Journal of Informatics Education and Research
ISSN: 1526-4726
Vol 4 Issue 2 (2024)

Transformation in Healthcare Industry to Boost Patient Engagement using AI

Dr. Priyanka Gandhi, Dr. Silky Madan, Dr. Geeta Sharma
Associate Professor, Jagan Institute of Management Studies, Sec-5, Rohini
Assistant Professor, Jagan Institute of Management Studies, Sec-5, Rohini
Associate Professor, Jagan Institute of Management Studies, Sec-5, Rohini

Abstract
Healthcare industry has been leading the way in the implementation of artificial intelligence (AI) technologies. The type of the services and susceptibility of a significant number of end-users have resulted in a substantial amount of research and discussion on the concept of artificial intelligence. We have conducted a mixed-method research to find the components of ethical AI in the field of healthcare and examine how it affects market performance and value creation. We have chosen Indian context as here AI technologies are not significantly developed yet. The findings from 11 in-depth interviews add to our knowledge of how different components of AI assisted healthcare organisations in providing better patient-centered care and evidence-based medicine. The theoretical framework is validated by PLS-SEM analysis of 150 survey responses. The findings from the study support the idea that patient's engagement with ethical AI solutions and perceived value, which results in improved market performance.
Keywords: engagement, artificial intelligence (AI), PLS-SEM, framework

Introduction

Artificial Intelligence has extended the wings in almost every domain in recent times, ranging from smart phones, watches, washing machines etc. to smart homes and even smart cities. Especially in the field of Healthcare, AI is significantly being used in past few years. It can be used in various diagnosis and treatments including patient monitoring, robot-assisted surgeries, patient data and risk analysis, drug discoveries and clinical trials, etc. AI technologies can be broadly classified as machine learning, computer vision, NLP, deep learning and context aware processing, which can be combined further to provide solutions for different sets of health care issues. The deep learning algorithms can diagnose diabetic retinopathy from eye scans with 90% accuracy (A.K. Triantafyllidis, A. Tsanas 2019). An AI-powered control centre at John Hopkins allowed staff to assign emergency department(ED) patients to inpatient beds 30% faster(Walls, A.E. 2018).A detailed study of AI applications in healthcare was presented in a review paper by Rosenberg et. al(2010).According to the study, the first progressive research by Gunn was proposed in 1976 in which he investigated the possibility of diagnosing intense stomach pain with PC analysis (Rosenberg et. al2010).The organizations like Google and IBM are working on incorporating AI in healthcare. Most of the AI enabled healthcare programmes are using Google's Deepmind Health or Watson's IBM for diagnosing specific diseases after collecting the data from mobile applications(Powles, J., Hodson, H. 2017).

The complexity of current medications, which need a vast amount of information to analyse, is directly tied to the rise of AI in the healthcare industry. Additionally, there aren't enough researchers to meet the demand for study.Thus, AI applications have been leveraging cutting-edge computation to help researchers in hospitals get around the constraints of human intelligence in the realm of medicine.It offers various advantages including ease of complex computations, increased accuracy, analysis of data collected from various means, solving complex problems in lesser time, and effective decision making.

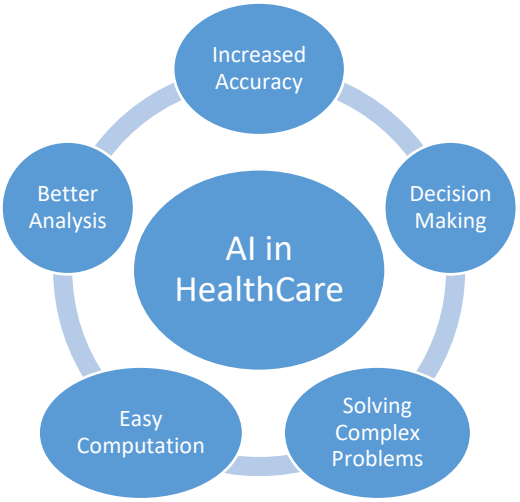


Figure 1: AI in Healthcare
Source: Author's Own Composition.

