

Bridging Technology and Care: The Role of Health Informatics in Modern Healthcare

Mohammed Javeedullah^{1*}

¹New England College 98 Bridge Street, Henniker, NH 03242

[¹JMohammed3GPS@nec.edu](mailto:JMohammed3GPS@nec.edu)



Corresponding Author

Mohammed Javeedullah

JMohammed3GPS@nec.edu

Article History:

Submitted: 20-05-2025

Accepted: 25-06-2025

Published: 30-06-2025

Keywords:

Health Informatics, Electronic Health Records (EHR), Patient-Centered Care, Data Privacy and Security, Interoperability.

American Journal of Artificial Intelligence and Computing is licensed under a Creative Commons Attribution-Noncommercial 4.0 International (CC BY-NC 4.0).

ABSTRACT

Health informatics is now a key part of health care, linking new technology with care focused on patients. The review focuses on explaining health informatics' main ideas, important components, and various areas of use, stressing how it has improved healthcare services. Because it enables easy data management, clinical support, and better sharing of messages, health informatics better ensures patient safety and better outcomes in health care. The piece also looks into the main advantages, such as better communications among caregivers, increasing telehealth availability, and personalized medicine. However, it also mentions some of the problems, like staying safe with health data, effective compatibility between systems, adoption by users, and moral issues involved. Illustrative examples and best strategies in this field are presented in this book. To conclude, the report describes future steps, pointing out how artificial intelligence, data analysis, and advanced digital tools can make healthcare more effective. Overall, this review points out how adopting health informatics helps improve the efficiency, fairness, and quality of care for patients.

INTRODUCTION

The healthcare field is now experiencing major changes because technology is playing an essential role in changing the way care is provided and managed. Health informatics plays a key role in this digital age since it combines information science, computer science, and healthcare. According to experts, the main purpose of health informatics is to unite healthcare providers and make patient care, choices for care, and management of the clinic more efficient [1-2].



Before, healthcare systems were not well-integrated since they relied on records made of paper and on disconnected information sources. The systems commonly caused inefficiency, repeated tasks, and errors in medicine since data was not easily available or shared across them [3]. When electronic health records (EHRs) appeared, it became possible to manage patient data centrally and using the same approach across the healthcare system. Today, EHRs provide a solid structure in health informatics, making it easier for different care facilities to exchange details and ensuring that clinicians work better as a team [4].

There are many other technologies and systems in health informatics, which include clinical decision support systems (CDSS), health information exchanges (HIEs), platforms for telemedicine, mobile health (mHealth) apps, and incorporating artificial intelligence (AI) and machine learning algorithms [5]. The purpose of these technologies is to boost the performance, safety, and results in healthcare delivery. By using CDSS, clinicians receive help in making proper diagnoses and therapy decisions, plus advice on how to avoid mistakes thanks to the use of data and medical guidelines [6].

It is also important to point out that health informatics focuses on teamwork among experts, patients, and the office staff as well as on technological tools. It makes sure that each patient is involved and technology helps more than hinders effective health care. Because health informatics makes necessary medical records available quickly, it makes care more continuous, encourages prevention, and gets patients involved in caring for themselves.

Although there are many advantages, introducing health informatics into today's healthcare has its share of difficulties. It is important to handle matters such as security, connection between systems, user interest, and ethics so that informatics solutions are implemented successfully [8]. Besides, when healthcare providers and patients lack equal access to technology and digital knowledge, health inequalities may become worse unless the situation is dealt with early.

The purpose of this review article is to discuss health informatics from all angles, showing how it has evolved, what it is made of, what it provides, the challenges it faces, and where it is headed in the future. The article combines available knowledge and best practices to explain how health informatics plays a key role in bringing technology and health care together [10]. All in all, looking at how health informatics influences healthcare is necessary for policymakers, healthcare workers, and patients, since it may significantly improve how healthcare is provided.

DEVELOPMENT OF HEALTH INFORMATICS

Health informatics has transformed over time by bringing new technologies, adjusting healthcare delivery, and facing the demand to handle large amounts of health information properly. Starting out simply in the mid-20th century, today the field is made up of many different and closely linked systems, as broader changes have occurred in medicine, technology, and society [12].

Health informatics started to develop in the 1950s and 1960s as doctors and support staff began to automate hospital record-keeping and other important processes. At the beginning, most systems based on punch cards were mainly used for handling hospital fees and arranging schedules [13]. Even though these experiments were basic, they did not change clinical care much [14].

Thanks to affordable computers in the 1970s and 1980s, it became possible to make applications more sophisticated. During this era, doctors began using computers to keep patient records and the first versions of clinical decision support systems (CDSS) appeared [15]. In research settings, the aim of these systems was to provide assistance to doctors by using clinical recommendations together with patients' medical information in the process of diagnosis and treatment planning. Yet, because there was no clear way for different programs to work together, share the same data, and have user-friendly designs, most people did not use e-commerce [16].

The use of electronic health records (EHRs) increased more than ever in the 1990s. When graphical user interfaces were introduced and database systems got better, the records of patients could be managed in a more complete and easy-to-reach way [17]. At this time, health information exchange (HIE) was created to make it simpler for different healthcare organizations to share important data. Still, making these systems secure and unified was difficult, which prevented them from reaching their full potential [18].

Due to the fast growth of the internet, mobile gadgets, and big data, the health informatics field has entered a new phase in the 21st century [19]. Because of the HITECH Act of 2009 in the United States, major incentives were given to promote the use of EHRs, which led to their nationwide rollout. It became clear through meaningful use of EHRs that technology was important not only for use but also for improving how patient care is provided [20].

Key Milestones in the Development of Health Informatics



1	1940S-1950S	Early use of computers in healthcare (e.g., administrative tasks).
2	1960S	Emergence of hospital information systems (HIS) and research in medical computing.
3	1990S	Growth of the internet; integration of telemedicine and digital imaging (PACS).
4	2010S	Big data, mobile health (mHealth), and wearable technology gain popularity.
5	2020S	AI, machine learning, blockchain, and interoperability advancements in healthcare.

Figure: 1 showing key milestones in the development of health informatics

At the same time, AI and machine learning made progress, supplying data scientists with strong tools to analyze, recognize patterns, and make predictions. Through these tools, it is possible to make better decisions in medicine, offer patient care that meets their needs, and use resources efficiently [21]. Bringing mHealth and wearable devices into use spread the impact of health informatics to other areas and allowed patients to manage their health regularly from home [22].

