ARTIFICIAL INTELLIGENCE CHATBOTS AND VIRTUAL ASSISTANTS IN HEALTHCARE: A COMPREHENSIVE LITERATURE REVIEW

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ABSTRACT

Artificial intelligence (AI) technologies have been widely utilized to improve the efficiency of healthcare institutions. This comprehensive literature review explores the evolution, applications, benefits, and challenges of AI driven virtual assistants and chatbots across clinical and administrative contexts. The study identifies different virtual assistant functions, including diagnostic and clinical decision support, virtual monitoring and adherence, virtual nursing, therapeutic and psychological support, and educational and administrative functions. Each plays a key role in improving healthcare services accuracy, adherence, and workflow while reducing clinical workload. However, major challenges regarding data privacy, trust, digital literacy, cost, and regulatory issues are hindering the application of such technologies.

Keywords: Artificial Intelligence, Chatbots, Virtual Assistants, Healthcare Technology

ÖZET

Yapay zekâ (YZ) teknolojileri, sağlık kurumlarının verimliliğini artırmak amacıyla yaygın bir biçimde kullanılmaktadır. Bu kapsamlı literatür taraması, klinik ve idari bağlamlarda YZ tabanlı sanal asistanlar ve sohbet botlarının evrimini, uygulamalarını, faydalarını ve karşılaşılan zorlukları incelemektedir. Çalışma, tanısal ve klinik karar destek, sanal izleme ve tedaviye uyum, sanal hemşirelik, terapötik ve psikolojik destek ile eğitsel ve idari işlevler olmak üzere çeşitli sanal asistan işlevlerini tanımlamaktadır. Bu işlevlerin her biri, sağlık hizmetlerinde doğruluğu, uyumu ve iş akışını geliştirirken klinisyenlerin iş yükünü azaltmada önemli bir rol oynamaktadır. Ancak veri gizliliği, güven, dijital okuryazarlık, maliyet ve düzenleyici engellerle ilgili önemli sorunlar, bu teknolojilerin yaygın olarak uygulanmasını sınırlamaktadır.

Anahtar Kelimeler: Yapay Zekâ, Sohbet Botları, Sanal Asistanlar, Sağlık Teknolojisi

1. INTRODUCTION

According to The Business Research Company, the global healthcare services market was valued at approximately $8.536 trillion in 2024. It was projected to reach $8.948 trillion in 2025, and is expected to be around $10.759 trillion by 2029. In reference to the AI in healthcare market analysis done by Grand View Research, the global market for AI in healthcare (software/hardware/services) was valued at roughly US $26.57 billion in 2024. According to PwC Strategy&, AI technologies currently represent less than 1% of the global healthcare market, but could influence over 30% of healthcare-related activities by 2030 (PwC Strategy&, 2023). Therefore, understanding how to efficiently and safely utilize AI technologies, including artificial assistants and chatbots, holds vital importance in the health sector.

Despite growing interest, the literature remains fragmented: studies often examine virtual assistants within narrow use cases (e.g., symptom checking or administrative triage) and provide limited cross-domain synthesis of what functions these systems perform, what benefits they reliably deliver, and what risks constrain real-world adoption. This fragmentation makes it difficult for healthcare managers, clinicians, and policymakers to compare applications, identify implementation priorities, and establish governance requirements.

Therefore, the aim of this comprehensive literature review is to summarize the evolution of AI-enabled chatbots and virtual assistants in healthcare, propose a structured categorization of their key functions across clinical and administrative contexts, synthesize evidence on benefits for efficiency, care continuity, and patient engagement, and highlight major challenges, particularly privacy, trust, digital literacy, cost, and regulation, while outlining practical recommendations for responsible integration.

2. EVOLUTION OF AI IN HEALTHCARE

The term Artificial Intelligence in the healthcare domain was first introduced in a conference proposal in 1955 at Dartmouth College. Yet, it was not until the early 1970s that the first AI applications were realized in the sector of medicine in the form of the expert system called MYCIN, whose intention was the diagnosis and treatment of blood infections. Since this pioneering project, there has been an increased interest in AI research, which eventually led to the creation of the American Association for Artificial Intelligence in the year 1979. In subsequent years, rapid technological advances revolutionized healthcare by expediting data collection and analysis, improving surgical precision, deepening diagnostic and biological assessments, and enhancing the integration of electronic health records (EHRs) for improved clinical decision-making (Chavali, 2024).