The growth of AI in healthcare relates to the complexities of modern medicines which requires a copious amount of information to analyse, and also there are limited numbers of clinicians to handle that need with human intelligence. Due to this, AI applications have been using advanced computing to overcome human intelligence limitations in the medical field using several techniques to assist clinicians in healthcare centres. One of the common technique is the use of expert systems that are based on rules which outlines the steps involved in transforming the inputs into actionable outputs The growth of AI in healthcare relates to the complexities of modern medicines which requires a copious amount of information to analyse, and also there are limited numbers of clinicians to handle that need with human intelligence. Due to this, AI applications have been using advanced computing to overcome human intelligence limitations in the medical field using several techniques to assist clinicians in healthcare centres. One of the common technique is the use of expert systems that are based on rules which outlines the steps involved in transforming the inputs into actionable outputs
Typically, a significant amount of data acquired from variety of health activities is used to train AI algorithms. The algorithm will be able to learn similar groupings of objects and associations between subject qualities and outcomes of interest by learning from a big dataset. A medical dataset will therefore include a variety of data types, including demographics, clinical laboratory data, pictures, and notes from physical examinations and medical devices.AI software can be deployed On-Premise or Cloud-Based to the end users. An end user can be an individuals, healthcare providers, pharma and biotech companies, healthcare insurance companies and others.

Literature Review

Artificial intelligence is the theory and creation of computer programmes that can perform activities and find solutions to issues that typically need human intelligence. There are two opposing viewpoints on use of AI in healthcare. Some perceive it as worthless or destructive, while others find it to be extremely beneficial. Furthermore, because people are wary of machines operating on their bodies, the use of AI in the healthcare sector has long been a contentious issue (Makda. A,2021). AI will enhance clinical decision-making, patient diagnosis, prevention, and therapy (A.K. Triantafyllidis, 2019). There is a lot of optimism that AI would eventually outperform humans in the healthcare industry. Better disease prevention, detection, diagnosis, and treatment might be made possible by AI. Cancer, neurology, cardiology, and diabetes are among the major diseases for which AI tools are used (Murali N.,2018). Additionally, AI can support rural health facilities and encourage rural area recruitment and retention. In the end, this may help create a global health care system that is more egalitarian (T.Q. Sun, 2019)
Practically speaking, in the medical setting, AI technologies may not be able to totally replace human doctors, but they might assist them achieve better results and more precision (Manne. R & Sneha, 2021). A study conducted by Makda and Saifi (2021) on the impact of AI on the healthcare industry in the UAE indicated that,

due to psychological and psychosocial factors involved in a doctor-patient relationship, AI is unlikely to be able to replace human doctors anytime soon. In addition, the survey results in this study report show that 78% of respondents are open to the idea of using AI-based solutions in the healthcare sector. Additionally, 86 percent of UAE physicians agree that AI will lighten their workload.

In a study by Lai et al. (2020) France, 40 persons were interviewed, including doctor, professionals, researchers and members of regulatory bodies. The majority of the physicians surveyed had favourable opinions about AI, its tools, and the advantages it may offer to patients in terms of time savings and timely alerts. AI may contribute to better medical delivery, cost-effectiveness, and patient safety. While some doctors claimed that AI may completely transform their specialties and patient care, others claimed that it would just accelerate current advancements in medical practice.

The use of AI technology in radiology and radiotherapy may be the most advanced of all medical specialities. In a research by Giansanti et al. (2020), 182 medical radiology technicians and healthcare professionals were interviewed about their interactions with radiology infrastructure. 87 percent of respondents said AI will complement human intelligence, 10 percent thought it would take the place of human judgement, and 3 percent thought it had no future.

Gillan et al (2018) interviewed 4 types of radiology experts and found comparable results. The survey examined AI in patient care. AI would improve treatment, said most. Efficiency, fresh and accessible data, clinical decision-making value, and increases in precision and complexity of care were emphasized.

Artificial intelligence (AI) aims to replicate human cognitive abilities. A radical change in healthcare is now being brought about by the increasing amounts of health records and the speedy advancement of analytics techniques. A variety of healthcare data types can be processed using AI (structured and unstructured). For unstructured data, natural language processing is a popular AI strategy. For structured data, machine learning techniques like the classic support vector machine and neural network as well as the more recent deep learning are used. The three main illness fields that make use of AI tools are cardiology, neurology, and cancer (Jiang F, 2017).