The COVID-19 pandemic has proved that health informatics helps enable telehealth, remote patient monitoring, and fast sharing of data, allowing resources to be used effectively when facing a health crisis [23]. They show that healthcare systems informatics should be secure, usable by several users, and able to handle any sudden changes in the healthcare sector.

All in all, the progress of health informatics has been driven by advances in technology, policy

decisions, and what patients and doctors require [24]. From the first days of using electronic data, health informatics has always advanced the way healthcare is given and received. To appreciate the opportunities and barriers in today's healthcare, we need to recognize the important changes experienced by the field [25].

CRUCIAL ASPECTS TO HEALTH INFORMATICS

A variety of technologies and systems combined in health informatics help make it easy to keep, find, and use health-related information [26]. The main parts of EHRs make healthcare today faster, smarter, and more effective. Being aware of these parts is important to grasp the full effect of health informatics on the healthcare industry [27].

The main focus of health informatics is the electronic health record (EHR), which holds all kinds of patient information, such as past treatments, medical diagnoses, the medications given, dates for immunizations, allergies, and the results from laboratory tests. Thanks to EHRs, sharing information among healthcare providers is smooth, which supports the continuity of their work and leads to safer results [28]. Unlike paper records, EHRs make it possible to access current patient information at any time for better clinical choice. Even though EHRs can greatly help healthcare systems, issues such as making different EHR systems work together, organizing data in the same way, and designing user interfaces are still being actively explored [29].

Decision support systems used by medical staff form an important side of health informatics. They access a patient's health information and use it, together with best practices and clinical data, to provide needed suggestions to healthcare teams in real time [31]. CDSS tools can guide doctors in spotting conditions, providing the best treatment options, warning about combining certain drugs, and alerting them about health care routines. CDSS tools have the ability to improve how is treated, avoid mistakes, and help standardize care. Still, the effectiveness depends largely on how accurate the data is, how easy it is for users to accept, and how it matches the daily routines in medical facilities [31]. HIEs make it possible for healthcare providers to access a complete record of the patient, regardless of the facilities the patient visited [31]. It becomes very important for patients who are treated by different doctors in various locations. Emergency situations benefit a lot from HIEs because their records help save lives. For HIEs to work, they must be built using strong data governance rules, formats that follow standards, and by obeying privacy and security laws [33].

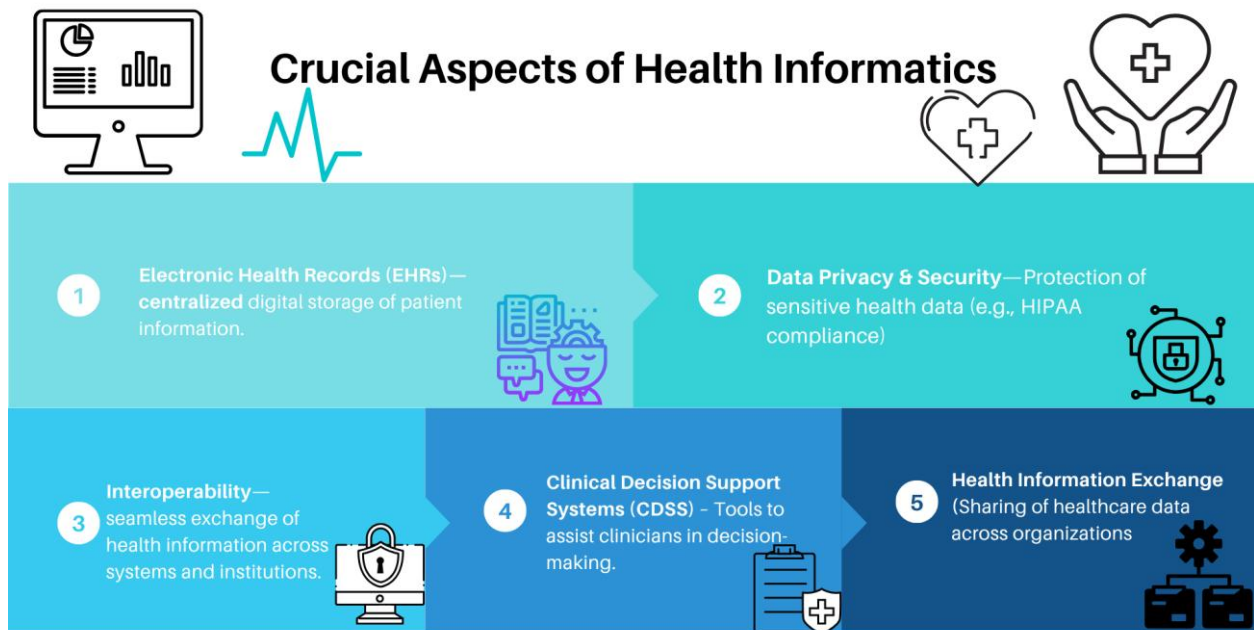


Figure: 2 showing crucial aspects of health informatics

Telemedicine and mHealth play a bigger role in health informatics now, particularly because of the COVID-19 pandemic. Through telemedicine, doctors can meet with patients remotely, which lowers travel for patients and increases chances to receive medical attention in regions that have less healthcare access [34]. At the same time, mHealth applications give patients the opportunity to keep an eye on their health records, communicate with their doctors, and handle ongoing diseases with the help of smartphones and wearable gadgets. As a result, patient engagement is strengthened, and a huge quantity of health data can now be used in EHRs to help manage the health of large communities [35].

Combining artificial intelligence and machine learning with health informatics is affecting the analysis of data and the way clinical work is done. Using AI, computers can go through a lot of information to spot patterns, foresee disease advancement, and better tailor medicine. Machine learning helps with software that will automate management duties, review patient records, and detect the blueprints of some diseases like cancer or sepsis. Even though AI holds great potential, it creates some issues around hidden processes, fairness, and making it part of daily healthcare.

In short, EHRs, CDSS, HIEs, telemedicine, mHealth, and AI make up a group that assist the delivery of personalized healthcare based on data. These advances are necessary to make sure the modern healthcare system achieves its goals of better results, more effective practices, and happier patients

[37].

BENEFITS AND OPPORTUNITIES IN HEALTH INFORMATICS

The use of technology in healthcare has caused major changes for the better in patient care. Incorporating informatics tools in care and administration allows the healthcare system to do more, help patients, enhance their own procedures, and give providers greater support [38].

