

Research Article

Enhancement of Patient Engagement and Healthcare Delivery Through the Utilization of Artificial Intelligence (AI) Technologies

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Abstract

Background: Patient engagement refers to the active involvement of individuals in their own treatment, decision-making, and partnering with healthcare providers. Due to the progress of Artificial Intelligence (AI), there is a groundbreaking shift happening in healthcare that is bringing numerous benefits to patients and health systems. AI technologies are not only used as instruments in healthcare but also evolving into collaborators for diagnosing and treating patients, as well as enhancing the quality of services, offering a personalized, timely, and interactive healthcare experience. This article delves into how AI is changing patient engagement by increasing effectiveness and catering to individual patient requirements.

Methods: The research made use of previously published materials on artificial intelligence, data, and robotic technologies in healthcare settings to explore ways in which patients can be effectively involved in the advancement of these technologies in healthcare settings.

Results: AI-powered decision support systems improve healthcare operations by giving instant access to data analysis and medical advice, ultimately aiding in making decisions based on real-time evidence. AI enables proactive healthcare interventions by detecting potential health issues in real time, allowing for remote patient monitoring. Motivating patients to actively participate can result in improved adherence to the treatment plan. Overall, patient engagement appears to be the most well-developed and progressive concept for enabling patients to participate actively in their healthcare.

Conclusions: AI technologies are more than just tools in healthcare; they are evolving into collaborators in patient involvement, providing a personalized, proactive and engaging healthcare journey. Further evidence is required to comprehend how patients engage in the process and if this leads to better quality of care. In the dynamic health sector, change management is essential for continuously updating and adjusting healthcare facilities to address the evolving needs of patients. Health systems that do not adjust to changes in a timely manner are unsuccessful.

Keywords: Artificial intelligence; Healthcare 4.0; Personalized Medicine; Patient Engagement; Health Outcomes; Quality of Care; European Union

Background

The emergence of Healthcare 4.0 has introduced a fresh era, where technologies such as Artificial Intelligence (AI), robotic technologies, the Internet of Medical Things (IoMT) and data analytics are seamlessly integrated to explore their combined joint effect on digitalization and innovation in healthcare. This collaboration enables increased automation, predictive maintenance, teamwork among robots, better quality control, and enhanced supply chain operations, leading to smarter decision-making and improved efficiency and flexibility. The seamless integration of AI, robotics, data analytics, and IoMT introduces innovative approaches for human-robot collaboration, telehealth, mobile health, eHealth, quality assurance, and more efficient healthcare services that tailor treatments to individual patient characteristics. The introduction of Healthcare 4.0

specifically helps shift from a focus on hospitals to a focus on patients, combining various departments, roles, and duties to improve patient healthcare results [1-3]. Figure 1 shows the key features of the shift employing technologies for automating and improving processes from Healthcare 1.0 to Healthcare 4.0.

In reality, the main goal of Healthcare 4.0 is to offer excellent patient care, increase patient satisfaction, have a user-friendly interface, make early predictions, support healthcare quality, enhance clinical results, manage expenses, and prioritize patient-centered care. It includes the implementation of processing abilities for managing data and provides the freedom to retrieve information from anywhere. Figure 2 illustrates the key pillars of a healthcare system that need to be transformed from Healthcare 1.0 to 4.0.

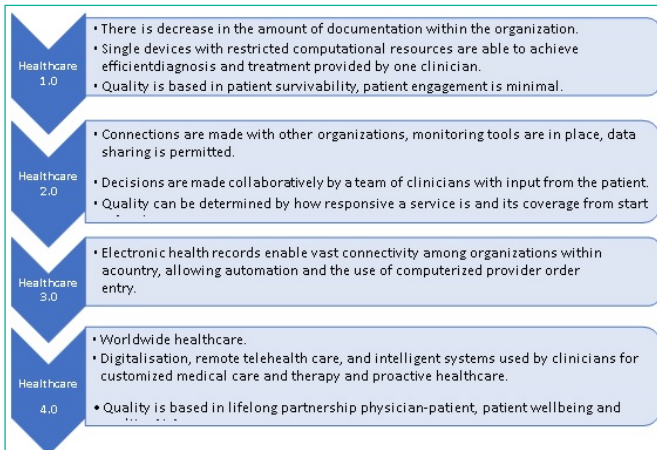


Figure 1: Key features of transition of Healthcare 1.0 to 4.0.