Artificial intelligence has the potential to substantially increase patient care and decreasing healthcare costs. As the population increases, it is expected that there will be a greater need for health services. Innovative approaches are required to improve the effectiveness and efficiency of the health service sector without incurring unnecessary costs (L.G Pee, 2019). Technology can provide the answers in this situation. In particular, Google's Deep Mind Health Technology creates an AI replica of the human brain that integrates machine learning and a neuroscientific system to empower healthcare professionals in their diagnostic and decision making activities. (M. Ardan, 2020).

Recently, IBM's Watson received favourable media coverage for its capacity to concentrate on precision medicine, particularly cancer diagnosis and treatment. Artificial neural networks (ANN) performed more accurately in classifying CVD and diabetes (Eren A, 2008)

Payers, care providers, and life sciences organizations currently use a variety of AI technologies. Providing suggestions for assessment and treatment of patients, keeping a track of patient involvement and compliance, and providing assistance in administrative chores are among the important application domains of AI (Davenport T, 2019). Healthcare greatly benefits from AI technologies such as machine learning, neural networks, deep learning, natural language processing, surgical robots, robotic process automation, etc.

A statistical technique called machine learning encompasses "teaching" machines with data and "learning" by fitting the model to that data. The most widespread use of traditional machine learning techniques in healthcare is precision medicine, which determines which therapeutic approaches are most likely to be successful for a patient based on a range of patient characteristics as well as the context of the therapy. (Lee SI, 2018).

An improved kind of machine learning is the neural network. This technology has been applied extensively in medical studies for a long time and has been in use since the 1960s. It is useful for classification tasks, such as determining if a patient would get a particular disease. (Sordo, 2002).

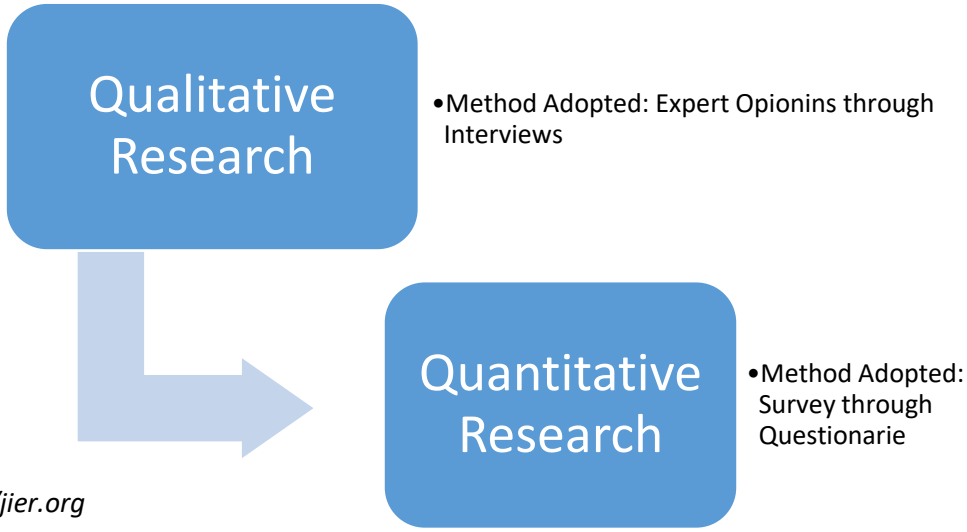
Among the most challenging forms of machine learning is deep learning, which involves neural network models that predict outcomes using several layers of input or variables. Deep learning is commonly employed by medical industry to identify potentially cancerous tumours in radiography images. (Fakoor. R, 2013)

