build willingness among the users to take services from MRs while enforcing participation, making them more familiar, and conveying the potential benefits.

CONCLUSION

Globally, MRs are increasingly used in healthcare to improve patient experience and overall satisfaction. They are considered reliable as they improve the accuracy and efficiency of medical procedures, reduce the risk of human errors, enhance patient outcomes, and even provide more comfort and convenience during medical procedures, especially rehabilitation, physical therapy, eldercare, etc. Better time management is one significant benefit that can improve patient care, reduce costs, and enhance operational efficiency. However, perceived risks are associated with their use, and proper monitoring is critical for maintaining patient safety. Therefore, it is essential to establish appropriate regulations, standards, and guidelines for their service and ensure adequate training and supervision of healthcare professionals who work with such robots.

In India's healthcare system, MRs have the potential to revolutionize how healthcare is delivered in the country. The studies have shown a growing interest in using MRs in India, and various stakeholders, including healthcare providers, policymakers, and patients, have a positive attitude toward their adoption as these can bring substantial benefits, including reduced costs and increased leverage while maintaining or improving access, equity, and healthcare quality. However, several challenges still need to be addressed, including the high price of MRs, regulatory frameworks, and proper training of healthcare professionals. Therefore, there is a need for continued research and investment in medical robotics to realize its potential fully in the Indian healthcare system.

REFERENCES

1. Burton, A., Chiou, E. and Gutzwiller, R. (2020). A Brief Literature Review on Human Perceptions of Service Robots with a Focus on Healthcare. Proceedings of the Human Factors and Ergonomics Society Annual Meeting. 64, 117-121. DOI:10.1177/1071181320641030.
2. Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology. MIS Quarterly, 13(3), 319–340.
3. Dilip, G., Guttula, R., Rajeyyagari, S., S. Hemalatha, Pandey, R.R., Bora, A., Kshirsagar, P.R.,
4. M.M. Khanapurkar & Sundramurthy, V. P. (2022). Artificial Intelligence-Based Smart Comrade Robot for Elders Healthcare with Strait Rescue System. Journal of Healthcare Engineering, 2022, 1–12. https://doi.org/10.1155/2022/9904870