It helps enhance the well-being and safety of patients greatly. Because EHRs make medical records simple to retrieve and check for accuracy, healthcare professionals avoid errors linked to missing or incomplete paper files. Because it handles all aspects of a patient's medical file, health informatics makes it easier to identify the right illness and treatment plan [39]. Besides, CDSS is designed to notify doctors if a drug might cause a problem with an existing condition or drug, thus lowering the risk of both mistakes and negative events. When data is available in real time, nurses can act in a timely manner and keep a close watch on patients, which supports the care of people with chronic and acute diseases.

Using health informatics, workers can perform routine jobs automatically, leading to a better structured workflow [41]. One example is computerized provider order entry (CPOE), which ensures orders are not written by hand and so cuts down on transcription errors and makes care delivery faster. Health information systems rule out the need for separate activities like scheduling, billing, and documentation, saving time and effort for doctors. People in different groups can communicate and share important data electronically, leading to fewer tests done and greater utilization of resources [42].

Evidence-based practice is promoted when clinical guidelines and research are added to health information systems due to health informatics. Doctors and nurses have information on new protocols, scientific research, and clinical data that allows them to address each person's situation properly [43]. In this way, care is made similar for everyone and treatments that are proven effective are regularly followed. Also, using informatics tools to study extensive patient data makes it possible to do clinical studies, examine the well-being of communities, and notice new health patterns, all of which help provide higher quality health services.

With health informatics, patients have the necessary resources to take part in their treatment decisions. Thanks to patient portals, many people are able to check, schedule appointments, communicate with providers, and monitor important numbers such as blood pressure, glucose levels, or their general

physical activity. As patients participate more, they are likely to follow their treatment plans closely, handle chronic illnesses with more ease, and enjoy their healthcare services more. In addition, telemedicine allows patients who live in isolated or underserved areas to receive help, because they do not have to travel far or pay as much [46].

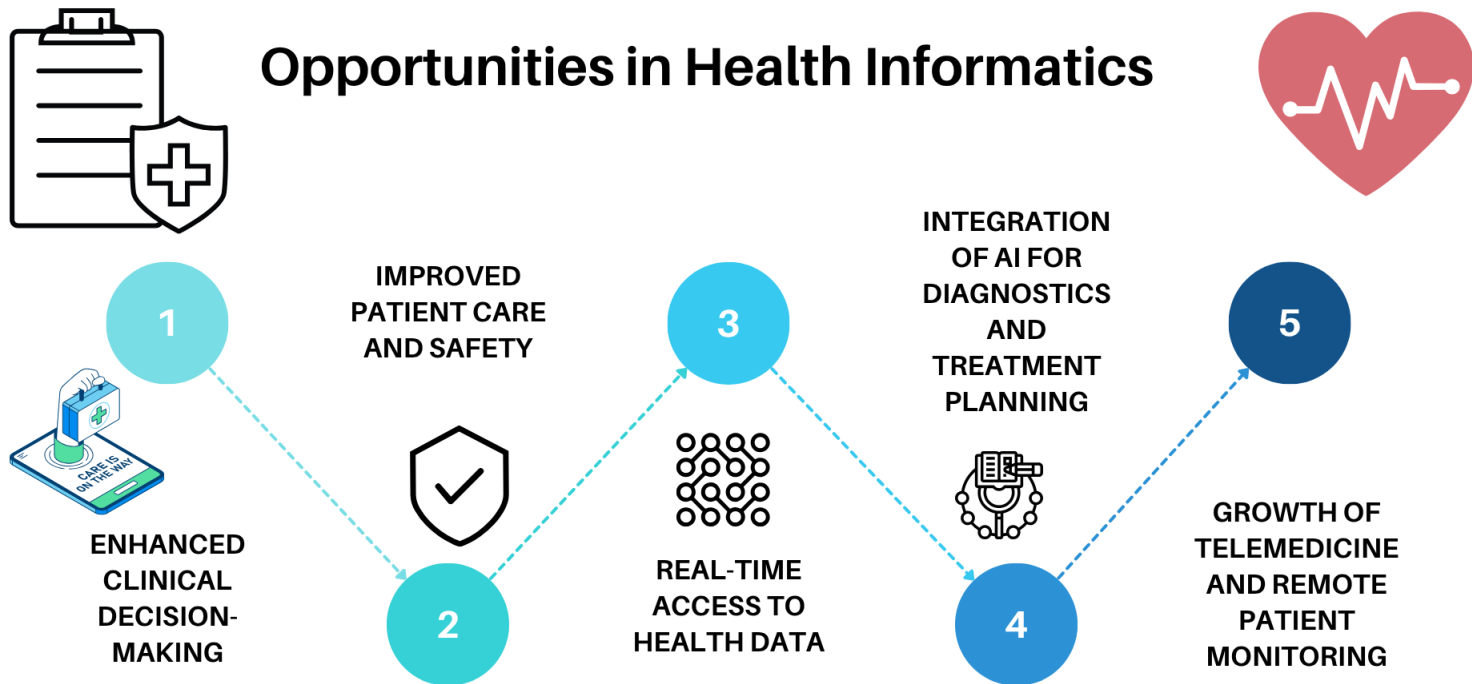


Figure: 3 showing opportunities in health informatics

There are many chances for innovation because health informatics continues to evolve. The combination of AI with ML in healthcare makes it possible for us to make better predictions, offer personalized medicine, and automate some medical tasks. By analyzing big data, it is possible to discover the health of a population, update health policies, and make better decisions in the event of an epidemic [47]. Interoperable health information exchanges (HIEs) are now increasing how different healthcare systems partner with each other by guaranteeing the delivery of quality care. Thanks to these opportunities, people's health gets better, the economy grows, and new healthcare models are created [48].

Overall, health informatics makes the healthcare system more efficient, effective, and focuses on the patients' needs. Through technology, health informatics assists them in making better medical choices, managing tasks efficiently, giving more evidence-based care, and helping patients participate [49].

ISSUES AND PROBLEMS IN HEALTH INFORMATICS

Even though health informatics has huge potential to revolutionize healthcare, it is still encountering several major challenges in being put into use. These concerns involve, among others, technology, organizational issues, legal regulations, ethics, and human aspects, and all of them are important to handle for health informatics to help improve healthcare as expected [50].

Making sure the sensitive data of patients is protected is among the top priorities in health informatics. Since healthcare data is private and not easy to protect, it frequently attracts cybercrime and becomes a main target for hacks and ransomware [51]. For electronic health records and other health data to stay protected, it is important to use encryption, access controls, and keep a close watch on systems. By following HIPAA in the United States, GDPR in Europe, and similar local data protection laws, extra trouble is caused. Breaches endanger the privacy of patients and can hurt the organization's reputation and finances as well [52].

