

Research on the Path of Artificial Intelligence-Driven Fine-Grained Hospital Operations

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Abstract: Fine-grained medical operations are a core driver of high-quality hospital development, essentially breaking away from traditional, inefficient management models to achieve precise governance across medical resources, service processes, cost control, and quality supervision. Leveraging the advantages of artificial intelligence—such as data mining, intelligent analysis, and autonomous iteration—hospitals can address issues like low operational efficiency, misallocation of resources, and outdated management practices. This paper explores the relationship between AI and fine-grained hospital operations, analyzing how their respective strengths can be integrated. It examines practical applications and implementation pathways through four dimensions: clinical service refinement, resource allocation optimization, cost control precision, and quality oversight. The study identifies existing challenges in current integration efforts, including inadequate technical compatibility, incomplete data systems, severe talent shortages, and insufficient regulatory frameworks. It discusses solutions and proposes improvement directions to promote public hospitals toward more refined, intelligent, and standardized operations, thereby advancing the healthcare industry to higher standards.

Keywords: Artificial intelligence; Hospital management; Medical services; Refined operations; High-quality development

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1. Introduction

After the new medical reform, the focus of China's healthcare industry has shifted from previous scale expansion to improving quality and efficiency. Fine-grained operations have become an essential path for hospitals to overcome development bottlenecks and enhance core competitiveness. Traditional hospital management models rely heavily on manual experience, resulting in rigid processes, subjective decision-making, and coarse control—limitations that fail to meet today's diverse and high-quality healthcare demands, nor do they enable efficient utilization of medical resources or precise quality management. With the widespread adoption of artificial intelligence (AI) technology, new technical support has emerged to transform hospital operations. By deeply analyzing data across all healthcare scenarios and leveraging intelligent capabilities, hospitals can reconstruct their operational mechanisms and break down barriers among service

delivery, resource allocation, cost control, and quality management. Therefore, this paper primarily explores the application scenarios, existing challenges, and improvement measures when AI is integrated with fine-grained hospital operations, aiming to help hospitals establish a modern, intelligent, refined, and sustainable operational system.

2. Main application areas of artificial intelligence in the fine-grained operation of hospital healthcare

2.1. Precision clinical services to reshape the patient care system

Clinical services constitute a core component of hospital operations and represent a key area for fine-grained management. Traditional clinical service processes are cumbersome, suffer from imbalanced doctor-patient ratios, and exhibit significant homogenization, failing to meet diverse patient needs. With the integration of artificial intelligence across the entire process, clinical services have achieved greater precision, personalization, and efficiency.

In pre-hospital care, intelligent triage and appointment systems use patient symptoms, disease categories, and department-specific diagnostic characteristics to automatically assign patients to appropriate departments and schedule appointments. This eliminates human error in triage, optimizes patient flow, and alleviates outpatient congestion. AI-assisted diagnosis systems integrate multidimensional data—including patient medical history, test results, and treatment records—to provide clinicians with decision-making support, enabling more accurate assessments and reducing the risks of misdiagnosis or missed diagnoses. Intelligent documentation systems automatically organize clinical workflows and generate medical records, significantly reducing repetitive administrative tasks for healthcare staff and allowing them to focus more on patient care ^[1].

2.2. Fine-grained resource allocation to enhance resource utilization efficiency

Imbalanced medical resource allocation and low utilization efficiency are major challenges restricting hospitals' refined operations. Artificial intelligence can leverage comprehensive operational data to establish dynamic resource allocation models, enabling precise matching and efficient use of various medical resources.

Regarding human resource allocation, AI can dynamically adjust staffing schedules based on departmental clinical workloads, patient flow changes, and staff working conditions, thereby optimizing healthcare personnel deployment. This prevents understaffing during peak periods and idle workforce during off-peak times, maximizing the value of human resources. In bed management, intelligent bed management systems can monitor bed occupancy and patient admission queues in real time, allocating beds according to the urgency of patients' conditions, reducing waiting times for admission, and improving bed turnover rates. For equipment and supply management, AI can monitor the operational status and usage frequency of medical devices, predict maintenance needs, and enable preventive maintenance, thus extending equipment lifespan. At the same time, by adjusting procurement, storage, and consumption of medications and medical supplies according to evolving clinical demands, AI ensures accurate alignment between supply and demand, avoiding both stockpiling and shortages ^[2].

