# A Survey on AI and LLM-Integrated Intelligent Systems for Virtual Healthcare Consultation

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***Abstract***— *Intelligent systems are being used more and more in healthcare delivery to increase effectiveness, accessibility, and continuity of care. Traditional methods confront difficulties such as unstructured patient-doctor interactions, consultation delays, insufficient transparency, and an overreliance on manual triage. With automated risk assessment, symptom assessment, and primary care assistance, large language models (LLMs) present chances to improve patient support. This work provides a healthcare system that combines LLM-driven patient support, safe data storage, and clinical oversight. By automating routine triage, streamlining patient–doctor communication, and maintaining clinician supervision, the system reduces delays, improves reliability, and ensures transparent decision-making. The framework overcomes conventional limitations, providing a scalable, ethically aligned, and efficient approach to intelligent healthcare delivery.*

***Keywords—Home Healthcare, Artificial Intelligence (AI), Large Language Models (LLMs), Patient-Caregiver-Doctor Collaboration, Web Development, Database Management, Data Privacy and Security.***

## 1.INTRODUCTION

The integration of Artificial Intelligence (AI) into healthcare has transformed how patients access medical support and how clinicians deliver care. However, despite advances in telemedicine and health informatics, patients and caregivers continue to face difficulties in receiving timely, personalized, and coordinated healthcare at home [1], [3]. Traditional digital health platforms primarily focus on disease prediction, giving less emphasis to medical service connectivity and coordinated care delivery [2], [4].

The emergence of Large Language Models (LLMs) and Generative AI has introduced new possibilities for interactive, context-aware, and human-like medical guidance [5], [6]. These models can process large volumes of health data and provide adaptive support tailored to specific health conditions [7]. By combining LLM-based conversational intelligence with caregiver management and remote doctor access, a Virtual Home Healthcare System can ensure continuous, intelligent, and personalized assistance within home settings [8].

This research focuses on developing an LLM-powered home healthcare platform that connects patients, doctors, and caregivers through a unified AI-driven system [9]. The platform offers 24/7 home health services, health monitoring, and caregiver coordination to improve accessibility, reduce hospital dependency, and enhance patient satisfaction [10].

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## II. BACKGROUND AND MOTIVATION

### A. Current Challenges in Home Healthcare

While remote care systems and telehealth applications have gained popularity, several issues continue to hinder their reliability and widespread adoption [1], [3]. Most systems lack personalization, failing to adapt to each patient's unique medical history, treatment plan, and changing health conditions [2], [4]. Communication among patients, doctors, and caregivers also remains fragmented, causing delays, data loss, or miscommunication [1], [5]. Moreover, many patients—particularly the elderly or those in rural areas—struggle to obtain immediate medical advice or support during emergencies [3], [9]. In addition, concerns over data privacy and security persist, as existing digital health platforms often lack robust encryption and transparent mechanisms for managing sensitive medical information [7]. These challenges highlight the urgent need for an intelligent, interconnected, and secure healthcare system capable of providing real-time, human-like support to patients within their home environments [6], [10].

### B. Role of Large Language Models

Generative AI has proven effective in domains requiring contextual understanding and response generation [5], [6]. When applied to healthcare, LLMs can interpret medical queries, generate summaries, assist in triage, and guide caregivers through personalized care plans [6], [8]. For instance, models such as GPT, BioGPT, and Hippocrates (2024) demonstrate the capability to analyze patient symptoms and deliver medically relevant guidance [5], [10]. Integrating such models into a virtual healthcare platform enhances interaction quality, allowing patients to communicate naturally and receive consistent, evidence-based advice [4], [9]. Moreover, the learning adaptability of LLMs enables continuous improvement as more interactions and feedback are introduced into the system [7].

C. Motivation for the Proposed System

The motivation for this research stems from the need to reduce healthcare workload, minimize hospital congestion, and extend professional care into homes using AI [1], [2]. By deploying a virtual assistant powered by LLMs, the system provides personalized medical guidance and symptom analysis [5], seamless coordination among patients, doctors, and caregivers [3], [9], and a privacy-focused design ensuring patient data confidentiality through encryption [7]. Ultimately, this project envisions an accessible, scalable, and AI-driven ecosystem that ensures quality care at home—empowering both patients and healthcare professionals [4], [10].