Still, the main challenge in health informatics today is getting health systems and different applications to interact, share, and understand the same data [53]. Even with more use of EHRs, a lot of the systems are not connected because the information is not shared smoothly due to different formats and standards. Never being able to connect different electronic healthcare systems may lead to missing data on patients, tests done several times, long waits for treatment, and higher healthcare bills. Even though efforts like adopting FHIR are still being made, there is still no worldwide adoption of such formats. Addressing challenges in system compatibility needs cooperation from both industry players and officials responsible for making healthcare policies [54].

For health informatics tools to work well, clinicians, administrative workers, and patients must be open to using them and learn how to use them. Avoiding new changes, not being able to use digital tools, and unanswered concerns about workload can stop users from adopting technology quickly [55]. Most healthcare professionals mention that they are unsatisfied with EHRs because of a difficult interface, time spent adding data, and interrupted workflows. If doctors do not get enough training and support, these obstacles can result in fatigue and poor use of informatics tools. It is necessary to support users, provide proper training, and conduct improvements to the system's ease of use to tackle these difficulties [65].

Health informatics deals with ethical and legal challenges that need to be sorted out cautiously. Because of issues like the use of informed consent, patients' freedom to make decisions, ownership of data, and bias in AI, close consideration and proper frameworks are necessary in this field [57]. If

AI analyzes data that does not adequately represent people, it could end up giving biased recommendations about healthcare. Lawyers and experts are still figuring out the laws concerning problems caused by telemedicine or decision support systems. To keep trust and accountability within health informatics, setting clear ethical guidelines is very important [58].

The lack of efficient infrastructure creates a big problem in many healthcare services located in rural or poor areas [59]. Because of limited internet access, old equipment, and little funding, it becomes hard to install and take care of electronic health systems. People with limited internet in their area might not be able to use the latest digital medical solutions, so health gaps could grow wider. To deal with these issues, we should invest appropriately and implement policies for fair use of technology [60].

Often, healthcare organizations encounter difficulties getting employees to accept new technology when it changes their normal way of working. To get past such problems, people must be guided effectively by leaders, have an enjoyable learning culture, and drive change [61]. If different specialists in health care and the right health informatics actions are lined up with organizational goals, integration will be easier.

Finally, even though informatics in healthcare is very helpful, its use is stalled by various issues [62]. To achieve the maximum benefits from health informatics and close the gap between technology and high-quality care, focus on security, interoperability, encouraging people to use the system, ethical issues, underlying infrastructure, and company culture is very important.

STUDIES AND COLLABORATIONS IN HEALTH INFORMATICS

One can get a sense of the major changes brought by health informatics in healthcare by considering cases where technology has been applied successfully [63]. These cases illustrate that strong use of health informatics tools can lift patient services, improve daily tasks, and encourage sharing between hospitals and clinics. Likewise, they make it possible to see important lessons that can help guide what to do in the future [64].

In America, Kaiser Permanente is both praised and known for its quick and effective adoption of electronic health records (EHRs). With the EHR system in place, medical information could be moved easily between hospitals, medical clinics, and pharmacies in the organization's network. This combination of two systems made healthcare better coordinated, reduced chances of medical errors, and maintained patient safety [65]. By reviewing a patient's entire history and important test results

at any moment, clinicians can accurately find the cause of illnesses and act in a timely manner. Kaiser Permanente's achievements demonstrate that good leadership strategies, a careful implementation plan, and regular education of users matter for successful use of EHRs [66].

VHA started to use CDSS, which help doctors and other clinicians decide the best treatment options using research data. The system includes clinical guidelines and issues warnings for drug interactions, notifies about needed care, and gives advice based on the patient's information [67]. It is reported by studies that VHA's CDSS has helped decrease cases of adverse drug effects and increase compliance with recommended guidelines. By demonstrating the importance of having decision support tools in daily clinical life, it underlines that the system shall be user-friendly to gain clinicians' trust and helpfulness [68].

Collaborations in Health Informatics

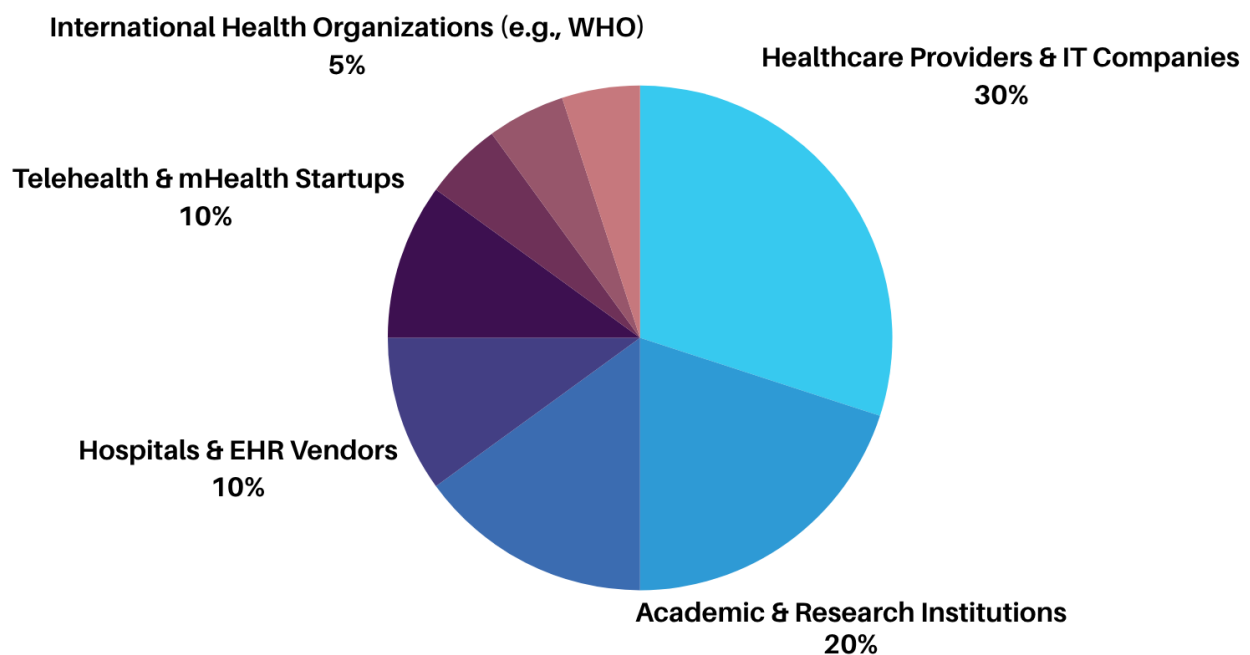


Figure: 4 showing collaborations in health informatics

Telemedicine services in India's rural regions allow more people to get healthcare, as it addresses issues related to location and resources. The Apollo Telemedicine Networking Foundation is one instance where doctors in big cities are linked to patients in areas with less medical care through the use of apps on phones and remote diagnostics [69]. With telehealth, people can access medical care

faster, pay less for transport, and take better care of long-lasting diseases. Such achievements indicate that telemedicine and apps for healthcare can help reduce healthcare inequality if they are supported by proper infrastructure and involve people in the community [70].