Early efforts to incorporate AI into established healthcare systems have faced persistent challenges, primarily stemming from ethical and practical concerns. These include difficulties in managing complex patient needs, reduced human interaction, issues of data privacy and response accuracy, limited accessibility for certain user groups, and the risk of excluding vulnerable populations (Kraaijeveld et al., 2025). Nevertheless, AI technologies have demonstrated notable success in specialized domains, particularly in medical image analysis, where their accuracy and efficiency have significantly enhanced diagnostic capabilities (Li et al., 2024). By 2025, an increasing number of healthcare institutions had adopted artificial intelligence technologies, directing significant investments toward radiology to support the

automated interpretation of medical imaging such as X-rays and MRI scans (Lawrence et al., 2025).

3. OVERVIEW AND TYPES OF PATIENT SUPPORT VIRTUAL ASSISTANTS

The rapid advancement of Artificial intelligence (AI) technologies are offering transformative potential within the healthcare sector to make services more personalized, efficient, and accessible. Among these innovations are virtual health assistants which are defined as AI-powered digital agents designed to support both patients and healthcare providers. These systems integrate hybrid AI architectures with natural language processing (NLP), machine learning (ML), and data analytics to provide customized health information, track patient conditions, and enhance communication between patients and medical professionals (Munjal et al., 2025). Virtual assistants appear in various forms, including chatbots, voice assistants, mobile health (mHealth) applications, and monitoring and adherence devices, all of which contribute to improving patient engagement, continuity of care, and health outcomes.

As highlighted across various literature sources, patient support virtual assistants can be broadly categorized into the following types: informational or administrative virtual assistants, diagnostic and clinical decision support assistants, virtual nursing or caregiving assistants, monitoring and adherence assistants, and empathetic and behavioral support assistants.

3.1. Informational and Administrative Virtual Assistants

Informational and administrative virtual assistants (VAs), commonly referred to as Virtual Health Assistants (VHAs), are artificial intelligence–driven digital tools designed to interact with patients through text, voice, or avatar-based communication. Using natural language processing (NLP) and machine learning (ML) technologies, these systems emulate human conversation and provide real-time, context-sensitive assistance in managing informational and administrative healthcare tasks. The primary aim of informational and administrative virtual assistants is to improve access, efficiency, and responsiveness within healthcare systems by automating routine, non-clinical operations. Acting as digital intermediaries between patients and healthcare providers, they reduce administrative workload, allowing clinical staff to devote more time to patient care (Nelson et al., 2025).

According to Nelson and his colleagues review, in practice, informational and administrative VAs serve to streamline communication and operational workflows across healthcare settings. Their key applications include:

- Appointment management: Automating booking, rescheduling, and reminder systems to minimise missed visits and administrative strain.
- Service navigation: Assisting patients in navigating hospitals, insurance procedures, and service options.
- Prescription management: Handling medication refill requests and delivering dosage reminders to improve adherence.
- Pre- and post-visit communication: Providing tailored instructions before appointments and follow-up information after discharge to ensure continuity of care.
- Administrative assistance: Addressing frequently asked questions, billing queries, and online portal support, thereby allowing staff to prioritise more complex patient needs.

3.2. Diagnostic and Clinical Decision Support Assistants

Diagnostic virtual assistants or as known as Symptom-checker bots are defined as automated tools that provide diagnosis or medical advice based on symptoms entered by the user. These normally use a series of questions and algorithms to suggest possible conditions or recommend seeking medical attention (Gilbert et al., 2020).

Symptom Checker Robots incorporate consumer-facing input, enabling patients to input their symptoms via a chat interface or a form. These robots automatically triage by gauging the intensity of the symptoms and recommending relevant activities, including self-care, consulting a physician, or visiting an emergency room. In most cases, robots are utilized 24/7 access via the web or mobile platforms which makes them highly accessible. Both technologies often run on data-driven algorithms such as decision trees or AI systems trained on large numbers of medical datasets and clinical guidelines. While none of the examined digital tools outperform general physicians, several had a high degree of diagnostic accuracy. Further system development and clinical validation may enable several of these tools to become key components in healthcare delivery, especially considering the utilities demonstrated during the COVID-19 pandemic (Gilbert et al., 2020).

"Neyim Var" application from Turkiye could well be considered one such example of a Symptom Checker Bot: it allows the user to input their symptoms and give them possible diagnoses or recommendations on what kind of medical care to seek. Like other symptom checker systems, it uses a structured question flow to assess user input and guide decision-making.

