Role of AI (Artificial Intelligence) and Machine Learning in Transforming Operations in Healthcare Industry: An Empirical Study

Dr. A.M. Arun Mohan[1], Dr. S. Senthil Kumar[2], Dr. Vamseedhar Annam[3], Mohit Yadav[4], Dr. P Vishnu Prasanth[5]

[1] *Associate Professor, Civil Department, Sethu Institute of Technology, Kariapatti*

[2] *Associate Professor, School of Computing and Artificial Intelligence, NIMS Institute of Engineering and Technology, NIMS University, Rajasthan, Jaipur, India.*
senthil.kumar@nimsuniversity.org

[3] *Professor and HOD, Sri Chamundeshwari Medical College, Hospital and Research Institute, Channapatna, Ramnagar*

[4] *Jindal Global University, Haryana, India. mohitaug@gmail.com*

[5] *Professor, Department of Physics, Mohan Babu University, Sree sainath Nagar, Tirupati, India.*
vishnuprasanthp@gmail.com

Abstract: Artificial intelligence (AI) represents a dynamic and disruptive field within computer science, composed to revolutionize the healthcare sector by primarily restructuring medical practices and healthcare delivery. With the production of complex healthcare data, AI is set to play an increasingly prominent role in this industry. Healthcare payers, providers, and institutions in the health sciences have already accepted various forms of AI. It is imperious for healthcare experts to grip the current landscape of Artificial intelligence and Machine Learning technologies and their potential to enhance the effectiveness, safety, and accessibility of healthcare services, ultimately achieving value-based care. The incorporation of artificial intelligence into healthcare offers many advantages, including enhanced patient care, more accurate diagnostics, improved operational efficiency, and cost reductions. A sample of 301 respondents was collected from healthcare industry. The factors that determine the Role of AI (Artificial Intelligence) and Machine Learning in Transforming Operations in Healthcare Industry are Early detection and prediction of disease, Drug development and discovery, Personalized treatment, and Remote monitoring and telemedicine.

Keywords: AI, Machine learning, big data analytics, Healthcare, Healthcare Robotics.

1. INTRODUCTION

Advancements of Artificial Intelligence and Machine Learning have the capability of revolutionizing several features of health care system, ushering in a future marked by greater personalization, precision, predictiveness, and portability. The extent to which these technological innovations will be adopted remains uncertain, whether through gradual integration or more radical transformations. Nonetheless, the profound impact of these technologies, along with the digital revitalization they bring, necessitates that health systems carefully consider how to adapt to this evolving landscape **(Bajwa, Munir, Nori, & Williams, 2021).** AI has already proved its utility in the pharmaceutical industry, offering the potential to revolutionize drug development and production. Additionally, AI can be harnessed in combination with physical robots to restructure the functioning of assisted living facilities, promoting the well-being of residents and reducing hospitalization rates. By facilitating conversations and social engagement with the elderly, AI-driven robots can assist in maintaining cognitive function. In the pharmaceutical sector, AI holds promise for enhancing product purity, increasing production efficiency, and reducing costs. Although AI has made significant steps in this field, it has not yet fully realized its potential. Despite being provided with vast amounts of data, accuracy of AI