From these and other experiences, different best practices appear to guide the correct application of health informatics. An example is involving clinicians, administrators, IT experts, and patients from the start to the end of the process, as this helps fulfill user needs and makes the system generally accepted [71].

FUTURE DIRECTIONS IN HEALTH INFORMATICS

As health informatics develops, people can expect important breakthroughs that will help technology support better patient care. New breakthroughs in AI, analyzing big data, personalized medicine, and digital tools for healthcare are set to make healthcare more exact, time efficient, and valuable to patients [72]. At the same time, to do so, the country must deal with existing issues and uncover the possibilities offered by new developments.

AI and machine learning are starting to play a leading role in the future of health informatics. They have the ability to analyze complicated health care data including records, pictures, and genetics far quicker and more accurately than any person could. With the help of AI, predictive analytics can spot individuals who are likely to get chronic diseases, allow early detection, and design the best treatment plans for them [73]. Using AI, doctors already can find out about cancer early, predict which patients might be readmitted to the hospital, and guide their clinical decisions. AI-based technologies will probably be used more closely with healthcare activities, helping clinicians give timely, personalized care [74].

The adoption of health informatics will be important for the progress of precision medicine that customizes care and preventive strategies for people depending on their biological, environmental, and lifestyle information. It is necessary to use powerful informatics tools to unite biology-related information with health and lifestyle factors [75]. The use of bioinformatics together with AI will give clinicians the tools to select therapies customized to each patient and help them reach better outcomes. It also helps to lower the cost of healthcare since patients are likely to receive the right treatment and fewer negative side effects [76].

The immediate need to practice social distancing made using telehealth and remote monitoring popular, and they are expected to increase even more. By making use of AI and virtual reality,

telemedicine will improve and include features for remote triage and remote consultations using wearables such as smartwatch sensors that continuously share health information [77]. Through remote monitoring, it will be possible to deal with chronic diseases early, lessen the number of hospitalizations, and allow care to reach those who live far from medical services. Future systems will be designed for users' convenience, will be able to communicate with many types of systems, and will have EHR integration, allowing better coordination between services provided anywhere [78].

Because of the sudden increase in healthcare data, population health management has many fresh opportunities. Tools in health informatics will rely more on big data analytics to find out major health trends, follow the outbreaks of diseases, and advise public health measures. Gathering data from things like social factors, environment, and the use of healthcare services can give a complete picture of elements affecting health outcomes. Thanks to this, regulations and policies can be changed in the best way possible to support better health equity [79].

In next steps, we should pay close attention to getting diverse healthcare systems and platforms to communicate and share information easily. If more places use global data standards such as HL7 FHIR, it will become much easier to manage care properly, reduce unnecessary actions, and improve data quality. With interoperability, patients will be able to use their health data in different places and on different systems [80].

When health informatics progresses, it will lead to the appearance of new ethical and regulatory challenges. Problems related to protecting privacy, fair use of algorithms, clear consent, and equal treatment in healthcare will have to be managed regularly [82]. It is important for policymakers, clinicians, and technologists to come together to establish systems that look after patient rights and encourage improvements. Making sure AI and digital health technology is handled wisely will depend on these initiatives.

As a final point, health informatics is sure to progress into a successful and promising area. By making use of new technologies and resolving main obstacles in healthcare, health informatics will keep improving the link between technology and treatment [83]. Knowing about the latest trends and promoting cooperation between stakeholders will help reach the goals offered by health informatics in the coming years.

CONCLUSION

Health informatics plays a major role in today's healthcare by linking advances in technology with caring for patients. The presence of electronic health records in healthcare systems around the world is helping to manage information more efficiently, support better choices by doctors, give patients better health results, and streamline operations. Since this field is still developing, there is no doubt that health informatics will continue to play a central role in tackling today's healthcare issues and offering better quality, safety, and accessibility.

In this report, we have discussed how important health informatics is in current healthcare by merging technology with patient treatment. Health informatics makes it possible for healthcare workers to use EHRs, CDSS, telemedicine, and even AI to give personalized and scientifically proven care. All the main aspects of health informatics blend together to deliver an environment that ensures smooth transmission of information, assists doctors in their daily tasks, and involves patients in handling their health.

Health informatics greatly improves and develops the healthcare field. One example is making sure health data is accurate and simple to access, arranging clinical work so less administration is involved, and using telehealth and mobile applications to leave patients with better healthcare. What's more, health informatics contributes to new developments thanks to personalized medicine, predictive analysis, and population health management, which could change healthcare around the world.

On the other hand, it is not an easy task to reap these benefits. There are still major issues when it comes to protecting health records, especially as cybersecurity threats keep growing. Since information cannot be shared easily, it is often hard to coordinate care for each patient. Efforts to use EHRs often encounter training issues, showing that the systems must be simple and fit well with clinical tasks. At the same time, concerns about data and AI require regular monitoring and strict rules. Also, problems such as old infrastructure and cultures in organizations need to be dealt with to guarantee everyone gets fair access to health informatics.

It has been shown from case studies that a successful health informatics program must involve careful planning, include different viewpoints, implement the project in steps, train all staff thoroughly, and stick to guidelines for governing data. They provide useful insights for health organizations that want to use informatics technologies as part of their daily operations.

Health informatics is expected to thrive and offer many opportunities as time goes on. AI, the analysis

of large sets of data, personalized medicine, and the use of telehealth will keep improving healthcare, so it is less general and more easily reached. Strong focus on both shared technology and good governance will help maximize these progresses while safeguarding patients and winning their trust.

All in all, health informatics combines healthcare and technology in such a way that it can play a key role in facing many of the problems in the modern healthcare field. Using innovation, lowering obstacles, and putting patients first helps health informatics make health care services more efficient, fair, and successful. Because technology and healthcare are moving forward at the same time, the field of health informatics will become more crucial in shaping health across the world.