Deep learning is increasingly being applied in radiomics, which involves the identification of clinically relevant patterns in mri scans that are not visible to the human eye. (Vial A, 2018). The most prevalent applications of

deep learning and radiomics in image analysis are in oncology. Their combination appears to promise enhanced diagnostic accuracy when contrasted with the earlier generation of automated image analysis methods referred as computer-aided detection or CAD. (Davenport T., 2019).
Speech recognition is done using natural language processing (NLP), which is also an element of deep learning. The main uses of NLP in the healthcare industry are the creation, understanding, and classification of published research and clinical data. NLP system is able to conduct conversational AI, create reports (for example, on radiological examinations), evaluate unstructured clinical notes on patients, and record patient interactions (Davenport, 2019).
Another AI tool, surgical robots, which were initially approved in the America in 2000, gave "superpowers" to surgeons by improving their vision, ability to perform precise and less intrusive surgeries, ability to repair wounds, and other such activities. (Davenport T, 2002). Some of the most common surgeries that are carried out with robotic arm are: head and neck surgery, prostatic surgery, and gynecologic surgery.
Robotic Process Automation (RPA) Technology is another AI tool that is used to perform administrative tasks that require information systems in healthcare. It organizes these tasks as though they are being completed by a human user following certain rules or instructions. RPA technology is less expensive, simpler to programme, and more transparent than other types of AI. It is employed in the healthcare industry for routine duties like billing, prior authorization, and patient record updates. When combined with certain other technologies like image recognition, it has the potential to retrieve information from faxed images so as to feed it into transactional systems. (Hussain. A, 2014).
In order to improve different treatment modalities, medication use, and disease management, electronic health records are crucial to the healthcare industry. By enabling analysis of data starting from the past to the present, they are able to provide a wealth of information. Artificial Intelligence can be utilised to interpret the records and provide the doctors with insights. Algorithms can use EHR to predict a disease's propensity based on past data and family medical history. (Eren A, 2008)

Methodology

Existing literature in the field of information systems development,Artificial Intelligence and chatbots advocates for a mixed-method study that employs both qualitative and quantitative strategy and gathers samples from both ends in order to draw more reliable conclusions (Venkatesh et al., 2013). This study makes the case that a mixed-method approach has the potential to improve understanding of the phenomena being studied, given the complexity of healthcare delivery. Thus, the use of diverse approaches is consistent with the study's goal of illuminating the dynamics of influence of AI and chatbots and other related technologies in the healthcare industry. This study uses a two-stage sequential design, as shown in Figure. 1,



Journal of Informatics Education and Research
ISSN: 1526-4726
Vol 4 Issue 2 (2024)

Figure 2: Depicts Research Design Adopted
Source: Authors own Composition.

Analysis

Qualitative Study

An exploratory qualitative study using in-depth interviews was done in the first stage (Study 1). To find the respondents of the study a purposive sampling was employed. The sampling criteria included the health experts comprising of doctors, administrative staff and hospital IT staff to understand implications and evaluation of AI and chatbots in healthcare. The interview candidates comprised of practitioners working in different major govt and private hospitals of Delhi and NCR. The implications of AI and chatbots in hospitals were highlighted in the exploratory interviews that consist of various open ended questions listed in Appendix 1. The interviews lasted for around 30 mins. conducted in their respective hospitals.

Quantitative Study

The quantitative study of the research is undertaken to understand and evaluate further the impact of AI and chatbots in hospitals from practitioner perspective.

The research aims to answer the following research questions:

1. What is the outreach of AI enabled services and chatbots in the hospitals of Delhi and NCR?
2. What is the impact of AI enabled services and chatbots on practitioner's operational efficiency?
3. What is the impact of AI enabled services and chatbots on enhancing the patient's satisfaction?

Based on the qualitative and extensive literature review the study to access the impact of AI enabled services and chatbots in hospitals is hypothesised as:

H1: AI enabled services and chatbots have a positive influence on operational efficiency of practitioners.

H2: AI enabled services and chatbots havea positive influence on enhancing the customer satisfaction.