5. Dwivedi, Y. K., Sharma, A., Rana, N.P., Giannakis, M., Goel, P. & Dutot, V. (2023). Evolution of artificial intelligence research in Technological Forecasting and Social Change: Research topics, trends, and future directions. Technological Forecasting and Social Change, 192, 1–17, DOI: https://doi.org/10.1016/j.techfore.2023.122579.
6. Esterwood, C., & Roberts, D. L. (2020). The personality of robots: A systematic review. International Journal of Social Robotics, 12(2), 441–454.
7. Ginoya, T., Maddahi, Y. and Zareinia, K. (2021). A historical review of medical robotic platforms. Journal of Robotics. 2021, 1-13, DOI: 10.1155/2021/6640031
8. Goher, K.M., Mansouri, N. & Fadlallah, S.O. (2017). Assessment of personal care and medical robots from older adults' perspective. Robotics and Biomimetics, 4(5), 1–7. DOI:https://doi.org/10.1186/s40638-017-0061-7
9. Hancock, P. A., Billings, D. R., Schaefer, K. E., Chen, J. Y. C., De Visser, E. J., & Parasuraman, R. (2011). A meta-analysis of factors affecting trust in human-robot interaction. Human Factors, 53(5), 517–527.
10. Hebesberger, D., Koertner, T., Gisinger, C. and Pripfl J. (2017). A Long-Term Autonomous
11. Robot at a Care Hospital: A Mixed Methods Study on Social Acceptance and Experiences of StaffandOlderAdults. International Journal of Social Robotics, 9, 417–429. DOI:https://doi.org/10.1007/s12369-016-0391-6
12. Indian Council of Medical Research. (2013) 'Twelfth Five Year Plan 2012-2017'. Retrieved from https://www.education.gov.in/sites/upload_files/mhrd/files/document-reports/XIIFYP_SocialSector.pdf (on 20th January 2023)
13. Javaid M., Haleem A., Vaishya R, Bahl S., Suman R., & Vaish A. (2020). 'Industry 4.0 technologies and their applications in fighting COVID-19 pandemic', Diabetes and Metabolic Syndrome: Clinical Research and Reviews, 14(4), 419–422. DOI:https://doi.org/10.1016/j.dsx.2020.04.032
14. Khan ZH, Siddique A, Lee CW (2020). 'Robotics Utilization for Healthcare Digitization in Global COVID-19 Management', International Journal of Environmental Research and Public Health. 17(11), 3819. https://doi.org/10.3390/ijerph17113819
15. Kumar, A.S., Nirmala, R.G., Christy, A.A. & Bharathi, SV.S. (2021). Evolution of Robotic Technology in the Medical Care System and CoronaVirus Risk Administration. Annals of the Romanian Society for Cell Biology, 25(1), 6582–6589.
16. Ljungblad, S., Kotrbova, J., Jacobsson, M., Cramer, H. and Niechwiadowicz, K. (2012). Hospital robot at work: something alien or an intelligent colleague?. In Proceedings of the 2012 ACM Conference on Computer Supported Cooperative Work, Feb, 177-186, DOI:https://doi.org/10.1145/2145204.2145233.
17. Nunnally, J. C. and Bernstein, I.H. (1978). Psychometric theory (3rd ed.). New York: McGraw- Hill.
18. Oksanen, A., Savela, N., Latikka, R. and Koivula, A. (2020). Trust Toward Robots and Artificial Intelligence: An Experimental Approach to Human–Technology Interactions Online. Frontiers in Psychology, 11, 1–13. DOI=10.3389/fpsyg.2020.568256
19. Ozturkcan, S. and Uygur, E. M. (2022). Humanoid Service Robots: The Future of Healthcare?. Journal of Information Technology Teaching Cases, 12(2), 163–170. https://doi.org/10.1177/20438869211003905
20. Park, N., and Del Pobil, A. P. (2013). Users' attitudes toward service robots in South Korea. Industrial Robot: An International Journal, 40(1), 77–87. DOI: http://dx.doi.org/10.1108/01439911311294273
21. Roy, N., Baltus, G., Fox, D., Gemperle, F., Goetz, J., Hirsch, T., Margaritis, D., Montemerlo, M., Pineau, J., Schulte, J. and Thrun, S. (2000). Towards personal service robots for the elderly. In *Workshop on Interactive Robots and Entertainment (WIRE 2000),* 25, 184.
22. Sarker, S., Jamal, L., Ahmed, S. F. and Irtisam, N. (2021). Robotics and artificial intelligence in healthcare during COVID-19 pandemic: A systematic review. Robotics and Autonomous Systems, 146, 1-18. DOI: https://doi.org/10.1016/j.robot.2021.103902.
23. Singla, R. and Nguan, C. (2022). Service Robots in Healthcare Settings. Biomedical Engineering. IntechOpen. DOI: 10.5772/intechopen.104640.
24. Sony, M., Antony, J. and McDermott, O. (2022). The impact of medical cyber–physical systems on healthcare service delivery. The TQM Journal, 34(7), 73-93. https://doi.org/10.1108/TQM-01-2022-0005

25. Sparrow, R. (2016). Robots and Respect: Assessing the Case Against Autonomous Weapon Systems. Ethics & International Affairs. Cambridge University Press, 30(1), 93–116. doi: 10.1017/S0892679415000647.
26. Stuck, R. E., & Rogers, W. A. (2018). Older Adults' Perceptions of Supporting Factors of Trust in a Robot Care Provider. Journal of Robotics, 2018, 1–12. DOI: https://doi.org/10.1155/2018/6519713
27. Tang, L. L., Chan, Y. W., & Shen, S. L. (2019). Investigating radio-frequency identification usage behaviors and organisational performance according to factors of user perception. International Journal of Services Technology and Management, *25(*3/4), 199-214.
28. Wisetsri, W. and Vijai, C. (2021). Rise of Artificial Intelligence in Healthcare Startups in India. Advances in Management, 14(1), 48–52.