remains limited. To unlock its full potential, artificial intelligence may benefit from further data acquisition and refinement of algorithms to achieve more accurate results **(Samineni et al., 2023).** The integration of AI into healthcare is a complicated and costly endeavour, demanding careful planning and strategic decision-making from healthcare organizations to ensure they produce tangible benefits. Evaluating AI approaches is a time-consuming yet crucial step, allowing organizations to identify and rectify issues before they become impossible. It's imperative, before implementation, to establish clear performance metrics and continuously assess AI's success throughout various stages of development and implementation **(Chen and Decary, 2020).** The healthcare sector consistently generates an immense volume of intricate data at a rapid pace. This data originates from various segments of the industry, including hospitals, healthcare providers, medical insurance, medical equipment, life sciences, and medical research. Advancement of technology have brought numerous possibilities to harness data in transforming healthcare system. Leveraging analytics, machine learning, and artificial intelligence on this extensive dataset enables the discovery of patterns and correlations, offering actionable insights to enhance healthcare delivery **(Mehta, Pandit, and Shukla, 2019).** AI plays a pivotal role in enhancing both the health and well-being of patients, offering valuable insights to healthcare professionals, and adapting to evolving societal healthcare patterns for improved care. Furthermore, it facilitates the collection of customer feedback to refine healthcare services. Across various industries, AI has become indispensable, driving automation that supports human roles and contributes to overall growth and productivity. The report underscores the utilization of AI tools to elevate existing healthcare practices while highlighting the challenges faced by clinical professionals in implementing machine learning technology **(Kiradoo, 2018).** AI has encouraged significant innovation in the field of medical science, leading to the cure of life-threatening diseases and a reduction in mortality rates. Leveraging sensors and the Internet of Things (IoT), emergency modules have been developed for patients, enabling caretakers and family members to monitor vital signs during critical situations. The integration of AI has ushered in advancements in medical fields such as patient check-ins, record-keeping, remote monitoring of diseases, surgical assistance, mental health therapy, staffing optimization, image analysis, and billing **(Singh, Soni, & Singh, 2022).** AI technologies are playing a pivotal role across various healthcare domains. These innovations have been created to strengthen medical imaging and diagnostics, combat pandemics, deliver virtual patient care, enhance patient involvement and adherence to treatment regimens, alleviate the administrative workload of healthcare practitioners, stimulate advancements in drug and vaccine development, oversee patient exercise compliance, and conduct gait analyses for technology-driven rehabilitation **(Al Kuwaiti et al., 2023).**

2. LITERATURE REVIEW

AI and ML is dignified to transform healthcare by expanding capabilities of healthcare experts, empowering them in allocation of more time for patient care and its management. Recent advancements in AI have positioned it as a essential technology in the healthcare sector. The tasks associated with diagnosis and healthcare management are often labour-intensive and demanding, but AI is introducing innovative technologies and approaches to address these challenges. Major challenges can be effectively addressed in future with the assistance of AI in healthcare management, enhancing medical capabilities and ensure best results for patients **(Efthymiou et al., 2020).** AI techniques offer significant support for comprehensive healthcare management, benefiting doctors, nurses, and administrators alike. Through AI applications, a predictive approach can be employed to enhance patient monitoring and provide doctors and medical researchers with a better understanding of risk perception **(Secinaro et al., 2021).** Machine Learning is a subcategory of artificial intelligence, is particularly impactful in healthcare. The purpose of machine learning is to improve the work of doctors and physician, which is crucial in healthcare systems facing a shortage of skilled professionals and an overload of cases. AI holds promise in optimizing clinical trial sample selection, gathering more data points, analyzing ongoing trial data, and minimizing data-related errors. ML-based techniques also aid in early detection of epidemic or pandemic indicators **(Javaid et al., 2022).** Information technology plays a crucial role in reducing healthcare diagnosis costs, with a significant focus on leveraging big data and its various applications. Over the past eight years, extensive research has been conducted in diverse sectors, including public, healthcare, transportation, banking, insurance, fraud detection, entertainment, and education, showcasing the widespread adoption of big data analytics. Particularly noteworthy is the extensive research and application of big data in the healthcare and education sectors. In the healthcare sector, four major components have garnered significant attention: patient care, real-time patient monitoring, disease prediction, and treatment enhancement. Researchers have made significant strides in using big data to optimize these aspects of healthcare **(Kaur, Sharma, & Mittal, 2018).** A remarkable advancement across various industries with the application of artificial intelligence and