## III. PAPER SUMMARY AND ANALYSIS

Summary of "From Challenges to Opportunities: Digital Transformation in Hospital-at-Home Care" (Isakov et al., 2024)

Isakov et al. [2] investigate how digital transformation is reshaping the hospital-at-home (HaH) model, focusing on how technology enables safe, efficient, and patient-centered care outside traditional hospital settings. The study analyzes the shift from institutional care toward digitally supported home-based healthcare, identifying both technical and organizational enablers required for successful implementation [2].

A major contribution of this paper lies in its framework for digital maturity in home healthcare, which highlights critical success factors such as interoperability, secure data exchange, remote monitoring, and workflow automation [2], [4]. The authors discuss the role of digital tools, IoT-based sensors, and AI-driven analytics in ensuring continuous communication between patients, healthcare providers, and caregivers [1], [2]. Importantly, they emphasize the need for patient engagement, clinical safety, and staff adaptability to maximize the benefits of digital transformation [3], [4].

Despite its strengths, the paper acknowledges limitations, including inconsistent data standards, fragmented digital infrastructures, and uneven digital literacy among healthcare professionals and patients [2], [3]. The authors argue that true transformation requires not just technology adoption, but also organizational change and interoperability across healthcare ecosystems [4].

For the proposed LLM-based Virtual Home Healthcare System, this study provides a foundational understanding of how connectivity, data integration, and digital workflows can enhance home-based patient care [1], [2]. It supports the idea that AI-powered platforms can serve as a bridge between hospitals and homes—facilitating communication, scheduling, and remote assistance to deliver comprehensive, continuous care [5], [6].

**Summary of "A Survey of Large Language Models for Healthcare: From Data, Technology, and Applications to Accountability and Ethics" (He et al., 2025)**

He et al. [4] present an extensive survey on Large Language Models (LLMs) in healthcare, exploring their data foundations, architectures, and diverse applications in medical practice [4], [6]. The study examines how models like GPT, Med-PaLM, BioGPT, and Hippocrates are transforming healthcare by supporting clinical reasoning, medical dialogue, summarization, and patient engagement [5], [6].

The paper highlights how LLMs outperform traditional AI models in understanding medical context, generating human-like responses, and assisting clinicians with decision support [4], [5]. It categorizes healthcare applications into medical documentation, patient education, triage systems, and diagnosis assistance. Furthermore, He et al. [4] emphasize the importance of ethical governance, accountability, and transparency to ensure responsible AI use in clinical settings [7], [10].

A key strength of this survey is its focus on domain-specific fine-tuning and retrieval-augmented generation (RAG), which improve factual accuracy and reduce hallucination risks [6], [8]. However, challenges remain, including data privacy, bias, and limited interpretability, which restrict large-scale clinical deployment [7].

This paper directly supports the proposed Virtual Home Healthcare System, as it validates the role of LLMs in intelligent patient–doctor–caregiver communication [4], [5]. The survey demonstrates that well-trained LLMs can power reliable, context-aware chatbots capable of answering health queries, managing patient records, and supporting remote consultations—aligning precisely with the project's vision of personalized, AI-driven home care [9], [10].