2.3. Fine-grained cost control to enhance hospital operational efficiency

Cost control is the core of a hospital's refined operations. Traditional cost management models are characterized by coarse accounting and delayed oversight, failing to achieve full-process cost traceability and precise control.

Artificial intelligence can establish a comprehensive, intelligent cost management system that enables fine-grained and dynamic management of hospital operational costs.

AI can integrate cost data from all hospital scenarios—including finance, logistics, clinical services, and operations—breaking down data silos across departments to ensure seamless, real-time aggregation of cost information. By leveraging intelligent algorithms, it conducts in-depth analysis of cost composition, flow, and waste, accurately identifying redundant expenses and inefficient losses during operations, thereby providing solid evidence for cost optimization ^[3]. The intelligent cost control system enables detailed cost accounting at the level of individual medical procedures, departments, and consumables, clearly defining accountability throughout each process. It establishes a complete closed-loop cost management model based on pre-event warnings, in-process controls, and post-event reviews. Intelligent cost management reduces unnecessary operating expenses, improves financial inflows and outflows, and achieves simultaneous enhancement of both public healthcare accessibility and hospital operational efficiency.

2.4. Fine-grained quality supervision to strengthen medical safety standards

Medical quality and safety are vital to hospital development. Traditional quality supervision relies on manual spot checks and post-incident corrections, resulting in limited coverage, delayed hazard detection, and inadequate implementation of corrective actions. Artificial intelligence enables continuous, round-the-clock, and precise monitoring of medical quality and safety.

AI can monitor the entire process of medical practices in real time, detecting issues such as inappropriate medication use, procedural violations, and non-standard workflows, and issuing timely alerts so staff can correct irregularities immediately. An intelligent risk control system dynamically monitors internal infections, clinical risks, and potential patient-doctor disputes, using data to identify latent safety concerns and proposing preventive measures before incidents occur, thus enabling proactive intervention. Based on medical industry standards and insurance policies, AI automatically audits the compliance of medical billing, insurance settlements, and clinical documentation, preventing operational risks arising from non-compliance and ensuring standardized, regulated hospital operations ^[4].

3. Current challenges in leveraging artificial intelligence for hospital operational precision

3.1. Inadequate data governance and limited data empowerment capabilities

Data serves as the core foundation for implementing artificial intelligence applications. Currently, most hospitals face delays in establishing robust data systems. Various internal business systems operate independently, with inconsistent data standards and incompatible interfaces, resulting in numerous data silos that prevent comprehensive integration and connectivity across the entire hospital. Medical data often contains redundant information, varies significantly in quality, and is not updated promptly. As a result, AI models lack precise, complete, and reliable data support, leading to low accuracy in intelligent decision-making and fine-grained analytics. This undermines the ability of data to effectively drive refined operational management.

3.2. Insufficient adaptation to technical scenarios and inadequate depth of practical application

Currently, artificial intelligence is primarily applied in basic service scenarios within hospital operations, with limited penetration into core operational processes. Most hospital AI systems offer only single functions, mainly

used for simplifying workflows and conducting basic data statistics. They have not yet developed systematic models for dynamic resource allocation, precise cost control, or in-depth quality supervision. Moreover, general-purpose AI technologies struggle to integrate effectively with the unique characteristics of healthcare settings, resulting in significant disparities in meeting the needs of different departments and clinical services. This leads to homogenization and superficiality in intelligent implementation, failing to deliver the intended empowerment across the entire operational workflow.

3.3. Significant shortage of interdisciplinary talent and weak operational support

Artificial intelligence brings new momentum to refined hospital operations, requiring professionals who possess expertise in medical knowledge, hospital management, and AI technology. However, current staff tend to focus narrowly on either clinical work or traditional administrative tasks, lacking digital and intelligent thinking. They are unable to operate AI systems, interpret data, or manage intelligent operations effectively. Meanwhile, AI specialists often lack understanding of the healthcare industry and operational management experience, making it difficult to accurately align technological development with hospitals' specific operational needs, resulting in a disconnect between R&D and real-world implementation.

