The Impact of Artificial Intelligence Large Language Models on Health Management Model Innovation in the Context of Digital Healthcare

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Abstract: This study aims to explore the impact of artificial intelligence large language models (LLMs) on health management model innovation in the context of digital healthcare. The research employs literature analysis and theoretical synthesis to construct a framework illustrating how LLMs influence health management innovation across three dimensions: service model, organizational management, and value chain ecosystem. The findings indicate that LLMs promote personalized and continuous service models through multi-source data integration and intelligent analysis, optimize organizational decision-making and resource allocation, enhance the dynamic capabilities of healthcare institutions, and facilitate cross-institutional collaboration and value co-creation, thereby improving the health management ecosystem. Based on these results, managerial implications are provided, emphasizing the adoption of LLM technologies to drive transformation in health management models. Future research directions include empirical validation, exploration of ethical and data security issues, and analysis of adaptability across different types of healthcare institutions. The study concludes that LLMs not only enhance the intelligence of health management but also provide a theoretical foundation and practical reference for organizational model innovation and health service ecosystem optimization.

Keywords: Digital Healthcare; Artificial Intelligence Large Language Models (LLMs); Health Management; Model Innovation; Management

1. Introduction

The rapid development of digital technologies has led to profound transformations in the healthcare industry. Digital healthcare, characterized by the integration of information technology, data analytics, and intelligent systems, has increasingly become a cornerstone for modern health management [1]. This transformation extends beyond simple digitization of medical records or telemedicine services; it encompasses a comprehensive shift in how healthcare services are delivered, monitored, and managed. Traditional health management models, which largely depend on manual experience and offline follow-up, face multiple limitations. These include low operational efficiency, insufficient personalization of care, uneven resource allocation, and delayed responses to emerging health risks. Consequently, these models are increasingly inadequate in addressing the growing demand for individualized health interventions and the systemic pressures faced by healthcare systems worldwide.

In this context, artificial intelligence (AI) has emerged as a critical enabler of innovation within digital healthcare. Among AI technologies, large language models (LLMs) stand out due to their powerful natural language processing, knowledge reasoning, and multi-source data integration capabilities [2]. LLMs can process and synthesize vast amounts of heterogeneous health data, enabling more precise risk prediction, personalized intervention, and patient engagement strategies. Unlike conventional AI tools, LLMs are capable of generating adaptive and interactive guidance that can emulate human communication patterns, enhancing the continuity and responsiveness of health management services [3].

The integration of LLMs into health management is not merely a technological advancement; it represents a strategic shift that has significant implications for service delivery, organizational practices, and ecosystem governance. Specifically, LLMs offer the potential to optimize care pathways, improve

patient adherence, and facilitate evidence-based decision-making within healthcare institutions. Furthermore, by enabling cross-institutional data sharing and collaboration, LLMs can support the co-creation of value across healthcare networks, thereby enhancing both operational efficiency and patient outcomes.

Despite these promising prospects, there remain critical gaps in understanding how LLMs influence health management model innovation from a managerial perspective. While previous studies have largely focused on the technical capabilities and clinical applications of AI, research on the mechanisms through which LLMs transform service models, organizational processes, and value creation within healthcare ecosystems remains limited. Moreover, issues related to privacy, ethics, and regulatory compliance further complicate the adoption of LLM-driven health management solutions, emphasizing the need for a comprehensive theoretical and practical framework.

Accordingly, this study aims to systematically examine the impact of LLMs on health management model innovation within the context of digital healthcare. It seeks to explore the pathways through which LLMs affect service model, organizational management, and ecosystem-level innovation, analyze the mechanisms by which data intelligence, knowledge empowerment, and organizational learning contribute to health management transformation, and provide actionable insights and theoretical contributions that guide healthcare institutions and digital health platforms in leveraging LLMs for sustainable innovation. By addressing these issues, the study advances the understanding of AI-driven health management innovation and establishes a structured foundation for both empirical research and practical implementation.

2. Literature Review

The development of digital healthcare has fundamentally reshaped the landscape of health management, offering new opportunities for improving service efficiency, personalization, and accessibility. Digital healthcare encompasses a wide range of technologies, including electronic health records, wearable devices, mobile health applications, telemedicine platforms, and cloud-based data analytics systems [4]. These technologies enable real-time collection, integration, and analysis of health data, which in turn supports proactive and continuous health management. As a result, healthcare is gradually shifting from reactive treatment models to preventive, patient-centered approaches that emphasize individualized care and long-term wellness [5].