3.3. Virtual Nursing or Caregiving Assistants

AI virtual nurses are digital, computer-based entities created to replicate the functions of human nurses by interacting with patients via text or voice-enabled technologies. These systems are employed in various healthcare tasks, including monitoring patient health, issuing reminders for medication and lifestyle-related activities such as physical exercise and meditation, supporting individuals with chronic conditions, offering psychosocial support, and managing appointment scheduling. The principal objectives of virtual nurses are to enhance patient engagement, improve health outcomes, and alleviate the workload of healthcare professionals by delivering continuous, personalized care (Chavali, 2024).

LEO360 robotic platform developed by ACIBADEM Hospital in Turkiye enables remote physicians to access patients and nurses in real-time through high-definition video and audio. Nurses can perform bedside diagnostic tests and transmit results instantly, significantly reducing delays in care. This led to fewer patient transfers to the main hospital and improved clinical efficiency. In a pilot study, the time needed for a physician to assess a patient depended only on how quickly the robot was moved into the room, saving valuable time. The system streamlined rounds and reduced complications by enabling rapid, virtual bedside presence.

3.4. Monitoring and Adherence Assistants

The Internet of Things (IoT) in healthcare refers to connected devices that gather and share data in real time, improving patient monitoring and health management. Wearable technologies, a core part of IoT, track health metrics from physical activity to vital signs, enabling a shift from reactive to proactive care (Olabiyi and Urus, 2025).

The integration of Artificial Intelligence (AI) and the Internet of Things (IoT) within healthcare delivery provides considerable potential for enhancing service quality, accessibility, and operational efficiency. Remote monitoring systems powered by IoT enable the continuous collection of real-time patient data, facilitating timely intervention and more effective management of chronic diseases. When combined with AI-based virtual health assistants, these technologies support interactive and individualized care. Through the application of machine learning, such systems are able to process extensive health datasets to extract insights, anticipate health developments, and assist in informed clinical decisions. Additionally, Natural Language Processing (NLP) capabilities improve communication by enabling virtual assistants to respond to patient queries with both precision and empathy (Kalusivalingam et al., 2021).

3.5. Empathetic and Behavioral Support Assistants

According to a 2025 study by the Harvard Business Review, the most prevalent applications of generative artificial intelligence (GenAI) have shifted toward emotional and social support contexts, particularly in therapy and companionship (Zao-Sanders, 2025).

4. BENEFITS OF AI-POWERED VIRTUAL MEDICAL ASSISTANTS

4.1. Enhancing Operational Efficiency and Reducing Costs

Artificial intelligence (AI) is significantly reshaping healthcare operations by automating many administrative and financial processes that traditionally consume clinicians' time. Tasks such as scheduling, billing, and record management are of, cited as leading contributors to physician burnout, are increasingly handled by Virtual Medical Assistants (VMAs) (Budd, 2023). By streamlining these functions, AI reduces clerical workload, enhances workflow efficiency, and allows healthcare professionals to dedicate more attention to patient care.

Financially, the healthcare industry faces growing costs, reduced reimbursements, and tightening profit margins (American Hospital Association, 2025). From a financial standpoint, generative AI has introduced major improvements in Health Revenue Cycle Management (RCM). It automates critical processes such as data entry, patient documentation, and compliance verification while supporting fraud detection and procurement activities. These intelligent systems minimize coding errors, ensure regulatory compliance, and apply predictive analytics to anticipate financial risks and optimize reimbursement strategies. Overall, AI-driven automation enables healthcare institutions to lower operational costs, improve administrative accuracy, and achieve a more sustainable balance between efficiency and patient-centered service delivery (Bhuyan et al., 2025).

4.2. Strengthening Clinical Decision Support and Data Utilization

Electronic systems used for medication management and prescription refills generate valuable data that support informed, data-driven decisions. By analyzing adherence patterns, trends, and the impact of interventions, healthcare providers can enhance the efficiency and quality of medication-related processes, ultimately improving patient outcomes. Strengthening these systems also increases patient satisfaction, promotes safety, and streamlines service delivery, contributing to more effective and patient-centered care (Akinyele, 2024).