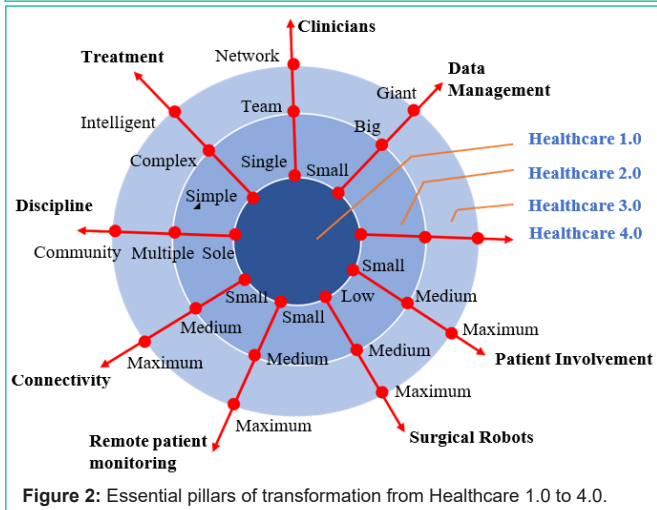


Figure 2: Essential pillars of transformation from Healthcare 1.0 to 4.0.

The eight pillars form the foundation of Healthcare 4.0, each of them playing a crucial role, more specifically:

- **Data management,** these data include personal information such as lab results, vital statistics, medical history and any other health-related information (clinical, electronic, and wearable) about patients. Data security and privacy are paramount in the healthcare sector, as safeguarding confidential patient data is crucial [4-6].
- **Clinicians,** their professionalism, the need for continued learning, training and education to stay ahead of changes, effective communication and relationship skills ensures that healthcare providers are equipped with the essential keys to deliver high- quality and up-to-date care and build a successful relationship with patients. Modern clinicians understand that their participation in global networks and research collaborations makes them more efficient and leads to positive outcomes [7,8].
- **Treatment,** is of utmost importance within a healthcare system, can include medicine, therapy, surgery, or other approaches to remediate a health problem. Although medical care targets physical conditions, emotional support and easing of anxieties frequently act as invisible pillars in healthcare. This principle emphasizes the significance of mental health, guaranteeing patients are emotionally as well as physically at ease [9].

- **Discipline,** this includes conducting frequent risk evaluations, establishing strong reporting mechanisms for adverse incidents, and adhering to safety procedures. Ensuring patient safety and preventing errors requires having a culture that prioritizes transparency and accountability [10].

- **Connectivity,** is the cornerstone of modern healthcare, where the integration of systems, data, and stakeholders is essential. By fostering seamless communication between various components of a healthcare system, ensures that healthcare organizations can efficiently manage their operations while staying agile in an ever-changing environment [7].

- **Remote Patient Monitoring (RPM),** enables patients to use mobile medical devices and technology to gather patient-generated health data (PGHD) and send it to healthcare professionals. Common physiological data collected from RPM programs consists of vital signs, weight, blood pressure, and heart rate. Once collected, patient data is sent to a physician's office using a specific telehealth technology that can be accessed through a computer, smartphone, or tablet. Remote patient monitoring is commonly used for patients who require chronic, post-hospitalization, or elderly care. By linking remote monitoring with high-risk patients, healthcare organizations can be alerted of potential health issues or monitor patient data in between visits [11].

- **Surgical robots,** using high-definition 3D visualization and tiny instruments, surgical robots allow surgeons to navigate through intricate anatomical structures with precise accuracy, receiving real-time alerts and guidance, which leads to reduced damage to surrounding tissues, less blood loss, and shorter hospital stays. Moreover, robotic surgery is promoting equal access to specialized medical care by removing geographical barriers, ensuring that all patients can access quality treatment [12].