The proposed conceptual model of the study is

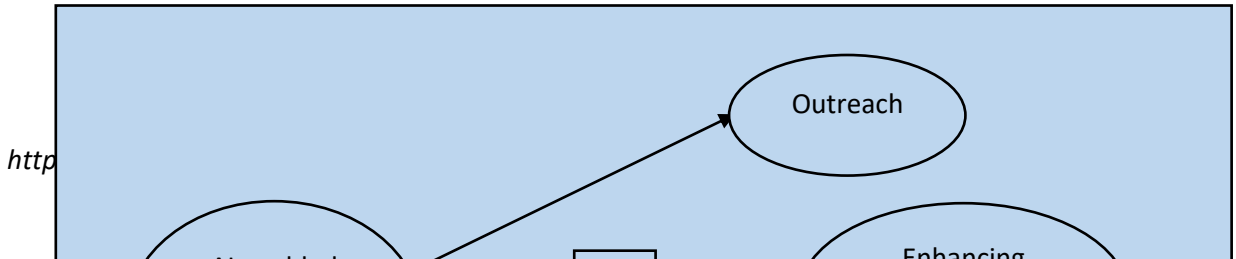


Figure 3: Proposed Conceptual Model.
Source: Author's Own composition.

For the quantitative evaluation of the proposed model, a measurement scale was developed. The three items i.e the outreach of AI enabled services and chatbots, impact of AI enabled services and chatbots on practitioner operational efficiency and lastly the impact of AI enabled services and chatbots on customer satisfaction; were the results of qualitative analysis and literature review. In order to determine the questionnaire's content validity, the survey instrument was pre-tested on several academicians.
The sample characteristics of the respondents is summarized in the table

Demographic variable	Frequency	Percentage (%)
Gender		
Male	65	43%
Female	85	57%
Department Wise Distribution		
Doctors	50	33%
Administrators	30	20%
Nurses and Paramedical Staff	50	33%
Others	20	13%
Hospital Type		
Govt. Hospital	60	40%
Private Hospital	90	60%
Age of the Practitioner		
20-30 years	20	13%
30-40 years	30	20%
40-50 years	45	30%
50-60 years	40	27%
Above 60 years	15	10%

Table 1: Demographic Characteristics
Source: Author's Own Composition

Model Specifications of different SEM Models
Regression Weights

			Estimate	S.E.	C.R.	P	Label
AI	<---	Outreach	.159	.045	3.431	***	
AI	<---	Operational Efficiency	.663	.052	8.831	***	
AI	<---	Customer Satisfaction	.085	.055	1.547	***	

Table 2: Regression Weights of Different Variables.

Model Fit summary

Model	NPAR	CMIN	DF	P	CMIN/DF
Default model	18	391.245	6	.000	53.541
Saturated model	20	.000	0		
Independence model	8	501.975	15	.000	32.398

Table 3 CMIN Model Results.

Baseline Comparison

Model	NFI Delta1	RFI rho1	IFI Delta2	TLI rho2	CFI
Default model	.539	-.653	.343	-.673	.331
Saturated model	1.000		1.000		1.000

Table 4 Baseline Comparison Model Results.

Discussions

Implications from Demographic analysis of the Data

This is used to illustrate the key elements of the data. This develops the foundation of essentially quantitative data analysis in addition to straightforward graphic analysis. According to the study's gender classification, women make up the majority of respondents (57%), while men make up at 43%. AI enabled devices and chatbots installation can assist healthcare businesses increase overall patient satisfaction by providing a centralised view of demographic information about patients, standardising and streamlining operations, and allowing proactive communication. Additionally, patients will be extremely satisfied with the care they receive, increasing the likelihood that routine preventive healthcare will remain a top priority. (Hag land, 2009).

According to distribution studies on the basis of hospital type, out of 150 respondents, 60% often visit private hospitals for medical care, while 40% prefer to receive it at a government hospital. AI benefits from a better understanding of customer wants and wishes, improved communication channels, timely and accurate data, and the gathering of inferred knowledge that fundamentally improves people's understanding without wasting time. However, corporate influence and manufactured demand marketing methods don't genuinely have any affect on healthcare, therefore the main "marketing" goal that a private for-profit healthcare institution may expect for is to deploy AI enabled devices and chatbots, which is the logical progression of observation building.(Vardasca and Martins, 2011; Oinas-Kukkonen et al., 2008).

According to the respondents' age distribution, the majority of them fall within the 30–50 year age range. It is clear from the analysis that older adults need medical attention from a healthcare agency. As a result, providing for them helps the business maintain its older customers, who are its main source of revenue. Additionally, a AI

framework can improve patient care by enabling hospitals to better understand patients' requirements and by improving communication by monitoring systems (Mohiuddin, 2019).