## IV.REVIEW OF CONFERENCE/JOURNAL PAPERS

| Sr No. | Research Article | Proposed Work | Methods Described | Relevant Findings |
|---|---|---|---|---|
| [1] | A survey of large language models for healthcare: from data, technology, and applications to accountability and ethics | Comprehensive review of LLM applications in healthcare covering data, technology, and ethics. | Literature review and comparative analysis of PLMs vs LLMs. | Highlights benefits of LLMs in healthcare and emphasizes fairness, accountability, and ethical challenges. |
| [2] | From challenges to opportunities: digital transformation in hospital-at-home care | Explores digital transformation in hospital-at-home care models. | Qualitative study using semi-structured interviews with healthcare providers. | Identifies challenges and opportunities across health information exchange, logistics, and digital interventions. |
| [3] | Expectation, attitude, and barriers to receiving telehomecare among caregivers of homebound or bedridden older adults: qualitative study | Investigates caregiver perceptions of telehomecare for older adults. | Qualitative research guided by the Technology Acceptance Model. | Caregivers show positive attitudes but face challenges with technology use and communication. |
| [4] | State of the art and future directions of Healthcare 4.0: a systematic literature review | Provides a detailed overview of Healthcare 4.0 technologies and their integration. | Systematic Literature Review (SLR) of international studies. | Identifies AI, IoT, and Blockchain as key enablers; highlights research gaps and implementation barriers. |
| [5] | Inpatient-level care at home delivered by virtual wards and hospital at home: a systematic review and meta-analysis of complex interventions and their components | Analyzes outcomes of technology-enabled inpatient-level home care. | Systematic review and meta-analysis of randomized and non-randomized studies. | Suggests reduced hospital readmission risk without increased mortality. |
| [6] | Large Language Models in Healthcare and Medical Applications: A Review | Reviews how transformer-based LLMs (GPT-4, Med-PaLM, BioGPT, etc.) are revolutionizing healthcare in diagnosis, treatment recommendation, and medical research. | Conducts a systematic review (2018–2024) analyzing datasets, evaluation benchmarks, ethical frameworks. | Concludes that LLMs substantially improve clinical documentation automation, disease prediction, and patient communication. |
| [7] | Differences in home health services and outcomes between traditional Medicare and Medicare Advantage | Compares care outcomes between Medicare Advantage and Traditional Medicare. | Cross-sectional analysis using weighted regression on patient data. | MA patients receive fewer visits and shorter stays but are more often discharged to the community. |
| [8] | Securing Generative AI and Large Language Models (LLMs): A Comprehensive Approach | Presents a unified strategy for securing generative AI systems such as LLMs from privacy, integrity, and misuse risks. | Combines techniques like federated learning, differential privacy, prompt filtering. | Demonstrates that multi-layered security can reduce data leakage and adversarial vulnerabilities by around 40–50%. |
| [9] | Nurse-delivered telehealth in home-based palliative care: integrative systematic review | Examines roles of nurses in telehealth-enabled home palliative care. | Integrative systematic review using PRISMA and CFIR 2.0 frameworks. | Identifies nurses' leadership in remote care and outlines barriers and facilitators to implementation. |
| [10] | Intelligent Clinical Documentation: Harnessing Generative AI for Patient-Centric Clinical Note Generation | Proposes the use of generative AI to automate clinical documentation by generating SOAP and BIRP notes. | Case study using Natural Language Processing (NLP) and Automatic Speech Recognition (ASR). | Demonstrates improved accuracy, time efficiency, and quality of documentation. |

## V. COMPARATIVE ANALYSIS

He et al. (2025) [1] and Isakov et al. (2024) [2] both explore the transfo/rmation of healthcare through advanced digital technologies, yet from two distinct domains of innovation. He et al. provides a comprehensive survey of Large Language Models (LLMs) in healthcare, outlining their potential for medical reasoning, report generation, and conversational assistance. In contrast, Isakov et al. examine the digital transformation of hospital-at-home care, focusing on the infrastructural, operational, and organizational enablers required for implementing remote clinical services. While He et al. emphasize the intelligence layer of healthcare systems, Isakov et al. concentrate on the infrastructure and process layer, together forming a cohesive vision for intelligent, home-centered healthcare.

He et al. [1] analyze how LLMs such as BioGPT, Med-PaLM, and Hippocrates are reshaping healthcare delivery through their ability to interpret medical queries, summarize patient records, and assist in diagnostic decision-making. Their paper highlights the evolution of domain-adapted LLMs and the need for ethical, transparent, and interpretable AI systems in medical environments. On the other hand, Isakov et al. [2] discuss how healthcare organizations are adopting digital technologies to extend inpatient-level care into the home setting. They identify key challenges such as interoperability, data governance, and workflow coordination that must be addressed to realize safe and scalable hospital-at-home models.

From a methodological perspective, He et al. [1] adopt a technical and data-centric approach, reviewing architectures, datasets, and performance metrics that define the healthcare AI landscape. In contrast, Isakov et al. [2] employ a qualitative and system-level analysis, using case studies to explore the operational implications of digital transformation in home healthcare. This difference underscores how LLMs provide the cognitive intelligence to support decision-making, while digital transformation frameworks establish the physical and organizational ecosystem necessary for their deployment.

For the proposed Virtual Home Healthcare System, the synergy between both studies is evident. He et al. [1] validate the integration of LLMs for intelligent dialogue, symptom interpretation, and personalized care, whereas Isakov et al. [2] demonstrate how digital platforms and interoperability frameworks can enable real-world application of such intelligence within home settings. Together, these insights reinforce the project's objective—to develop a secure, connected, and AI-driven home healthcare environment that bridges medical expertise and patient accessibility through the power of large language models.