- **Nevertheless,** while data, clinicians, treatment, discipline, remote patient monitoring, surgical robots and connectivity are fundamental pillars in operation of a health system, it is widely agreed that patient involvement plays the most vital role in patient well-being and is a key indicator of future health results. Healthcare researchers spend a lot of time and effort creating patient engagement strategies because it has been proven to enhance patient adherence and compliance with clinical protocols [13,14]. The focus of this research is to explore the factors that influence patients' involvement in healthcare and the use of artificial intelligence; the challenges in integrating patient engagement into regular healthcare practice; and methods to improve patient engagement. Understanding the elements that impact patient engagement is essential to enhance the utilization of AI in healthcare support through improved development and implementation.

Methods

Purpose of the Study

This article's purpose is to explain the advantages of progress in artificial intelligence and robotic technologies, big data, data analytics, and the Internet of Things (IoT) in patient involvement and adherence. At present, there is a shortage of conceptual frameworks that address patient involvement with these technologies. Thus, the purpose of this

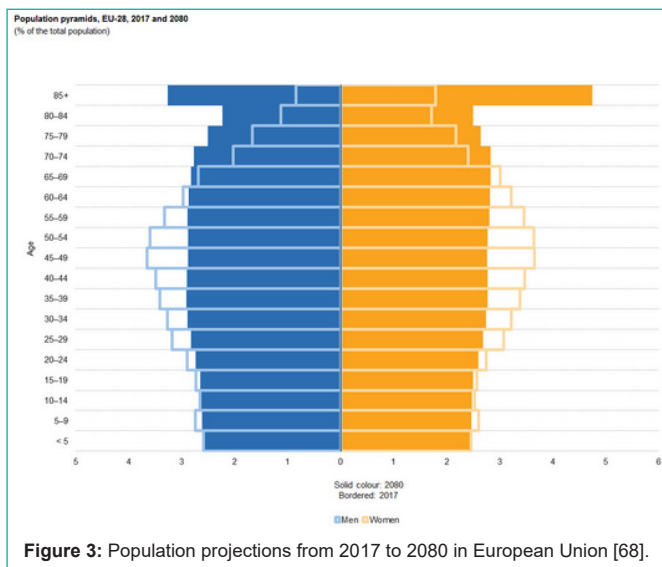


Figure 3: Population projections from 2017 to 2080 in European Union [68].

paper is to lay the groundwork for a conceptual framework to be used in upcoming studies.

Material and Analysis

The research made use of information from sources on AI, data analytics, IoT, and robotics in patient engagement and compliance. The validation and qualification of the publications' methodologies were determined by how closely they corresponded with the subject matter. The review of literature used certain databases and digital journals, among other sources: Scopus, PubMed, Elsevier Direct, Medline, EBSCO, CINAHL, PsycINFO and Web of Science. Sources of information were found through keyword-based searches in such databases, online repositories and digital libraries, while considering the publication date, author and the article type. The literature chosen consisted of research articles deemed important for addressing the research inquiries raised in this study.

Results

The Importance of Patient Engagement in Healthcare Delivery

Patient engagement involves actively engaging patients in the management of their own health. It includes an array of actions and behaviors that enable patients to engage in their own medical care, guaranteeing they get the appropriate treatment tailored to their individual traits, requirements, desires, and circumstances. Involved patients are well-informed and enthusiastic about obtaining information, engaging in collaborative decision-making, embracing healthy habits, collaborating with healthcare providers, ultimately resulting in enhanced clinical results and patient contentment [13-15]. Conversely, non-compliance occurs when a patient does not follow a prescribed treatment plan or adhere to recommended medications.

In the past twenty years, there has been a rise in collaborative methods that prioritize 'patient care'. For instance, Shared Decision-Making (SDM) involves including patients in care decisions, whereas self-management and patient education strategies focus on improving patients' knowledge and skills to enable them to have more control over their care [16]. Recently, the concept of 'partnership in care'

which introduced with model of Healthcare 4.0 has viewed patients as equal members of healthcare teams. This innovative approach integrates aspects from various care methods, including taking into account patient preferences and needs during care provision, engaging patients in decision-making, collaboratively devising a care plan, and empowering patients to manage their own care [2]. Previous research focusing on patients as collaborators found that care partnership involves patients taking proactive steps to connect their expectations with their actual healthcare consultation experience [17]. Engaging patients in care is essential for reaching the best possible health results. Patients who take an active role are more likely to adhere to treatment regimens, participate in preventative health measures, and maintain a healthy lifestyle. Successful involvement of patients can result in enhanced patient contentment, decreased hospital return visits, and improved overall health results. It includes giving patients the knowledge, abilities, and assurance to participate actively in their healthcare [14].