REFERENCES

- [1]. Gentles SJ, Lokker C, McKibbin KA. Health information technology to facilitate communication involving health care providers, caregivers, and pediatric patients: a scoping review. *Journal of medical Internet research*. 2010 Jun 18; 12(2):e1390.
- [2]. Khasseh AA, Jatoi AJ. Bridging the Digital Divide in Healthcare: Addressing Inequities for Improved Access and Outcomes. *Journal of Social Informatics and Global Health*. 2022 Dec 21; 1(1):49-58.
- [3]. Tuzii J. Healthcare information technology in Italy, critiques and suggestions for European digitalization. *Pharmaceuticals Policy and Law*. 2018 Oct;19(3-4):161-76.
- [4]. Leon N, Schneider H, Daviaud E. Applying a framework for assessing the health system challenges to scaling up mHealth in South Africa. *BMC medical informatics and decision making*. 2012 Dec;12:1-2.
- [5]. Li, J. P. O., Liu, H., Ting, D. S., Jeon, S., Chan, R. P., Kim, J. E., & Ting, D. S. (2021). Digital technology, tele-medicine and artificial intelligence in ophthalmology: A global perspective. *Progress in retinal and eye research*, 82, 100900.
- [6]. Correa R, Shaan M, Trivedi H, Patel B, Celi LAG, Gichoya JW, et al. A systematic review of 'fair' AI model development for image classification and prediction. *J Med Biol Eng*. 2022; 42:816–27.
- [7]. Kharrazi H, Gamache R, Weiner J. Role of informatics in bridging public and population health. In *Public health informatics and information systems 2020* Jul 18 (pp. 59-79). Cham: Springer International Publishing.
- [8]. Shivshankar S, Makhija N, Mathusudhanan P. Digital imaging and communication in

- medicine (DICOM): Biomedical and health informatics: Imaging and interoperability using HL7 and DICOM. In Smart Healthcare and Machine Learning 2024 Jul 13 (pp. 299-317). Singapore: Springer Nature Singapore.
- [9]. Gamache R, Kharrazi H, Weiner JP. Public and population health informatics: the bridging of big data to benefit communities. Yearbook of medical informatics. 2018 Aug;27(01):199-206.
- [10]. Javaid M, Haleem A, Singh RP. Health informatics to enhance the healthcare industry's culture: An extensive analysis of its features, contributions, applications and limitations. Informatics and Health. 2024 Sep 1; 1(2):123-48.
- [11]. Gabrani G, Gupta S, Verma L, Vyas S. The Role of Health Informatics in Achieving Sustainable Development Goals. In Sustainability and Health Informatics: A Systems Approach to Address the Climate Action Induced Global Challenge 2024 Sep 24 (pp. 73-98). Singapore: Springer Nature Singapore.
- [12]. Ellahham S, Ellahham N, Simsekler MCE. Application of artificial intelligence in the health care safety context: opportunities and challenges. Am J Med Qual. 2019; 35:341–8?
- [13]. Focsa MA, Rotaru V, Andronic O, Marginean M, Florescu S. Bridging Gaps in Telemedicine Education in Romania to Support Future Health Care: Scoping Review. JMIR Medical Education. 2025 May 14;11(1):e66458.
- [14]. Sisk BA, Antes AL, Burrous S, DuBois JM. Parental attitudes toward artificial intelligence-driven precision medicine technologies in pediatric healthcare. Children. 2020; 7:145.
- [15]. Nøhr C, Kuziemyky CE, Wong ZY, editors. Context Sensitive Health Informatics: Redesigning Healthcare Work. IOS Press; 2017 Aug 18.
- [16]. Cheng VWS, Piper SE, Ottavio A, Davenport TA, Hickie IB. Recommendations for designing health information technologies for mental health drawn from self-determination theory and co-design with culturally diverse populations: template analysis. J Med Internet Res. 2021; 23:e23502.
- [17]. Bauer GR, Lizotte DJ. Artificial intelligence, intersectionality, and the future of public health. Am J Public Health. 2021; 111:98–100.
- [18]. Trewin S, Basson S, Muller M, Branham S, Treviranus J, Gruen D, et al. Considerations for AI fairness for people with disabilities. AI Matters. 2019; 5:40–63.
- [19]. Nelson R, Staggers N. Health informatics: An interprofessional approach. Elsevier Health Sciences; 2013 Jun 14.

- [20]. Martin-Sanchez F, Iakovidis I, Nørager S, Maojo V, de Groen P, Van der Lei J, Jones T, Abraham-Fuchs K, Apweiler R, Babic A, Baud R. Synergy between medical informatics and bioinformatics: facilitating genomic medicine for future health care. *Journal of biomedical informatics*. 2004 Feb 1;37(1):30-42.
- [21]. Tiase VL, Carroll WM. Nursing informatics today and future perspectives for healthcare. *InHealth Informatics* 2022 Jul 29 (pp. 231-241). Productivity Press.
- [22]. Banjo O. Bridging Traditional and Modern Health Systems: The Role of Digital Health in Traditional Medicine Integration in Nigeria. *medRxiv*. 2025:2025-04.
- [23]. Lee KH, Kim MG, Lee JH, Lee J, Cho I, Choi M, Han HW, Park M. Empowering healthcare through comprehensive informatics education: the status and future of biomedical and health informatics education. *Healthcare Informatics Research*. 2024 Apr 30; 30(2):113-26.
- [24]. Snyder CF, Wu AW, Miller RS, Jensen RE, Bantug ET, Wolff AC. The role of informatics in promoting patient-centered care. *The Cancer Journal*. 2011 Jul 1; 17(4):211-8.
- [25]. Berg M. Health information management: integrating information technology in health care work. Psychology Press; 2004.
- [26]. Lund BD, Wang T. Chatting about ChatGPT: How may AI and GPT impact academia and libraries? *Library Hi Tech News*. 2023. <https://doi.org/10.1108/LHTN-01-2023-0009>
- [27]. Rexhepi H. *BRIDGING THE INFORMATION GAP: Supporting Evidence-Based Medicine and Shared Decision-Making through Information Systems* (Doctoral dissertation, BrandFactory AB).
- [28]. Holmes, E. A., O'Connor, R. C., Perry, V. H., Tracey, I., Wessely, S., Arseneault, L., ... & Bullmore, E. (2020). Multidisciplinary research priorities for the COVID-19 pandemic: a call for action for mental health science. *The Lancet Psychiatry*, 7(6), 547-560.
- [29]. Koch S, Hägglund M. Health informatics and the delivery of care to older people. *Maturitas*. 2009 Jul 20; 63(3):195-9.
- [30]. Thompson TG, Brailer DJ. The decade of health information technology: delivering consumer-centric and information-rich health care. Washington, DC: US Department of Health and Human Services. 2004 Jul 21.
- [31]. Soyege OS, Nwokedi CN, Tomoh BO, Mustapha AY, Mbata AO, Balogun OD, Forkuo AY,

Iguma DR. Health informatics in developing countries: Challenges and opportunities.