machine learning, with medicine being a prime beneficiary. AI includes computational programs that match human intelligence, replicating problem-solving abilities and learning capabilities. ML, a subdivision of AI, excels at automatically identifying patterns in raw data, making it a valuable tool in healthcare. Machine learning restructures complex and time-consuming tasks in healthcare, leveraging the rapid development of ML algorithms, faster processors, and the availability of digital health data. It enhances the correctness of traditional techniques of image processing and analyze radiological images to predict the presence of specific diseases. Additionally, ML is employed in evaluating retinal images to assess potential visual threats in patients **(Rahmani et al., 2021).** These advancements in AI and ML are revolutionizing the healthcare industry, ultimately leading to more cost-effective and efficient diagnosis and treatment processes. AI algorithms, combined with machine learning and deep learning technologies, along with high-speed processors, have made AI a powerful tool in healthcare. The application of AI in healthcare is expected to undergo significant improvements in future. Artificial Intelligence is crucial initial diagnosis, both in developed and developing countries, reducing the reliance on human professionals. AI and machine learning have gained trust for their ability to streamline workflows, support decision-making, and ensure safety and accuracy. With the impending AI-driven future, it is imperative for medical professionals to have a fundamental understanding of AI technology and its basic solutions, as this knowledge will lead to better outcomes for patients **(Ragavi, Sheela, & Kannaiyan, 2020).** Digital healthcare system is an increasing consent that would probably bring significant transformation in the healthcare system in developing nations particularly. There are still many challenges faced by the system in full implementation of AI and machine learning. Just like any disruptive transformation, there is a fight from those who enjoy its benefits from present system of healthcare, regardless of the potentials for better quality and access of customer care. An increasing acceptance of AI and machine learning. The widespread adoption of digitalization all over the world has brought certain transformation and have shifted balance of power between providers of healthcare as well as patients and have necessitated transformation in the roles played by healthcare workers **(Mitchell & Kan, 2019).** The healthcare sector has actively incorporated digital technology, accompanying in a transformative shift from traditional mechanical. The widespread utilization of digital technology in healthcare encompasses various aspects such as accessing medical knowledge resources, enhancing the quality of patient care, and optimizing clinical support. This adoption of digital advancements within the healthcare industry is expected to yield substantial cost savings and improve overall efficiency, especially given the pressing need for timely healthcare services. In low-income countries, digital health systems hold the promise of enhancing healthcare performance and facilitating the achievement of strategic healthcare objectives **(Paul et al., 2023).** Digital technologies offer reliable, accessible, and convenient healthcare solutions, but their effective implementation necessitates a robust infrastructure for both patients and healthcare providers. Nonetheless, the integration of digital technologies into healthcare encounters several challenges, including the willingness of healthcare professionals and patients, insufficient infrastructure, financial constraints, and a lack of experience, among other hurdles. Hence, it becomes crucial for stakeholders to enhance individuals' digital health literacy to raise awareness about the numerous benefits that digital health solutions can offer. Digital health innovations are designed to reduce time, enhance accuracy and efficiency, and seamlessly integrate technologies to enhance the existing healthcare landscape. Furthermore, digital health has the potential to better prepare us for future infectious diseases and pandemics **(Sikandar et al., 2022).** The digitalization of healthcare is instrumental in delivering efficient services to both consumers and citizens, contributing significantly to the vision of a Digital Nation in India. Internet and communication technology (ICT) play a pivotal role in shaping how health-related data is collected, delivered, and utilized by individuals. The healthcare industry bears direct responsibility for human well-being and health, necessitating continuous upgrades and advancements. These upgrades not only enhance entire system of healthcare industry but also boost its efficiencies. Digital Health has made a profound impact globally, empowering us with knowledge and making healthcare more accessible to the public. This innovative platform has the potential to transcend barriers of time and distance, improving healthcare accessibility and bridging the gap in demand between patients and healthcare providers. The healthcare system faces a complex and global challenge of reimagining and modernizing its infrastructure to expand the delivery of treatment. In addition to meeting current technical requirements and objectives, healthcare services must also address the evolving expectations of patients and public policy criteria **(Kumar, Verma & Bharti, 2020).**

Objective

To identify the Role of AI (Artificial Intelligence) and Machine Learning in Transforming Operations in Healthcare Industry.

3. METHODOLOGY

This study considered a sample of 301 people was collected from people working in healthcare sector. Random sampling method was used for collection of data, and scrutinized by "Explanatory Factor Analysis" for outcome   .

Study's findings

Below table is about general details of respondents which shows that 62.46% are male while 37.54% are female. Among them, 32.22% are between 30 to 35 years, 34.89% are between 35-40 years, and 32.89% are above 40 years. Regarding hospital type, private hospitals are 39.53% and public hospitals are 60.47%.