Advantages of AI in Patient Engagement and Healthcare Delivery

The healthcare sector has experienced a significant change due to recent advancements in AI technology. These AI technology solutions are especially advantageous for encouraging self-management due to their simplicity, low cost, 24/7 support, and valuable information and instructions. These situations resulted in the use of AI to enhance patient involvement and reinforce the doctor-patient bond, more specifically [18]:

Enhances accessibility to health information, as the use of AI technologies allows patients to have greater knowledge about their healthcare situation and treatment choices than ever before. Self-service portals, virtual assistants and chatbots offer 24/7 guidance and support, can work autonomously to answer common questions via a live chat on a website or even answer incoming phone calls and help direct callers to the appropriate department, exemplify AI patient engagement effectively. Additionally, there are artificial intelligence-powered applications available for medical advice allowing individuals to access information (not for emergencies), receive recommendations for healthcare providers or future steps in their treatment based on the analysis of their medical background and health information [19-21].

Improves personalization of care, although AI may appear detached at first, AI systems actually examine extensive patient data such as medical histories, genetic information, in order to offer personalized health advice and treatment strategies. Understanding a person's social determinants of health (SDoH) can influence their health and attitude towards healthcare based on the environment they interact with daily, including where they live, work, and play, impacting engagement. For instance, inquiring about their level of education can assist healthcare providers in gauging their patient's literacy abilities and adjusting the language in subsequent communications. Asking about a patient's cultural or religious beliefs can help healthcare providers suggest a treatment plan that matches the individual's personal choices. This constant, personalized interaction fosters a deeper patient involvement in their own health journey [22-25] Create personalized communication, as AI technology is a valuable language tool that allows providers to better connect with patients through written communications delivered through various channels like text

message, portals, and hard copy post- appointment plans. This degree of personalization can greatly enhance the patient's involvement in their healthcare, making sure that the advice provided is pertinent and practical for the individual. Moreover, many researchers highlight the significance of ChatGPT's capacity to grasp and interact in various languages, as well as comprehend the cultural nuances related to healthcare and technology. Additionally, research indicates that utilizing applications and internet platforms that enable patients to communicate with healthcare providers can increase engagement rates by over 60% [22,26-30].

Improves predictive analytics, tailored risk assessments for specific diseases using familial background, genetic and biomarker analysis, social factors, and recent lifestyle changes following consultations with healthcare providers. Utilizing artificial intelligence for predictive analysis in the healthcare sector can enhance patient results and reduce expenses. Predictive analytics uses statistical models and machine learning algorithms to analyze data from Electronic Health Records (EHRs), claims data, and other sources in order to predict future health outcomes. AI plays a crucial role in the healthcare industry by efficiently utilizing predictive analytics to classify potential risks. Risk stratification involves identifying individuals with an increased likelihood of developing a specific disease and providing them with tailored treatments. AI has the ability to identify individuals who are at a significant risk of developing illnesses such as diabetes, heart disease, or cancer and provide customized solutions like altering their diet, keeping track of their medication, or undergoing screenings [31-33].

Enhanced Diagnosis and Treatment, medical imaging is essential for identifying and treating various diseases such as cancer, heart disease, and eye problems. AI has the ability to improve the accuracy and efficiency of medical image evaluation by automatically detecting and examining images. The utilization of deep learning algorithms, which employ neural networks to analyze large quantities of data, shows great potential when used for examining images in medical imaging as a form of artificial intelligence. These algorithms can identify patterns in medical images and forecast the existence of illness or damage. These algorithms are capable of precisely examining CT and MRI scans to identify tumors and detect additional signs of cancer. AI algorithms have been utilized for analyzing retinal images with high precision in detecting eye conditions such as diabetic retinopathy and glaucoma [26,34-36].