- [32]. Yasnoff WA, O'Carroll PW, Koo D, Linkins RW, Kilbourne EM. Public health informatics: improving and transforming public health in the information age. *Journal of Public Health Management and Practice*. 2000 Jan 1; 6(6):67-75.
- [33]. Sood S, Mbarika V, Jugoo S, et al. What is telemedicine? A collection of 104 peerreviewed perspectives and theoretical underpinnings. *Telemed J E Health*. 2007; 13:573-590. doi:10.1089/tmj.2006.0073
- [34]. Petersen A. Digital health and technological promise: A sociological inquiry. Routledge; 2018 Nov 21.
- [35]. Gu D, Li T, Wang X, Yang X, Yu Z. Visualizing the intellectual structure and evolution of electronic health and telemedicine research. *International journal of medical informatics*. 2019 Oct 1; 130:103947.
- [36]. Damaj IW, Iraqi Y, Mouftah HT. Modern development technologies and health informatics: Area transformation and future trends. *IEEE Internet of Things Magazine*. 2020 Nov 17; 3(4):88-94.
- [37]. Cummins N, Schuller BW. Five crucial challenges in digital health. *Frontiers in digital health*. 2020 Dec 8; 2:536203.
- [38]. Claes S, Berckmans D, Geris L, Germeys I, Van Audenhove C, Van Diest I, Van Hoof C, Van Hoyweghen I, Van Huffel S, Vrieze E. Mobile health revolution in healthcare: Are we ready?.
- [39]. Yathiraju N, Mohapatra A. The Implications of IoT in the Modern Healthcare Industry post COVID-19. *International Journal of Smart Sensor and Adhoc Network*. 2023 Jan;3(4).
- [40]. Naithani K, Tiwari S, Chauhan AS, Wadawadagi RS. Smart health revolution. *Big Data Analytics and Intelligent Applications for Smart and Secure Healthcare Services*. 2025 Feb 26:129.
- [41]. Sittig S, Iyengar MS, Florez-Arango JF, Chaudhry BM. Creating, Sustaining, and Evaluating Personalized Digital Health Systems. In *2024 IEEE International Conference on Big Data (BigData)* 2024 Dec 15 (pp. 5884-5890). IEEE.
- [42]. Gray K. Climate change, human health, and health informatics: a new view of connected and

- sustainable digital health. *Frontiers in Digital Health*. 2022 Mar 15; 4:869721.
- [43]. Kim J. Big data, health informatics, and the future of cardiovascular medicine. *Journal of the American College of Cardiology*. 2017 Feb 21; 69(7):899-902.
- [44]. Blazona B, Koncar M. HL7 and DICOM based integration of radiology departments with healthcare enterprise information systems. *International journal of medical informatics*. 2007 Dec 1;76:S425-32.
- [45]. Embi PJ, Payne PR. Clinical research informatics: challenges, opportunities and definition for an emerging domain. *Journal of the American Medical Informatics Association*. 2009 May 1; 16(3):316-27.
- [46]. Remes O, Brayne C, Van Der Linde R, Lafortune L. A systematic review of reviews on the prevalence of anxiety disorders in adult populations. *Brain Behav*. 2016; 6(7):e00497
- [47]. Chiang Y-M, Chang Y. Stress, depression, and intention to leave among nurses in different medical units: Implications for healthcare management/nursing practice. *Health Policy*. 2012; 108(2–3):149–57.
- [48]. Maharaj S, Lees T, Lal S. Prevalence and risk factors of depression, anxiety, and stress in a cohort of Australian nurses. *Int J Environ Res Public Health*. 2019; 16(1):61.
- [49]. Brandford AA, Reed DB. Depression in registered nurses: a state of the science. *Workplace Health Saf*. 2016; 64(10):488–511.
- [50]. Yathiraju N, Mohapatra A. The Implications of IoT in the Modern Healthcare Industry post COVID-19. *International Journal of Smart Sensor and Adhoc Network*. 2023 Jan; 3(4).
- [51]. Zeb S, Lodhi SK. AI and Cybersecurity in Smart Manufacturing: Protecting Industrial Systems. *American Journal of Artificial Intelligence and Computing*. 2025 Apr 7; 1(1):1-23.
- [52]. Alzyoud M, Hunitie MF, Alka'awneh SM, Samara EI, Salameh WE, Haija AA, Al-shanableh N, Mohammad AA, Al-Momani AA, Mohammad SI. Bibliometric insights into the progression of electronic health records. In *Intelligence-Driven Circular Economy: Regeneration Towards Sustainability and Social Responsibility—Volume 2* 2025 Jan 21 (pp. 49-62). Cham: Springer Nature Switzerland.
- [53]. Puyol-Antón E, Ruijsink B, Mariscal Harana J, Piechnik SK, Neubauer S, Petersen SE, et al. Fairness in cardiac magnetic resonance imaging: assessing sex and racial bias in deep learning-based segmentation. *Front Cardiovasc Med*. 2022; 9:859310.