AI has emerged as a pivotal enabler in this transformation. Existing studies highlight two major areas of AI application in health management. First, health monitoring and risk prediction [6]. Machine learning and deep learning models are employed to analyze multidimensional data, including vital signs, medical histories, and lifestyle factors, to detect early signs of chronic conditions, cardiovascular diseases, and other high-risk health issues. This allows for timely preventive interventions and more effective resource allocation. Second, clinical decision support. AI algorithms can rapidly retrieve, synthesize, and reason across vast datasets and medical literature, offering evidence-based recommendations that enhance the accuracy, efficiency, and consistency of clinical decisions [7].

Despite these advances, traditional AI applications face significant limitations. Many models operate within isolated datasets, creating data silos that impede knowledge transfer across institutions [8]. Furthermore, algorithmic interpretability and transparency are often inadequate, limiting clinical trust and broader adoption [9]. Most models also exhibit limited generalization across different diseases or patient populations, and their integration into organizational workflows remains challenging. These limitations constrain the capacity of conventional AI to fully support comprehensive health management models.

The emergence of large language models (LLMs) represents a potential solution to these challenges. LLMs are trained on massive, multi-domain datasets and possess strong capabilities in natural language understanding, knowledge integration, and reasoning [10]. In health management, LLMs can process heterogeneous clinical and lifestyle data to provide personalized recommendations, facilitate interactive patient engagement, and support decision-making at both individual and organizational levels [11]. Unlike traditional AI, LLMs

exhibit greater adaptability and generalization across various health scenarios, enabling more comprehensive coverage of medical conditions, patient demographics, and service contexts. Additionally, LLMs can dynamically update their knowledge base in response to new data, allowing health management strategies to evolve continuously [12].

While LLMs show substantial promise, current research primarily focuses on their applications in clinical support, medical information processing, and diagnostic tasks, such as medical imaging analysis, electronic health record summarization, and literature mining. There is limited systematic research examining how LLMs drive innovation in health management models, particularly from a managerial perspective. Existing studies often address technical capabilities or case-specific applications without exploring the underlying mechanisms through which LLMs influence service model transformation, organizational processes, and value co-creation across healthcare ecosystems. This gap limits the understanding of the full potential and strategic implications of LLM adoption in health management.

Furthermore, ethical, privacy, and regulatory considerations remain underexplored in current literature. The integration of LLMs in health management requires careful governance to ensure data security, patient confidentiality, and compliance with legal frameworks. These challenges underscore the importance of developing a comprehensive theoretical and managerial framework to guide the deployment of LLMs in health management, ensuring both effectiveness and sustainability.

In summary, the existing literature provides a foundation for understanding AI applications in health management but reveals several critical gaps. Although traditional AI has demonstrated benefits in monitoring, prediction, decision support, and patient engagement, its limitations constrain broader innovation in health management models. LLMs offer enhanced capabilities that could address these limitations, but their potential to transform service models, organizational practices, and healthcare ecosystems has not been systematically examined. This study therefore seeks to fill this gap by analyzing the mechanisms through which LLMs drive innovation in health management models, offering theoretical insights and practical guidance for healthcare institutions and digital health platforms.

3. Theoretical Analysis

In the context of digital healthcare, LLMs represent not only a technological advancement but also a key driver of health management model innovation. To systematically examine this influence, this study adopts the Technology Acceptance Model, Dynamic Capability Theory, and Value Co-creation Theory to construct a conceptual framework illustrating LLMs' impact on health management innovation across service, organizational, and ecosystem dimensions.

3.1 Service Model Innovation

LLMs integrate and analyze multi-source health data to provide personalized and precise health management plans. Unlike traditional models, LLMs generate dynamic intervention recommendations based on patient history and real-time monitoring, while facilitating human-like interactive guidance. This capability enhances service continuity and interactivity, transitioning health management from one-way communication to interactive, full-lifecycle management, thereby driving service model innovation.

3.2 Organizational Management Innovation

LLMs offer data-driven support for decision-making and resource allocation within healthcare institutions. By synthesizing knowledge and reasoning in real time, LLMs assist management in optimizing strategic planning, staff scheduling, clinical pathway design, and operational workflows. Additionally, LLMs enhance organizational learning by rapidly processing medical literature and clinical cases, enabling institutions to shift from experience-driven to data-driven management, and improving dynamic capabilities and adaptability to external environments.