Implications from Qualitative Study.

The use of new technology in the healthcare industry is being driven by emerging trends like expanding service demand, a shift in emphasis toward overall wellbeing, and rising costs of high-quality care. Medical institutions are changing the rules of patient contact by utilising the power of conversational AI. The creation and application of numerous AI solutions in the healthcare industry are definitely rapidly expanding.

Medical or healthcare chatbots can be utilised for a variety of goals, from bettering patient experiences and assisting medical personnel to optimising healthcare processes and revealing useful insights. Medical chatbots are one of the most developed and influential AI-powered healthcare solutions created thus far, and they are poised to transform the way payers, medical care providers, and patients communicate with one another.

The practitioners were very confident about the fact: There is little doubt that these chatbots' relevancy and accuracy will rise as well. But much more will be needed for the adoption of healthcare chatbots to be effective. To create chatbot solutions that can handle the issues facing healthcare today, a careful balancing act between human empathy and artificial intelligence will be necessary.

Based upon Qualitative study implications the questionnaire was prepared and evaluated to study the impact to AI and chatbots in increasing the operational efficiency of practitioners in the hospitals and also to evaluate the impact on enhancing the patient's satisfaction.

Implications from Quantitative study

Healthcare AI is expanding quickly, and this trend is expected to continue. The AI can manage the entire healthcare portfolio thanks to ready-to-use conversational AI in healthcare modules. Utilizing chatbot technology in the healthcare industry enables physicians to continuously give prompt responses, notifications, and reminders. Patients benefit from shorter wait times and immediate access to care. Chatbots with AI capabilities can recognise patients' faces and interpret their behaviour to provide a customised answer that increases patient happiness. Some of the key benefits of AI Enabled devices and Chatbots highlighted in the research are:

1. Improved and enhanced patient access.
2. More Scalable interactions with patients.
3. Improve Operational Efficiency by boosting brand awareness.
4. In long run can also help in saving the money.
5. Helps to automate the entire data deployment.

However artificial intelligence in healthcare is still a relatively recent development, these instruments cannot be entirely held accountable for patients' engagement outside of client service and other essential tasks.

Conclusion

This study adopted a mixed method approach that involved qualitative research using expert opinions and quantitative research was carried out through a survey using a questionnaire. On the basis of the study it can be said that the installation of AI enables services and chatbots can help in increasing the overall patient satisfaction in the healthcare industry by centralizing and streamlining the patient information and hence enabling proactive communication. It can further assist the healthcare industry in increasing their revenue by paying attention to the medical needs of those falling in the age bracket of 30-50 years. AI in healthcare is expanding at a rapid pace; specially the chatbot technology that enables doctors to provide a quick response to patient queries and sending notifications and reminders to patients. Similarly, patients also benefit from shorter waiting times and customized responses that makes them satisfied and happy. Apart from these benefits, AI enabled devices and chatbots improve the overall operational efficiency, and patient experience in the healthcare industry.

References

1. A.K. Triantafyllidis, A. Tsanas, Applications of machine learning in real-life digital health interventions: review of the literature, J Med Internet Res, 21 (2019), p. e12286, 10.2196/12286