Reducing Healthcare Disparities, AI-powered telemedicine platforms are surpassing challenges related to geographic distance by expanding patients' access to virtual medical appointments and services. This is particularly advantageous for patients facing mobility challenges, residing in underserved or rural areas, contributing to leveling the playing field in healthcare. Additionally, AI's ability to understand and process multiple languages enhances its effectiveness in serving different populations, leading to more patients receiving easily comprehensible care. This is another example of AI advancement, perhaps paradoxically, improving personalized healthcare in areas with limited access [37-40]. Improves Education of patients, AI tools play a vital role in equipping patients with information on their health concerns and possible treatments. These systems have the capability to streamline intricate medical information, aiding patients

in comprehending it more effectively and enabling them to make educated choices regarding their healthcare. AI's advanced processing allows for uncovering potential in overlooked data sets through sophisticated analysis [41,42]. Establishing trust, satisfaction and the continuity of care. When patients actively participate in their health, they tend to make improved decisions for their overall well-being in the long run. They are more prone to noticing symptoms of sickness and disease early on and will seek treatment preemptively to prevent complications. Patients show increased trust and satisfaction with their healthcare system as a consequence. Moreover, ongoing support is a successful approach to helping patients adopt preventative health measures. Consistent care is essential for high- risk patients with chronic conditions in order to significantly reduce health complications and medical costs for all individuals. Furthermore, it provides a great opportunity to increase patient numbers by offering additional services such as screenings, wellness checks, and promoted services to generate extra income [14,18,43-45].

Improves data aggregation, as healthcare apps collect, save, analyze and handle vast amounts of data in one place, it is able to condense the information and extract crucial insights that are essential for a provider to be aware of. This leads to better care by utilizing IoT and real-time RPM, enabling providers to efficiently grasp all aspects of their patients' needs for delivering timely services [46,47].

- Enhances the organization of personal health information, scheduling, and follow- up care by providing apps that allow individuals to retrieve data at their convenience and have the potential to improve a patient's overall health results. AI technology enables patients to control their health data and complete tasks such as booking their own appointments. Specifically, machine learning and workflow engines are being utilized more and more to aid in complex interventions and healthcare services.

- Studies have shown that using timely messaging and customized content to encourage specific actions shows potential as an effective strategy. Additionally, AI technology has the capability to assist patients in completing registration forms online, leading to quicker admissions and avoiding office delays caused by paperwork. Additionally, some applications have been granted the capability to monitor the patient's progress and provide reminders for medication adherence. Patients who are not engaged do not follow post-treatment instructions, which increases the chance of being readmitted. Aftercare is crucial for every patient's treatment; however, it is regrettable when over 40% of patients misinterpret, disregard, or opt not to adhere to aftercare guidance. If the instructions for post- treatment care are difficult or demand significant adjustments to one's daily routine, up to two-thirds of individuals may not follow them. Failure to follow post-treatment guidelines can result in negative health results, the need for hospital readmission, and potentially fatal consequences [22,48-50].

- Enable patients to connect with peers who share similar health objectives in order to work towards achieving those goals, such as through a platform for setting and tracking goals, as well as offering support and motivation. Encouraging patients to actively participate in managing their fitness, nutrition, activity, and health connects well-being to the medical field [51,52].

- Improves democratizing of healthcare, typically, individuals go to hospitals or medical centers so that healthcare professionals can use their knowledge, training, and hands-on experience to diagnose and treat illnesses. The belief is that patients have a lack of education and are unable to communicate about their illness. Shared decision making revolutionizes healthcare by increasing its democratic nature. Shared decision making does not involve a clinician making all decisions in a dictatorial way, but rather it puts the patient on an equal footing with the clinician. They work together to determine necessary tests, treatment options, and the patient's ultimate care plan. Shared decision-making requires more time because it involves a significant dedication to informing the patient. However, engaging the patient in their own healthcare improves patient involvement and significantly increases patient contentment [53-56].

- Healthcare Providers (HCPs) can more effectively document their notes using the technical language they are trained in and most comfortable with, enabling the AI to then translate it into simpler language tailored to the patient's individual needs. Newer iterations of generative AI, like ChatGPT, are now being employed in different healthcare applications, such as streamlining lengthy tasks like summarizing, writing notes, and creating reports, resulting in time-saving and improved efficiency. It assists patients in checking symptoms, scheduling appointments, and managing medications, encouraging patient adherence and education, as well as the self-management of chronic conditions. This not only increases the efficiency of the physician, but also improves the overall quality and empathy of the end product received by the patient [57,58].