3.3 Value Chain and Ecosystem Innovation

LLMs promote collaboration across institutions and platforms by enabling data sharing and knowledge flow, supporting cross-sector value co-creation. Healthcare providers, insurers, pharmaceutical companies, and digital health platforms can leverage LLMs to develop data-

driven health solutions collaboratively. This cross-boundary integration optimizes overall health management efficiency and generates new business models and collaborative paradigms, fostering a more open and dynamic health service ecosystem.

Overall, the mechanism through which LLMs drive health management model innovation can be conceptualized as data intelligence—knowledge empowerment—organizational learning. At the data intelligence level, LLMs provide information foundations for management and services through multi-dimensional data integration. At the knowledge empowerment level, LLMs translate complex medical knowledge into actionable recommendations, enhancing decision-making and service quality. At the organizational learning level, LLMs facilitate continuous feedback and iterative optimization, enabling dynamic evolution and sustainable innovation.

From a theoretical perspective, LLMs function as catalysts for transforming health management from static, experience-based models toward intelligent, collaborative, and innovation-driven systems. This conceptual framework provides a structured explanation for LLM applications in health management and forms the basis for subsequent empirical research and managerial practice.

4. Conclusion

This study systematically investigates the impact of artificial intelligence large language models (LLMs) on health management model innovation in the context of digital healthcare. The analysis demonstrates that LLMs play a critical role in driving innovation across three dimensions: service model, organizational management, and value chain ecosystem. At the service level, LLMs enable intelligent, personalized, and continuous health management by integrating multi-source data and providing adaptive recommendations. This improves patient experience, enhances intervention effectiveness, and supports proactive health management across the full lifecycle. At the organizational level, LLMs facilitate data-driven decision-making, optimize resource allocation, and enhance workflow efficiency. By processing vast amounts of medical knowledge in real time, LLMs strengthen organizational learning capabilities and dynamic responsiveness, allowing healthcare institutions to shift from experience-driven to evidence-driven management. At the ecosystem level, LLMs promote cross-institutional collaboration and value co-creation, integrating healthcare providers, insurers, pharmaceutical companies, and digital health platforms into a more coordinated and innovative health service ecosystem.

The study provides several managerial implications. First, healthcare institutions should actively leverage LLMs to enhance service personalization and operational efficiency, ensuring that patient-centered, data-driven approaches are embedded in routine practice. Second, organizations need to establish governance mechanisms that ensure the effective integration of LLMs into decision-making, clinical pathways, and resource management, while addressing challenges related to data privacy, ethics, and regulatory compliance. Third, fostering collaboration across healthcare ecosystems can maximize the benefits of LLM applications, supporting collective innovation and sustainable development of health services. These implications highlight the strategic value of LLMs not only as a technological tool but also as a catalyst for organizational and ecosystem-level innovation.

From a theoretical perspective, this study contributes to the literature by integrating digital healthcare, AI large language models, and health management innovation into a coherent framework. It identifies the mechanisms through which LLMs influence service models, organizational processes, and ecosystem-level value creation, providing a structured approach for understanding AI-driven health management transformation. The conceptual framework of data intelligence—knowledge empowerment—organizational learning clarifies the pathways through which LLMs facilitate health management innovation and lays the groundwork for future empirical research.

Future research directions include empirical validation of LLM applications in different healthcare contexts to quantify their impact on patient outcomes, organizational efficiency, and ecosystem collaboration. Moreover, deeper exploration of ethical, privacy, and regulatory issues is essential to ensure safe and responsible deployment of LLMs. Finally, comparative studies across various types of healthcare institutions, regions, and service models could provide insights into the adaptability and

scalability of LLM-driven health management innovations, enabling more tailored and context-specific implementation strategies.

In conclusion, artificial intelligence large language models represent a transformative force in digital healthcare, offering new opportunities to enhance service intelligence, organizational efficiency, and ecosystem collaboration. Their application not only advances the operational and strategic capabilities of healthcare institutions but also provides a theoretical and practical foundation for sustainable innovation in health management. By facilitating personalized, data-driven, and collaborative health services, LLMs are positioned as a key driver of the next-generation health management model.

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