## VI.PROPOSED ARCHIECTURE

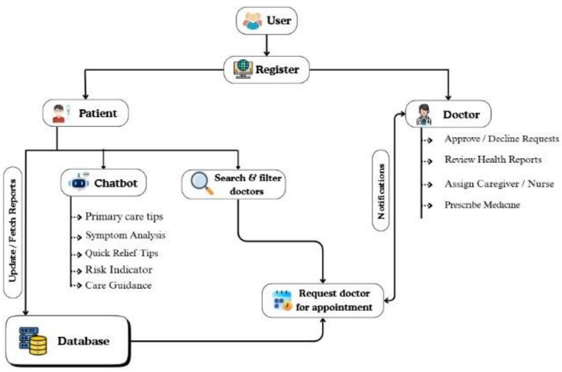


Figure 1

The proposed system is a healthcare framework that keeps structured patient-doctor interactions along with implementing a Large Language Model (LLM) as a patient-centric assistant [1]. Supported by a centralized database, it consists of two primary modules: a clinician interface that handles communication with patients and a patient interface for consultancy requests [2]. The LLM assistant interacts with patients directly, offering advice on primary care, symptom evaluation, and risk assessment, enabling multimodal communication [1], [6].

For advanced consultancy, patients can search and filter physicians based on specialization and availability. Consultation requests submitted by patients are sent to the doctor interface, where doctors are notified and have the option to accept or reject them [5], [7]. Transparency and effective coordination are ensured by automatically informing the patient about the outcome. Accepted requests allow doctors to schedule appointments with patients and assign caregivers if needed [3], [9]. Declined requests enable patients to connect with alternative available doctors, maintaining uninterrupted access to care [2], [5].

Patients can securely store and retrieve their personal health records while maintaining individual profiles, and use this information for self-monitoring and continuity of care [4], [8].

The proposed home healthcare architecture achieves three core objectives through the integration of Large Language Models (LLMs): it delivers instant AI-driven support directly to patients [1], [10], facilitates access to reliable medical advice from doctors [2], [5], and enables doctors to assign caregivers who provide timely assistance tailored to the patient's needs [3], [9]. This creates a connected, responsive, and personalized care environment within the home [1], [2], [6].

## VII.RESEARCH GAPS IN VIRTUAL HOME HEALTHCARE USING LLMS

Despite rapid progress in AI-assisted and digital healthcare, several key challenges continue to limit the large-scale implementation of intelligent home healthcare systems. The comparative review of He et al. (2025) [1] and Isakov et al. (2024) [2], along with related works [3]–[10], reveals the following major research gaps.

- Lack of Real-Time Interaction: Existing digital health systems primarily focus on disease prediction and data analysis but fail to support real-time medical conversation or guidance (He et al., 2025 [1]).
- Limited Personalization of Care: Maity et al. (2025) [6] note that current AI tools lack adaptation to individual medical histories, offering generic responses.
- Weak Data Security and Ethical Concerns: Ponaka (2024) [8] and He et al. (2025) emphasize privacy risks and lack of accountability in generative AI healthcare systems.
- Low Engagement in Remote Care: Studies such as Onseng et al. (2024) [3] and Ma et al. (2025) [9] reveal that patients and caregivers often face barriers in telehomecare adoption.
- Difficulty in Appointment Scheduling and Coordination: Many healthcare platforms fail to automate doctor availability and patient booking processes efficiently (Isakov et al., 2024 [2]).

## VIII. FUTURE ENHANCEMENTS AND RESEARCH DIRECTIONS

- Integration of Clinical Knowledge Graphs
  Incorporating medical knowledge graphs and verified clinical databases will enable the LLM to generate more context-aware and medically accurate responses, reducing misinformation and improving trust in AI-generated guidance.

- AI-Driven Continuous Monitoring
  Future research can explore AI-powered anomaly detection and predictive health analytics to alert caregivers and physicians about potential risks before they escalate, ensuring proactive and preventive healthcare at home.