3.4. Outdated management systems and incomplete integration mechanisms

Intelligent, refined operations differ significantly from traditional hospital management models and require corresponding management systems and operational frameworks to support them. Most hospitals still rely on conventional management structures, without establishing standardized operating guidelines, procedural systems, or evaluation mechanisms for AI applications. In smart operational environments, unclear responsibilities and poorly connected processes lead to low utilization rates of intelligent devices and systems.

4. Optimization pathways for AI-driven fine-grained hospital operations

4.1. Establishing a robust data governance system to strengthen the foundation of intelligent empowerment

Hospitals should establish a unified medical data platform to break down data silos across outpatient services, inpatient care, logistics, finance, and equipment management, while standardizing data formats and interface protocols across all business systems. A routine data governance mechanism should be implemented to clean, calibrate, and update data, eliminating redundant or obsolete information to ensure data authenticity, completeness, and timeliness. A comprehensive privacy and security framework for medical data must be developed, with strict controls over data collection, storage, application, and sharing throughout the entire lifecycle. Under the premise of compliance with data security regulations, hospitals should maximize data value extraction, providing solid database support for AI-driven precision operations.

4.2. Deepening scenario-based technological iteration to enhance supply-demand alignment

Addressing pain points and diverse scenario requirements in hospital fine-grained operations, AI technologies should be applied across specific operational contexts. Moving beyond generic, homogenized intelligent applications, dedicated AI algorithms and customized systems should be developed for four key operational modules: clinical services, resource allocation, cost control, and quality supervision. Focus should be placed on tackling complex operational challenges such as multi-disciplinary diagnostic support, dynamic resource

optimization, accurate cost tracking, and comprehensive risk prevention, moving beyond basic and superficial applications. A technical implementation adaptability evaluation mechanism should be established, continuously improving system performance based on the unique operational characteristics of different departments, ensuring seamless integration between intelligent technologies and hospital-specific operational scenarios.

4.3. Building a multidisciplinary talent ecosystem to strengthen core operational capabilities

A tiered and categorized talent development and recruitment system should be established to address shortages in intelligent operations. Existing medical staff and operational managers should receive specialized training in digital operations, AI applications, and intelligent system operation, cultivating local talent who possess both medical expertise and intelligent operational thinking. Targeted recruitment of professionals in AI, data mining, and intelligent operations maintenance should be conducted, guiding them to deeply engage with healthcare operational scenarios and optimize technology applications according to hospitals' fine-grained needs. A collaborative mechanism between clinical and technical personnel should be established, supported by a regular communication and cooperation platform, enabling precise alignment between technological innovation and operational demands, thus creating a virtuous cycle of technology empowerment, practical implementation, and continuous improvement.

4.4. Establishing sustainable operational mechanisms to standardize integrated development

In line with the characteristics of AI applications and the requirements of fine-grained operations, hospital operational management systems should be restructured. Standards for intelligent operational processes, role definitions, and operational procedures should be refined, clearly specifying job responsibilities and performance evaluation criteria for each position within intelligent operations, streamlining inter-process coordination mechanisms to ensure efficient implementation. Regular mechanisms for system maintenance, technological iteration, and outcome review should be established, periodically assessing the effectiveness of intelligent operations and identifying existing issues, continuously refining intelligent operation strategies based on industry trends and hospital needs. An evaluation system for intelligent operations should be created, incorporating AI empowerment outcomes and fine-grained operational performance into departmental and individual assessments, thereby promoting ongoing innovation and evolution of operational models, ultimately achieving deeper, longer-term, and higher-quality collaboration between artificial intelligence and medical fine-grained operations.

5. Conclusion

Artificial intelligence has opened new pathways for refined hospital operations, effectively addressing the traditional issues of coarse, delayed, and inefficient hospital management. It plays an irreplaceable role in optimizing medical services, revitalizing healthcare resources, controlling operational costs, and strengthening medical safety. Currently, the integration of AI with refined hospital operations is still in continuous exploration, facing challenges such as inadequate data governance, poor scenario adaptability, talent shortages, and outdated institutional frameworks. Moving forward, hospitals should be developed according to the goal of high-quality growth, grounded in data governance, centered on practical application scenarios, supported by talent development, and safeguarded by improved systems. This will continuously expand the depth and breadth of AI applications in hospital operations, transforming traditional experience-based management into intelligent

operations, enhancing overall service capabilities and operational efficiency, and thereby providing strong momentum for the entire healthcare industry.

Disclosure statement

The author declares no conflict of interest.

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