- Improves administrative tasks, as the process of coding, charting, billing, and invoicing requires meticulous attention, the use of AI frees up time for healthcare employees to devote to other crucial responsibilities. Around 25% of the time a nurse spends in a hospital is currently dedicated to administrative duties rather than patient care. Inputting patient data into Electronic Medical Records (EMRs) is a part of the charting process. Using Natural Language Processing, AI has the ability to automatically examine patient information and create chart notes, which improves precision and completeness of medical records and also reduces time consumption. Utilizing tools for generating charts can be advantageous for analyzing data from structured and unstructured sources like lab results and written observations. Moreover, typing mistakes and accidental key presses can lead to significant delays in the coding and billing process, ultimately hindering effectiveness. As a result, AI can handle daily tasks and data management, enabling healthcare staff to concentrate on patient care, potentially enhancing the personal bond in their role, increasing efficiency and precision, and reducing wait times [59-61].

Considerations on Patient Engagement Powered by Artificial Intelligence

Despite initial success of AI technologies in enhancing patient engagement, there remains an amount of skepticism and challenges from patients regarding AI. The significance of human touch in healthcare is essential for physician-patient relationship. AI is currently unable to fully replicate empathy, non-verbal cues, voice intonation, eye contact, physical space, and human understanding which are crucial in healthcare delivery. Trust and reassurance from patients are crucial, especially in sensitive situations or when addressing complex

emotional and ethical dilemmas. While conversational AI may appear thoughtful and sympathetic, it ultimately cannot truly empathize like humans do because it does not possess genuine emotions. The evaluation of the importance of this for patients is still in progress. Another obstacle faced is ensuring data privacy in healthcare systems that utilize AI, requiring careful handling of patient data sensitivity, leading to concerns about security and privacy. For these reasons, patients and their families need to agree to their data being used and it must be stripped of identifying information to protect their privacy. Ensuring the safety and effectiveness of AI applications for clinical use is also difficult due to meeting stringent regulatory requirements. Issues related to ethics and morality, like prejudice and unfair treatment in AI algorithms, present difficulties in their implementation, necessitating thorough scrutiny and ongoing verification to prevent harm to individuals. Not unusual, healthcare decisions involve ethical dilemmas that require personal judgment [26,62- 66].

Discussion

Around the world, there is a trend moving away from the traditional physician- patient dynamic as physicians now work together with patients towards healing, as research in medicine has demonstrated that a robust connection between the physician and the patient enhances the effectiveness of the medical treatment provided [67]. With healthcare expanding to include more than just patient care, it is crucial for leaders to focus on promoting positive mental attitudes and preventing preventable diseases. In the EU, the average life expectancy has greatly improved in the last sixty years, going up from 69 years in 1960 to 80.1 years in 2021. Further, Eurostat's population projections show an increase in the percentage of people aged 80+ from 5.5% to 12.7%, with those aged 65+ totaling 29.1% of the EU's population by 2080 (Figure 3). The old- age dependency ratio is projected to rise to 52.3% [68]. This drastic change requires us to shift our views on aging, our relationships across age groups, our communication with diverse healthy aging communities, our adaptations to personal and communal environments, and our shared learning opportunities.

Additionally, there is a growing number of people have multiple chronic illnesses, with chronic diseases being responsible for around two-thirds of global deaths. This rise is challenging, given that individuals with long-term multiple health conditions require intricate care that can be hard and costly to provide. Chronic conditions and patients with multiple health issues need effective management at the primary care level and personalized care to support their independence and maintain a high quality of life [69-72]. Additionally, more and more patients in various categories, including post- operative individuals and those with disabilities, are opting for home-based treatment over hospital care due to concerns about contracting infections in medical settings. This trend is expected to shift the current hospital-centered healthcare system towards a home-based model in the near future, according to experts. This was especially evident during the Covid-19 outbreak, which highlighted the significance of patients being able to retrieve their health data, reliable online medical assistance, analyzing large amounts of data digitally, identifying patterns, and forecasting the virus's spread [73-75]. In the same context, over the last decade, there has been a surge in migration to the European Union, especially