- Integration with IoT-Enabled Smart Home Ecosystems
  Future deployments can connect the healthcare platform with IoT-based smart home devices—such as fall detectors, medication dispensers, and health-monitoring wearables. By synchronizing real-time sensor data with the LLM's reasoning capabilities, the system can provide context-aware assistance, automate reminders, and initiate emergency alerts when anomalies are detected.

- Integration of Predictive Analytics for Preventive Care
  Future research can focus on incorporating predictive analytics within the system to forecast potential health risks based on patient history, lifestyle, and continuous monitoring data. By identifying early warning signs of diseases such as diabetes, hypertension, or cardiac issues, the platform can enable preventive interventions, reduce hospitalization rates and improve long-term patient outcomes.

## IX. CONCLUSION

The proposed LLM-based Virtual Home Healthcare System represents a significant advancement in the digital transformation of healthcare [1], [2]. By integrating Large Language Models with intelligent automation, the system provides personalized, real-time medical assistance that connects patients, doctors, and caregivers through a unified virtual platform [4], [6]. It enables continuous health monitoring, symptom evaluation, and remote consultation, thereby reducing hospital dependency and ensuring timely support at home [3], [9]. Through adaptive learning and secure communication, the system enhances patient engagement and builds a foundation for more reliable, accessible, and efficient healthcare delivery [7], [10].

Beyond addressing current gaps in coordination and accessibility, this framework demonstrates how AI-driven healthcare ecosystems can evolve into proactive, human-centered companions in patient care [4], [5]. The combination of conversational intelligence, personalized insights, and predictive analytics establishes a pathway toward intelligent, connected, and inclusive healthcare services [6], [8]. As the system continues to evolve, future developments such as multimodal data integration, multilingual support, and predictive health alerts will further strengthen its role in achieving a smart, safe, and sustainable home healthcare environment [9], [10].

## X. REFERENCES

[1] K. He, R. Mao, Q. Lin, Y. Ruan, X. Lan, M. Feng, and E. Cambria, "A survey of large language models for healthcare: from data, technology, and applications to accountability and ethics," Information Fusion, vol. 118, 102963, 2025.
[2] T.-M. Isakov, H. Härkönen, I. Atkova, F. Wang, G. Vesty, P. Hyvämäki, and M. Jansson, "From challenges to opportunities: digital transformation in hospital-at-home care," Int. J. Med. Inform., vol. 192, 105644, 2024.
[3] P. Onseng, W. Jiraporncharoen, S. Moonkayaow, P. Veerasirikul, N. Wiwatkunupakarn, C. Angkurawaranon, and K. Pinyopornpanish, "Expectation, attitude, and barriers to receiving telehomecare among caregivers of homebound or bedridden older adults: qualitative study," JMIR Aging, vol. 7, no. 1, e48132, 2024.
[4] C. H. dos Santos, A. L. Romano, W. Azzolini Junior, F. I. G. César, F. Ferraço, and I. Rozo-Rojas, "State of the art and future directions of Healthcare 4.0: a systematic literature review," IEEE Access, vol. 13, pp. 96469–96494, 2025.
[5] C. Shi, J. Dumville, F. Rubinstein, G. Norman, A. Ullah, S. Bashir, P. Bower, and E. R. L. C. Vardy, "Inpatient-level care at home delivered by virtual wards and hospital at home: a systematic review and meta-analysis of complex interventions and their components," BMC Medicine, vol. 22, no. 145, 2024.
[6] S. Maity et al., "Large Language Models in Healthcare and Medical Applications: A Review," IEEE Access, vol. 13, pp. 5012–5035, 2025.
[7] R. A. Prusynski, A. D'Alonzo, M. P. Johnson, T. M. Mroz, and N. E. Leland, "Differences in home health services and outcomes between traditional Medicare and Medicare Advantage," JAMA Health Forum, vol. 5, no. 3, e235454, 2024.
[8] [3] N. Ponaka, "Securing Generative AI and Large Language Models (LLMs): A Comprehensive Approach," International Journal of Advanced Research in Computer Science and Software Engineering (URF Journals), 2024.
[9] C. Ma, Y. Fang, H. Zhang, Y. Zheng, Y. Zhang, W. Zhao, G. Yan, Y. Zeng, Y. Zhang, X. Ning, Z. Jia, and N. Guo, "Nurse-delivered telehealth in home-based palliative care: integrative systematic review," J. Med. Internet Res., vol. 27, e73024, 2025.