AI-driven medical assistants have become pivotal in advancing clinical efficiency by optimizing documentation, diagnostic accuracy, and decision-making processes. Speech-to-text systems such as Nuance's Dragon Medical and Google's Medical AI employ natural

language processing (NLP) to convert clinicians' verbal inputs into structured medical records, substantially reducing transcription errors and cognitive workload, with studies showing up to a 40% reduction in documentation time. Furthermore, AI platforms like IBM Watson Health integrate and analyze patient data from multiple sources, including clinical notes, laboratory results, and medical imaging, to validate diagnoses and identify potential discrepancies, yielding approximately a 25% improvement in diagnostic precision. Beyond diagnostics, AI-enhanced electronic health records (EHRs) elevate patient safety by issuing real-time alerts for drug interactions, missing data, and unaddressed risk factors, contributing to an estimated 30% decrease in medication-related errors and supporting more reliable, data-informed clinical decision-making (Batista, 2025).

4.3. Promoting Patient Engagement and Communication

AI-powered **Virtual Medical Assistants (VMAs)** enhance patient engagement by improving accessibility, personalization, and communication in healthcare (**Kumar, 2025**). Their key contributions include:

- **Efficient communication:** Automate appointment scheduling and provide accurate medical advice, reducing administrative workload and improving responsiveness.
- **Mental health support:** Deliver cognitive behavioral therapy, emotional regulation, and continuous psychological assistance.
- **Medication and lifestyle adherence:** Send personalized reminders to promote regular medication use and healthy behaviors.
- **User experience:** Improve patient satisfaction through adaptive and user-friendly interfaces that encourage long-term engagement.
- **Crisis readiness:** Maintain continuity of care during pandemics or emergencies through voice and conversational AI tools.
- **Personalized care:** Integrate patient data to deliver inclusive, tailored healthcare services that enhance self-management and overall well-being.

4.4. Advancing Treatment Outcomes and Remote Monitoring

Virtual Medical Assistants (VMAs) play a crucial role in maintaining the continuity of care by monitoring patient adherence, tracking symptoms, and facilitating consistent communication between patients and healthcare providers. Their ability to detect early deviations from treatment plans and alert clinicians allows for timely, personalized interventions that improve health outcomes and care quality.

The integration of AI-driven systems into healthcare delivery has led to measurable advances in accessibility, responsiveness, and treatment personalization. Through real-time consultations and remote monitoring, AI-powered telehealth platforms extend care to underserved regions while easing pressure on emergency departments by virtually triaging non-urgent cases. Moreover, precision medicine tools such as Tempus and IBM Watson for Oncology utilize genomic and clinical data to design individualized treatment strategies, resulting in greater therapeutic accuracy, improved adherence, and enhanced patient outcomes overall (Batista, 2025).

5. CHALLENGES AND RISKS OF VIRTUAL MEDICAL ASSISTANTS

5.1. Data Privacy, Security, and Ethical Governance

The study by Piñeiro-Martín et al. (2023) highlights several critical risks associated with AI-powered virtual assistants, particularly regarding data privacy, security, and ethical governance. The authors emphasize that these systems frequently process sensitive personal information, often without adequate safeguards, exposing users to potential misuse, identity theft, and confidentiality breaches. Ethical concerns also arise from the lack of transparency and accountability in AI decision-making, the absence of dedicated regulatory frameworks, and the persistence of algorithmic bias and discrimination stemming from unbalanced training data. Furthermore, the study warns of the dangers of user overreliance and emotional attachment, as human-like conversational interfaces can create a false sense of trust and autonomy. These findings underscore the urgent need for stronger data governance, bias mitigation, and ethical oversight in the design and deployment of AI-driven virtual assistants.

Beyond regulatory compliance, the ethical use of artificial intelligence in healthcare requires ongoing attention to accuracy, user privacy, transparency, and bias mitigation in both model design and development. Recent findings also highlight the growing challenge posed by the public's ability to customize generative AI models to create health-related tools, which introduces new risks around accountability, safety, and information reliability (Chu et al., 2025).

5.2. Ensuring Trust, Accuracy, and Human Empathy

Both patients and healthcare professionals have expressed ongoing concerns regarding the accuracy, reliability, and ethical integrity of information produced by AI-driven systems. Key ethical challenges involve accountability, transparency, and algorithmic bias, which complicate trust in automated clinical decision-making. The absence of human empathy and emotional nuance further limits the suitability of AI assistants in sensitive healthcare contexts,

such as mental health support or end-of-life care, where compassion and interpersonal understanding are crucial (Chow & Li, 2024).