Details of Participants

Variable	Participants	% age
Gender		
Male	188	62.46
Female	113	37.54
Total	**301**	**100**
Age in years		
30 to 35	97	32.22
35 to 40	105	34.89
Above 40	99	32.89
Total	**301**	**100**
Hospital type		
Private hospital	119	39.53
Public hospital	182	60.47
Total	**301**	**100**

"Factor Analysis"

"KMO and Bartlett's Test"

| "Kaiser-Meyer-Olkin Measure of Sampling Adequacy"		.855
"Bartlett's Test of Sphericity"	"Approx. Chi-Square"	6146.591
	df	153
	Significance	.000

In above table "KMO and Bartlett's Test" above, KMO value found is .855

"Total Variance Explained"

"Component"	"Initial Eigenvalues"			"Rotation Sums of Squared Loadings"		
	"Total"	"% Of Variance"	Cumulative %	"Total"	"% Of Variance"	Cumulative %
1	7.325	40.692	40.692	**4.085**	22.696	22.696
2	2.938	16.323	57.015	**3.762**	20.900	43.596
3	2.484	13.801	70.816	**3.585**	19.916	63.512

"Component"	"Initial Eigenvalues"			"Rotation Sums of Squared Loadings"		
	"Total"	"% Of Variance"	Cumulative %	"Total"	"% Of Variance"	Cumulative %
4	2.155	11.973	82.789	**3.470**	19.277	**82.789**
5	.604	3.356	86.145			
6	.534	2.964	89.109			
7	.369	2.049	91.157			
8	.290	1.612	92.770			
9	.260	1.446	94.216			
10	.224	1.244	95.460			
11	.196	1.087	96.547			
12	.163	.906	97.453			
13	.119	.662	98.115			
14	.097	.542	98.657			
15	.091	.503	99.160			
16	.076	.424	99.583			
17	.047	.259	99.842			
18	.028	.158	100.000			

All four factors making contribution in explaining total 82.789% of variance. The variance explained by Early detection and prediction of disease is 22.696%, Drug development and discovery is 20.900%, Personalized treatment is 19.916%, and Remote monitoring and telemedicine is 19.277%.
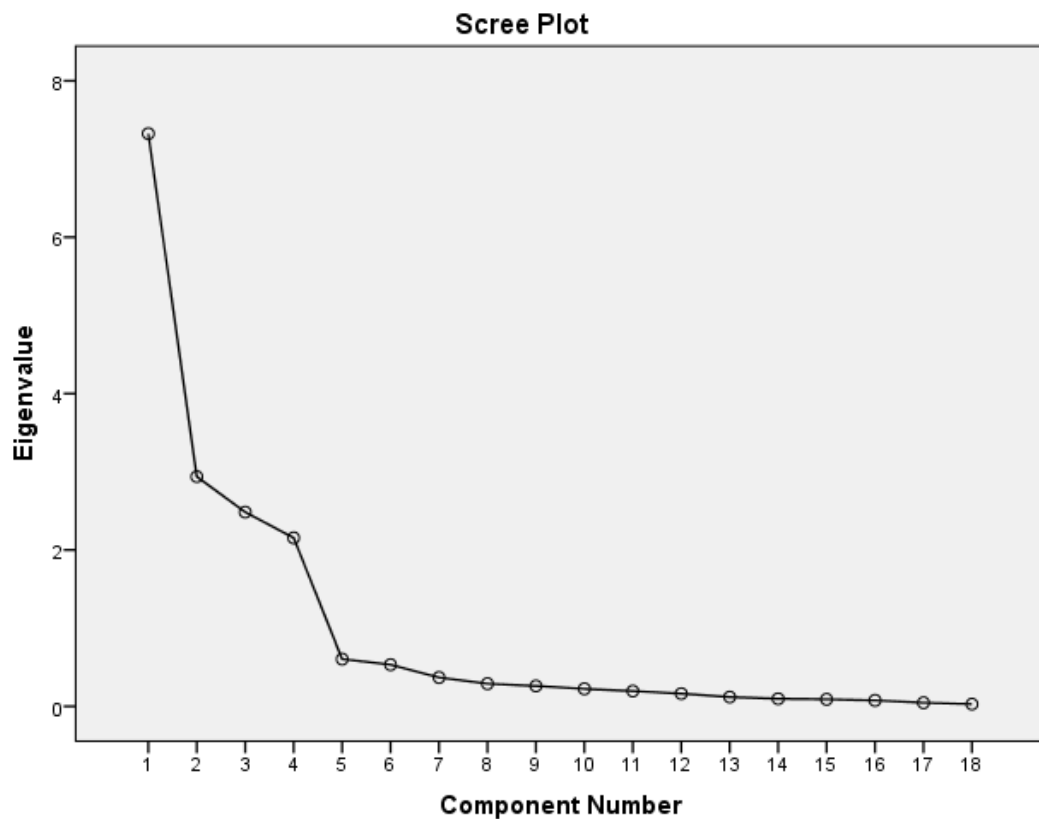
Scree Plot