- [54]. Tang L, Li J, Fantus S. Medical artificial intelligence ethics: a systematic review of empirical studies. *Digit Health*. 2023; 9:20552076231186064
- [55]. Straw I. The automation of bias in medical artificial intelligence (AI): decoding the past to create a better future. *Artif Intell Med*. 2020; 110:101965.
- [56]. Bragazzi NL, Khamisy-Farah R, Converti M. Ensuring equitable, inclusive and meaningful gender identity- and sexual orientation-related data collection in the healthcare sector: insights from a critical, pragmatic systematic review of the literature. *Int Rev Psychiatry*. 2022; 34:282–91.
- [57]. Alreshidi MS, Alharbi SH, Alotaibi NM. Bridging Gaps between Pharmacy, Nursing, and Laboratory Sciences: A Multidisciplinary Approach. *International journal of health sciences*.; 6(S10):2120-32.
- [58]. Pagoto S, Nebeker C. How scientists can take the lead in establishing ethical practices for social media research. *Journal of the American medical informatics association*. 2019 Apr; 26(4):311-3.
- [59]. Safran C, Bloomrosen M, Hammond WE, Labkoff S, Markel-Fox S, Tang PC, Detmer DE. Toward a national framework for the secondary use of health data: an American Medical Informatics Association White Paper. *Journal of the American Medical Informatics Association*. 2007 Jan 1; 14(1):1-9.
- [60]. Pramanik PK, Solanki A, Debnath A, Nayyar A, El-Sappagh S, Kwak KS. Advancing modern healthcare with nanotechnology, nanobiosensors, and internet of nano things: Taxonomies, applications, architecture, and challenges. *Ieee Access*. 2020 Apr 3; 8:65230-66.
- [61]. Iqbal, J. D., & Biller-Andorno, N. (2022). The regulatory gap in digital health and alternative pathways to bridge it. *Health Policy and Technology*, 11(3), 100663
- [62]. Jayaraman, P. P., Forkan, A. R. M., Morshed, A., Haghighi, P. D., & Kang, Y. B. (2020). Healthcare 4.0: A review of frontiers in digital health. *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery*, 10(2), e1350.
- [63]. Efthymiou E. Integrating digital and narrative medicine in modern healthcare: a systematic review. *Medical education online*. 2025 Dec 31; 30(1):2475979.
- [64]. Jindasook, C. (2021). Exploring drivers and barriers towards utilizing telepharmacy among pharmacists in Bangkok.
- [65]. Kavanagh, O. N., Courtenay, A., Khan, F., & Lowry, D. (2022). Providing pharmaceutical care remotely through medicines delivery services in community pharmacy. *Exploratory Research in Clinical and Social Pharmacy*, 8, 100187

- [66]. Chiasson M, Reddy M, Kaplan B, and Davidson E. Expanding multi-disciplinary approaches to healthcare information technologies: what does information systems offer medical informatics? *International journal of medical informatics*. 2007 Jun 1; 76:S89-97.
- [67]. Shah GH, Khurshid A, Chopak-Foss J. Assessing and addressing health inequities and disparities: The role of health informatics. *Frontiers in Public Health*. 2023 Mar 21; 11:1161892.
- [68]. Alharbi HS, Alhumaydhan MM, Al-Otaibi FS, Al-Mahna SA, Alqirit NS, Alboti NS, Alshubramy SA, Alzafiri NE, Alshammari MH, Alshammari AF, Alshammari RA. A Comprehensive Review of Technology in Nursing: Bridging Care and Innovation. *Journal of International Crisis and Risk Communication Research*. 2024;7(S9):1822.
- [69]. Abbasi N, Nizamullah FN, Zeb S. Ai in healthcare: Using cutting-edge technologies to revolutionize vaccine development and distribution. *JURIHUM: Jurnal Inovasi dan Humaniora*. 2023 Jun 14; 1(1):17-29.
- [70]. Wilson GM, Obasanya M. Principles of Health Informatics. In *Nursing Informatics: A Health Informatics, Interprofessional and Global Perspective* 2022 Jul 26 (pp. 15-38). Cham: Springer International Publishing.
- [71]. E. Jeong, N. Park, Y. Choi, R.W. Park, D. Yoon, Machine learning model combining features from algorithms with different analytical methodologies to detect laboratory-event-related adverse drug reaction signals, *PLoS. One* 13 (2018) e0207749.
- [72]. Zeb S, Nizamullah FN, Abbasi N, Qayyum MU. Transforming Healthcare: Artificial Intelligence's Place in Contemporary Medicine. *BULLET: Jurnal Multidisiplin Ilmu*. 2024; 3(4):592385.
- [73]. Ianculescu M, Alexandru A. Silver digital patient, a new emerging stakeholder in current healthcare. *ProActiveAgeing: a case study. Studies in Informatics and Control*. 2016 Dec 1; 25(4):461-8.
- [74]. Kisekka V, Giboney JS. The Effectiveness of Health Care Information Technologies: Evaluation of Trust, Security Beliefs, and Privacy as Determinants of Health Care Outcomes. *J Med Internet Res*. 2018; 20(4):e107. Published 2018 Apr 11. doi:10.2196/jmir.9014
- [75]. Kaye R, Kokia E, Shalev V, Idar D, Chinitz D. Barriers and success factors in health information technology: A practitioner's perspective. *Journal of Management & Marketing in Healthcare*. 2010 Jun 1;3(2):163-75.

- [76]. Nizamullah FN, Zeb S, Abbasi N, Qayyum MU, Fahad M. AI in Healthcare: Breaking New Ground in the Management and Treatment of Cancer. Asian Journal of Engineering, Social and Health. 2024 Oct 18; 3(10):2325-43.
- [77]. Chakilam C. Leveraging AI, ML, and Big Data for Precision Patient Care in Modern Healthcare Systems. European Journal of Analytics and Artificial Intelligence (EJAAI) p-ISSN 3050-9556 en e-ISSN 3050-9564. 2024 Dec 10; 2(1).
- [78]. Melnick ER, West CP, Nath B, et al. The association between perceived electronic health record usability and professional burnout among US nurses. J Am Med Inform Assoc. 2021; 28(8):1632-1641. doi:10.1093/jamia/ocab059
- [79]. Karaferis D, Balaska D, Pollalis Y. Digitalization and Artificial Intelligence as Motivators for Healthcare Professionals. Japan J Res. 2025;6(3):103. doi: 10.33425/2690-8077.1170
- [80]. Ansari B. ADVANCES IN TELEMEDICINE: BRIDGING TECHNOLOGY AND HEALTHCARE. Journal of Health, Medical Research and Innovations. 2023 Dec 31; 1(4):194-203.
- [81]. Umayal KM. Strategic Integration of Digital Health Technologies for Enhanced Patient-Centered Care in Modern Healthcare Management. Management. 2024; 11(S1):68-73.
- [82]. Wable PM, Bhargavi G, Kishore GB, Sathish K, Reuben GV. Leveraging Artificial Intelligence for Predictive Health Diagnostics: Innovations, Applications, and Ethical Considerations in Modern Healthcare. Library of Progress-Library Science, Information Technology & Computer. 2024 Jul 15;44(3).
- [83]. Ohalet NC, Ayo-Farai O, Onwumere C, Maduka CP, Olorunsogo TO. Functional data analysis in health informatics: A comparative review of developments and applications in the USA and Africa. World Journal of Advanced Research and Reviews. 2024; 21(1):1097-114.