Moreover, excessive dependence on AI-mediated interactions may risk weakening the patient–clinician relationship, fostering feelings of isolation and diminishing the human connection central to holistic care. Participants in a recent qualitative study observed that virtual assistants often lack authenticity and emotional depth, describing interactions as impersonal and overly standardized. They emphasized that human caregivers are uniquely capable of perceiving subtle non-verbal cues and emotional signals, qualities that remain difficult for AI systems to replicate. While newer models, such as ChatGPT, were viewed as an improvement over earlier non-generative chatbots, users still perceived them as limited substitutes for genuine human interaction, highlighting the need for caution when integrating AI into emotionally sensitive domains of healthcare (Kraaijeveld et al., 2025).

5.3. Bridging Digital Literacy and Accessibility Gaps

Not all individuals possess the digital literacy or technological access required to effectively engage with virtual medical assistants (VMAs). Vulnerable populations—including older adults, low-income groups, and those in rural or underserved regions—often encounter barriers to equitable digital participation, restricting the widespread adoption of these technologies. Research by Kraaijeveld et al. (2025) highlights that such accessibility issues extend beyond infrastructure to encompass communication and cognitive challenges. Participants in their study expressed uncertainty regarding whether virtual assistants could adequately accommodate the diverse needs and abilities of all users. Many reported difficulties in formulating precise questions or interacting with systems that tend to generate brief, overly standardized responses. In contrast to human caregivers, who can interpret subtle cues, redirect conversations, and recognize underlying issues, AI systems lack the nuanced understanding necessary to navigate complex or emotionally sensitive care requests. Consequently, these limitations underscore the risk that digital healthcare tools may unintentionally exclude those most in need of support, reinforcing existing inequities in access to care.

5.4. Navigating Regulatory Compliance and Liability Frameworks

The regulatory approval and standardization of AI-driven chatbots in healthcare present considerable challenges, as these systems evolve faster than current oversight mechanisms can adapt. Regulatory authorities such as the U.S. Food and Drug Administration (FDA), the European Medicines Agency (EMA), and other regional bodies employ rigorous evaluation

processes to ensure the safety, reliability, and clinical efficacy of AI-enabled medical devices. However, these procedures are often lengthy, resource-intensive, and complex, particularly given the pace at which new AI applications are developed (Sun & Zhou, 2023).

The absence of universal regulatory standards and the rapidly advancing nature of generative AI technologies further complicate oversight efforts. While ongoing initiatives seek to modernize regulatory frameworks, significant gaps remain in defining criteria for approval, risk classification, and post-market surveillance. Notably, large language models such as ChatGPT, Gemini, and Claude are typically categorized as informational tools rather than medical devices, exempting them from formal clinical evaluation processes. Nonetheless, as both healthcare professionals and the general public increasingly rely on these systems for medical guidance and administrative support, there is a growing imperative for robust auditing, transparency measures, and proactive safety monitoring to prevent misuse and ensure responsible deployment within healthcare environments (Chu et al., 2025).

6. CONCLUSION AND RECOMMENDATIONS

Artificial intelligence and virtual medical assistants have emerged as a revolutionizing force in the field of medicine and have shown immense promise to enhance efficiency, accuracy, and accessibility. Yet, alongside these developments, there exist pressing concerns and issues associated with ethics, regulations, and implications related to accessibility and trust, particularly with respect to matters such as data security and protection. The incorporation of artificial intelligence into medical processes needs to happen with a multifaceted approach.

To promote responsible use, there arise several crucial recommendations. First, there is a pressing need to formulate universal regulations across nations about the validation, liability, and risk level pertaining to these AI applications within the healthcare sector. Moreover, there is a need to incorporate pre-use and post-use monitoring to identify the level of safety and accuracy of these AI applications. Finally, there is a need to increase research on their social effects on moral foundations, particularly concerning mental illnesses and end-of-life care. Finally, there is a need to make such technologies more inclusive by promoting digital literacy programs.

This review maps how AI-driven chatbots and virtual assistants are being applied across clinical and administrative healthcare tasks and summarizes the benefits and barriers most consistently reported in the literature. Its scientific value lies in organizing a scattered evidence base into a coherent overview that can inform hypothesis generation, evaluation metrics, and responsible implementation. Despite promising signals for improving access,

efficiency, and patient engagement, strong clinical validation and governance frameworks are still limited.

Therefore, further research should move beyond descriptive reports toward controlled clinical studies and well-documented case studies that evaluate safety, effectiveness, equity, and workflow integration. The present review also provides a foundation for a planned case study/pilot, offering a structured starting point for selecting use cases, defining outcomes, and establishing ethical and regulatory safeguards.

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