Screeplot

"Rotated Component Matrix"

Serial No.	Survey Statement	"Factor Loading"	"Factor Reliability"
	Early detection and prediction of disease		**.946**
1.	AI makes analyses of patient data easier	.911	
2.	Easy to maintain electronic health records of patients	.890	
3.	Genetic information helps in early detection of disease	.853	
4.	Digital images and information help in predicting health status	.837	
5.	ML helps in making personalized treatment plans	.825	
	Drug development and discovery		**.975**
1.	AI has made drug development easier and faster	.944	
2.	ML analyses biological data for drug development	.939	
3.	Clinical trial designs are optimized through machine learning	.938	
4.	It helps in effective drug discoveries and its developments	.931	
	Personalized treatment		**.955**
1.	Allows tailored treatment according to medical history and characteristics	.964	
2.	Personalized treatments are more effective and efficient	.931	
3.	Tailored treatment according to patient reduces adverse effects	.901	
4.	AL provides tailored treatment after monitoring lifestyle and genetic makeup of patient	.847	
	Remote monitoring and telemedicine		**.881**
1.	ML and AI facilitated remote monitoring of patients	.848	
2.	Patients can now consult doctors through video-calls without visiting physically	.846	
3.	Remote monitoring through AI was highly useful during global crisis like COVID-19	.824	
4.	AI analyse patient generated data to provide timely health alerts	.782	
5.	Patient can consult best doctors anywhere in the world through AI enabled devices	.720	

Factors and associated variables

The first factor is Early detection and prediction of disease, the variables included under this factor are AI makes analyses of patient data easier, Easy to maintain electronic health records of patients, Genetic information helps in early detection of disease, Digital images and information help in predicting health status, and ML helps in making personalized treatment plans. Second factor is Drug development and discovery, it includes variable like AI has made drug development easier and faster, ML analyses biological data for drug development, Clinical trial designs are optimized through machine learning, and It helps in effective drug discoveries and its developments. Third factor is Personalized treatment, the variables included are Allows tailored treatment according to medical history and characteristics, Personalized treatments are more effective and efficient, Tailored treatment according to patient reduces adverse effects, and AL provides tailored treatment after monitoring lifestyle and genetic makeup of patient. The fourth and last factor is Remote monitoring and telemedicine, it includes variables like ML and AI facilitated

remote monitoring of patients, Patients can now consult doctors through video-calls without visiting physically, Remote monitoring through AI was highly useful during global crisis like COVID-19, AI analyse patient generated data to provide timely health alerts, and Patient can consult best doctors anywhere in the world through AI enabled devices.

"Reliability Statistics**"**

"Cronbach's Alpha"	"Number of Items"
.909	18

Total reliability of 18 items including variables in context of Role of AI (Artificial Intelligence) and Machine Learning in Transforming Operations in Healthcare Industry is 0.909

4. CONCLUSION

Artificial intelligence is a technology field primarily focused on automating tasks, enabling systems to act, react, and think in ways resembling human capabilities. This transformative technology is shifting us from manual work towards automation driven by computational intelligence, with the potential to significantly impact various aspects of our virtual future. This shift often requires fewer human operators and relies more on technology to accomplish tasks. AI's applicability spans across virtually every industry, with machine learning algorithms finding widespread use. One notable and increasingly prominent domain where machine learning is making a significant impact is healthcare. Machine learning applications in healthcare are diverse, ranging from managing chronic disease cases to harnessing patient health data. Robots equipped with AI can assist with surgery, medication dispensing, and patient care in hospitals. They can perform tasks with precision and reduce the risk of human error. Machine learning technology aids medical professionals in generating personalized treatment solutions tailored to individual patient's medical history and characteristics. These techniques also support decision-making processes, be it in financial aspects like insurance claims or disease diagnosis. Moreover, machine learning plays a crucial role in maintaining comprehensive patient medical records and identifying diseases at their early stages. This early detection allows for timely and appropriate medical interventions, ultimately improving patient outcomes.