2. Eren A, Subasi A, Coskun O.. A decision support system for telemedicine through the mobile telecommunications platform. Journal of Medical Systems. (February 2008;32(1):31–5.
3. Fakoor R, Ladhak F, Nazi A, Huber M. Using deep learning to enhance cancer diagnosis and classification. A conference -presentation The 30th International Conference on Machine Learning, 2013.
4. Davenport TH, Glaser J. Just-in-time delivery comes to knowledge management. Harvard Business Review 2002. https://hbr.org/2002/07/just-in-time-delivery-comes-to-knowledge-management.
5. Laï, M.-C.,Brian, M. and Mamzer, M.-F. (2020) "Perceptions of Artificial Intelligence in Healthcare: Findings from a Qualitative Survey Study among Actors in France." Journal of Translational Medicine, vol. 18, no. 1
6. Lee SI, Celik S, Logsdon BA, et al. A machine learning approach to integrate big data for precision medicine in acute myeloid -leukemia. Nat Commun 2018;9:42
7. L.G. Pee, S.L. Pan, L. Cui, Artificial intelligence in healthcare robots: a social informatics study of knowledge embodiment, J Assoc Inf Sci Technol, 70 (2019), pp. 351-369, 10.1002/asi.24145
8. Giansanti, D. Rossi, I. & Monoscalo, L. (2021) "Lessons from the COVID-19 Pandemic on the Use of Artificial Intelligence in Digital Radiology: The Submission of a Survey to Investigate the Opinion of Insiders." Healthcare, vol. 9, no. 3
9. Gillan, C. Milne E, Harnett, N., Purdie, T., Jaffray, D. and Hodges B. (2018) "Professional Implications of Introducing Artificial Intelligence in Healthcare: An Evaluation Using Radiation Medicine as a Testing Ground." Journal of Medical Imaging and Radiation Sciences, vol. 49 (1)
10. Hagland, M. (2009). Clinical transformation: under pressure to alter the cost/quality paradigm, hospital organizations are turning to IT. *Healthcare informatics: the business magazine for information and communication systems*, *25*(14), 24-26.
11. Hussain A, Malik A, Halim MU, Ali AM. The use of robotics in surgery: a review. Int J Clin Pract 2014;68:1376–82.
12. M. Coeckelbergh; Health care, capabilities, and AI assistive technologies, Ethical Theory Moral Pract, 13 (2010), pp. 181-190
13. M. Ardan, G.B.G. Ferry Fadzlul Rahman, The influence of physical distance to student anxiety on Covid-19, Indonesia, J Crit Rev, 7 (2020), pp. 1126-1132, 10.31838/jcr.07.17.141
14. Mohiuddin, A. (2019). Patient Relationship Management: Patient Care with CRM Approach. *PharmaTutor*, *7*(4), 22-36.
15. Oinas-Kukkonen, H., & Harjumaa, M. (2008, February). Towards deeper understanding of persuasion in software and information systems. In *First international conference on advances in computer-human interaction* (pp. 200-205). IEEE.
16. Powles, J., Hodson, H. (2017). Google DeepMind and healthcare in an age of algorithms. *Health Technol (Berl)*.7(4), 351-367. 10.1007/s12553-017-0179-1-DOI-PubMed.
17. T.Q. Sun, R. Medaglia Mapping the challenges of Artificial Intelligence in the public sector: evidence from public healthcare Gov Inf Q, 36 (2019), pp. 368-383, 10.1016/j.giq.2018.09.008
18. Rosenberg, A.L., Tripathi, R.S., & Blum, J.M. (2010). The most influential articles in critical care medicine. *Journal of Critical Care, 25*, 157 - 170
19. Sordo M. Introduction to neural networks in healthcare. OpenClinical, 2002. www.openclinical.org/docs/int/neuralnetworks011.pdf
20. Vardasca, T. R., & Martins, H. (2011, June). Patient Relationship Management in public healthcare settings. In *2011 IEEE International Conference on Communications (ICC)* (pp. 1-4). IEEE.
21. Venkatesh, V., Brown, S. A., & Bala, H. (2013). Bridging the qualitative and quantitative divide: Guidelines for conducting mixed methods research in information systems. *MIS Quarterly*, *37*(1), 21–54.
22. Vial A, Stirling D, Field M, et al. The role of deep learning and -radiomic feature extraction in cancer-specific predictive modelling: a review. Transl Cancer Res 2018;7:803–16.
23. Walls, A.E. (2018), Capacity Command Center: Machine Learning & Hospital Management at Johns Hopkins. Capacity Command Center: Machine Learning & Hospital Management at Johns Hopkins - Technology and Operations Management (hbs.edu) retrieved on 8th August, 2022 13:51(IST).
24. Yu K.-H., Beam A. L., Kohane I. S. (2018). Artificial Intelligence in Healthcare. *Nat. Biomed. Eng*. 2 (10), 719–731. 10.1038/s41551-018-0305-z - DOI - PubMed.