in southern countries, resulting in a higher prevalence of illnesses and diseases that were once eliminated. This has put pressure on healthcare systems and caused a lack of healthcare workers, especially physicians [76]. Smart Healthcare Monitoring (SHM) systems benefit patients by providing remote monitoring, continuous real-time data for better disease management, timely treatment, and reducing errors. As such, this system overcomes geographical barriers by tracking patients from a distance, and also cuts down on healthcare expenses [77]. Individuals utilize ubiquitous smartphones, applications (apps), portals, and other self-service tools not only for communication but also as powerful tools for monitoring health and telemedicine tailored to their needs. The increase in popularity of health apps and health tracking software is in part due to people's increasing fascination with wearable devices and new apps that empower and motivate patients to take more control of their healthcare. Thus, numerous applications heavily depend on social networking and communal interactions, enabling users to continually monitor their actions and measure themselves against their friends, relatives, and the wider community. In addition, the trend of healthcare consumerization has led to a new type of patients who behave more like consumers, advocating for their needs and selecting providers that can fulfill them. Patients are increasingly viewing healthcare services as consumer products, rather than purely medical services, this means that they expect the same level of convenience, service, and personalization that they experience in other aspects of their lives. Consequently, patients are increasingly interested in being involved in medical decision-making and desire to have access to their health records [78-81].

Patients can get ready for a future where remote monitoring is common, allowing continuous health surveillance and early issue detection, reducing the need for medical facilities. In order to improve the implementation and effective utilization of AI in healthcare services and interactions with patients, health systems must explore strategies to overcome obstacles and address any worries patients may have. Regrettably, numerous healthcare organizations use a uniform strategy for patient engagement, sending identical messages through the same channels to all patients with a specific health condition or care requirement. While this approach might work for certain individuals, it may not resonate with other patients who have varying motives, priorities, willingness to change, and communication styles. Customizing patient involvement for each person will confirm that their voice is recognized and their specific requirements are addressed. Although there is no definitive proof on the best strategies to involve patients, studies show that strategies for engaging patients in safer care can be classified into three main categories: a) receiving efficient access to healthcare information and feedback in either retrospective or real-time. Successful and significant involvement begins with empowering patients and healthcare providers.

Patients should possess adequate knowledge concerning their health status and healthcare procedures in order to become well-informed participants in decision-making. Therefore, healthcare providers and policymakers must guarantee that patients and their families can obtain precise, suitable, and current information and comprehend how to utilize it. Patient-held documents can assist in encouraging and empowering patients. b) educating patients and healthcare providers on safe healthcare. Evidence indicates that healthcare providers may exert influence during consultations by

utilizing professional language or technical terminology, which can impede effective communication. The way providers view a patient affects how they communicate during consultations, with better communicators often experiencing more patient-centered care. Therefore, it is crucial to focus on educating providers on attitudes and behavior in order to enhance shared decision-making and the patient-provider relationship, and c) involving patients in system or service enhancements. Further investigation is needed to determine the most effective way to integrate best attributes and how patients can utilize data effectively to enhance results. Informatics and human factors researchers must collaborate with health vendors, healthcare providers, and their data to understand how patients utilize health IT tools and improve their influence on patient care for advancement. This evidence is crucial for increasing value for patients, clinicians, and healthcare organizations, as well as for driving progress [42, 82-85].

Conclusion

AI-powered patient interaction marks a pivotal moment in healthcare delivery. Through personalized care, enhanced medical decision-making, and effective resource allocation, this technological breakthrough has the ability to transform the manner in which patients receive treatment. The use of AI technology in patient engagement has the potential to revolutionize healthcare facilities by providing functions like remote monitoring, personalized treatment plans, and improved patient results. In order to fully take advantage of AI in healthcare, it is crucial for all stakeholders to prioritize patient well-being, privacy, and transparency during this evolving landscape. The healthcare sector needs to collaborate with tech experts, lawmakers, and ethicists to meet the needs and address issues critical to patients. Certainly, these technological developments will influence the future of the healthcare sector, offering a customized system that meets specific needs and is guided by data.

Author Statements

Declaration of Interest

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Conflict of Interest

Each author declares that he or she has no commercial associations (e.g., consultancies, stock ownership, equity interest, patent/licensing arrangement etc.) that might pose a conflict of interest in connection with the submitted article.

Author's Contribution

Dimitris Karaferis is the first author of this manuscript. All authors were involved in all steps for preparation of this article, including final proofreading and gave final approval of the version to be published.

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