5. REFERENCES

[1] Bajwa, J., Munir, U., Nori, A., & Williams, B. (2021). Artificial intelligence in healthcare: transforming the practice of medicine, *Future Healthcare Journal*, 8(2), 188-194.

[2] Samineni, R., Likhitha, M., Anjaneswari, Y.R., Padmavathi, S., Prasad, M.G., Giri, S. & Pattanaik, A. (2023). Artificial Intelligence Role in Health Care: Transforming Future Medicine, *Journal for Basic Sciences*, 23(1), 891-904.

[3] Chen, M., & Decary, M. (2020). Artificial intelligence in healthcare: An essential guide for health leaders, *Healthcare Management Forum,* 33(1), 10-18.

[4] Mehta, N., Pandit, A., & Shukla, S. (2019). Transforming healthcare with big data analytics and artificial intelligence: A systematic mapping study, *Journal of Biomedical Informatics*, 100, 1-14.

[5] Kiradoo, G. (2018). Role Of Application of Artificial Intelligence (AI) And Its Importance in The Healthcare Industry, *International Journal of Advanced Research in Engineering and Technology*, 9(2), 104-107.

[6] Singh, S., Soni, A., & Singh, V.P. (2022). The Role of Artificial Intelligence in Transforming the Healthcare Sector, *International Journal of Research Publication and Reviews*, 3(5), 248-251.

[7] Al Kuwaiti, A., Nazer, K., Al-Reedy, A., Al-Shehri, S., Al-Muhanna, A., Subbarayalu, A.V., Al Muhanna, D., & Al-Muhanna, F.A. (2023). A Review of the Role of Artificial Intelligence in Healthcare, *Journal of personalized Medicine*, 13(951), 1-22.

[8] Efthymiou, I.P., Sidiropoulos, S., Kritas, D., Rapti, P., Vozikis, A. & Souliotis, K. (2020). AI transforming Healthcare Management during Covid-19 pandemic, *HAPSc Policy Briefs Series*, 1(1), 130-138.

[9] Secinaro, S., Calandra, D., Secinaro, A., Muthurangu, V. & Biancone, P. (2021). The role of artificial intelligence in healthcare: a structured literature review, *BMC Medical informatics and decision making*, 21(125), 1-23.

[10] Javaid, M., Haleem, A., Singh, R.P., Suman, R. & Rab, S. (2022). Significance of machine learning in healthcare: Features, pillars and applications*, International Journal of Intelligent Networks*, 3, 58-73.

[11] Kaur, P., Sharma, M., & Mittal, M. (2018). Big Data and Machine Learning Based Secure Healthcare Framework, *Procedia Computer Science*, 132, 1049–1059.

[12] Rahmani, A.M., Yousefpoor, E., Yousefpoor, M.S., Mehmood, Z., Haider, A., Hosseinzadeh, M., & Naqvi, R.A. (2021). Machine Learning (ML) in Medicine: Review, Applications, and Challenges, *Mathematics*, 9, 1-52.

[13] Ragavi, V., Sheela, S., & Kannaiyan, G.N. (2020). Impact of Artificial Intelligence in the field of Health Care, *Journal of Physics: Conference Series*, 1831, 1-6.

[14] Mitchell, M., & Kan, L. (2019). Digital Technology and The Future of Health Systems, Health Systems & Reform, *DOI: 10.1080/23288604.2019.1583040*, 1-10.

[15] Paul, M., Maglaras, L., Ferrag, M.A. & Almomani, I. (2023). Digitization of healthcare sector: A study on privacy and security concerns, *ScienceDirect*, 9, 571-588.

[16] Sikandar, H., Abbas, A.F., Khan, N. & Qureshi, M.I. (2022). Digital Technologies in Healthcare: A Systematic Review and Bibliometric Analysis*, International Journal of Online and Biomedical Engineering*, 18(8), 35-48.

[17] Kumar, A., Verma, A.K., & Bharti, J. (2020). Aspects of Digitalization of Healthcare in India, *International Journal of Research and Analytical Reviews*, 7(1), 404-407.