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Practical Reflections on AI-Powered KPI Performance Improvement from the Perspective of Hospital Managers

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Abstract: In the context of high-quality development in public hospitals, Key Performance Indicators (KPI) have become an important management tool for hospital managers to enhance medical quality, operational efficiency, and service levels. However, traditional hospital KPI management exhibits significant shortcomings in data integration, dynamic monitoring, and decision support, struggling to meet the demands of refined management. This study aims to systematically analyze the mechanism through which Artificial Intelligence (AI) enhances hospital KPI performance from the perspective of hospital managers, construct an analytical framework for AI-empowered hospital KPI management, and explore its implementation pathways in management practice. Employing a normative research method, this paper summarizes the limitations of traditional hospital KPI management and synthesizes the empowering role of AI on KPI performance across aspects such as medical quality control, operational efficiency improvement, cost management, and patient experience optimization. The results indicate that by enhancing the real-time and prospective nature of data analysis, AI contributes to transforming hospital KPI management from outcome-oriented to process-oriented, and from experience-driven to data-driven. The study posits that systematically integrating AI into the hospital performance management system helps increase the scientific rigor and sustainability of managerial decision-making, providing crucial support for the high-quality development of hospitals. This research offers theoretical reference and managerial insights for hospital managers advancing the practice of AI-empowered performance management.

Keywords: Artificial Intelligence; Hospital Management; KPI Performance; Refined Management; High-Quality Development

1. Introduction

Against the backdrop of deepening healthcare system reform and advancing the high-quality development of public hospitals, the hospital management environment is becoming increasingly complex (Zhang et al., 2025). The continuous growth in demand for medical services and the ongoing reforms in healthcare payment methods present hospital managers with multiple challenges of "cost control, efficiency improvement, quality assurance, and service optimization (Almehwari et al., 2024)." KPI performance management, serving as a vital tool linking hospital strategic goals with specific management actions, is widely applied in areas such as medical quality evaluation, operational management, and performance allocation (Fallahnezhad et al., 2024).

However, in practice, traditional hospital KPI management models often rely on manual statistics and experiential judgment, making it difficult to reflect hospital operational status in a timely and comprehensive manner, thereby constraining the scientific nature of management decisions (Bemgal & Haggerty, 2025). In recent years, the advantages of Artificial Intelligence (AI) technology in data processing, pattern recognition, and predictive analytics have provided a new technological pathway for hospital KPI management (Maleki Varnosfaderani & Forouzanfar, 2024). How to systematically recognize the value of AI in KPI performance enhancement from the perspective of hospital managers and promote its deep integration with hospital management practices is an urgent issue requiring exploration.

2. Literature Review

2.1 Research Progress on Hospital KPI Performance Management

Key Performance Indicators (KPIs) were initially introduced into the healthcare field primarily to measure hospital operational efficiency and medical service quality. The Balanced Scorecard theory proposed by Kaplan (2009) provided an important theoretical foundation for hospital performance evaluation, emphasizing the synergy of multi-dimensional performance across finance, customers, internal processes, and learning and growth. Subsequently, scholars introduced KPI concepts into public hospital management practices, gradually forming an indicator system centered on medical quality, operational efficiency, cost control, and patient satisfaction (Karampotsis et al., 2024).

Existing research generally agrees that KPIs have played a positive role in promoting standardized hospital management and enhancing performance transparency (Amer et al., 2022; Liu et al., 2025). However, some scholars point out that traditional KPI management models overly rely on outcome-based indicators, potentially leading to "management for the sake of assessment" while neglecting process management and continuous improvement (Varela et al., 2023). In the context of high-quality development in public hospitals, reliance solely on manual statistics and experiential judgment is insufficient to meet the needs of refined management.

2.2 Research on Hospital

Informatization and Digital Performance Management

With the improvement of hospital informatization levels, the role of information systems in performance management has gradually garnered attention. Research indicates that performance data collection based on Hospital Information Systems (HIS) can improve statistical efficiency but still faces shortcomings in data integration and in-depth analysis (Ahmed et al., 2023). Some scholars propose constructing big data-based hospital performance management platforms to achieve multi-system data fusion and comprehensive analysis (Li et al., 2024; Pietronudo et al., 2022).

However, existing research on digital performance management largely remains at the level of informatization tools, lacking intelligent analysis and predictive functions, which hampers the provision of prospective support for management decisions (Cosa & Torelli, 2024). This also creates practical space for the application of AI technology in performance management.

2.3 Research on the Application of Artificial Intelligence in Healthcare Management

Initial research on Artificial Intelligence in the medical field primarily focused on areas such as medical imaging, clinical decision support, and disease prediction (Wang et al., 2023). In recent years, AI has gradually expanded into healthcare management and hospital operations. Research indicates that machine learning algorithms hold high application value in patient flow prediction, bed management, and resource allocation optimization (Tello et al., 2022).

Some scholars have begun to focus on the role of AI in smart hospital construction and medical quality management, such as intelligent medical record quality control, intelligent scheduling, and intelligent medical insurance auditing (Fatema et al., 2021; Gao et al., 2024). These studies suggest that AI can significantly enhance management efficiency and risk identification capabilities, providing technological support for hospital performance improvement.

2.4 Research Gaps in AI-Empowered Hospital KPI Management

Although existing research explores KPI management, hospital informatization, and AI applications from various angles, comprehensive analysis reveals the following gaps:

1.Existing research is often conducted from technical or system development perspectives, lacking systematic analysis from the viewpoint of hospital managers.

2.Research on AI applications tends to focus on single scenarios, lacking holistic linkage analysis with the KPI performance system.

3.Research on how AI promotes the transformation of hospital performance management models remains fragmented, lacking a clear management logic framework.

Therefore, it is necessary to systematically explore how AI empowers KPI performance management from the standpoint of hospital management practice and analyze its managerial value in the high-quality development of hospitals.

3. Research Methodology

3.1 Research Object

The research object of this study is the empowering mechanism of Artificial Intelligence within the hospital KPI performance management system and its impact on management decisions. Specifically, the research focuses on the application methods of AI technology in core performance dimensions such as hospital medical quality management, operational efficiency improvement, cost control, and patient service, as well as how it supports management decisions to drive overall hospital KPI performance improvement.

From the perspective of the research subject, this paper adopts the viewpoint of hospital managers (including decision-makers and middle-to-senior management personnel) as the primary analytical lens, focusing on the managerial value of AI in hospital performance governance rather than specific clinical technical effects.

3.2 Research Design and Approach

This study employs a research design combining normative research and literature analysis. The research approach is as follows:

First, systematically review domestic and international literature related to hospital KPI performance management and AI medical applications, summarizing the main viewpoints and gaps in existing research. Second, based on hospital management practice, summarize and analyze the practical problems inherent in traditional KPI management models. Third, construct an analytical framework and conceptual model for AI-empowered KPI performance management from the perspective of hospital managers. Finally, discuss the managerial logic and practical implications of the model.

This research design is suitable for the current research context where AI-empowered hospital performance management is still in the exploratory stage and empirical data is not yet mature.

3.3 Literature Analysis Method

This paper employs literature analysis as one of its fundamental research methods, systematically retrieving and analyzing relevant research findings both domestically and internationally concerning hospital performance management, KPI system construction, AI medical applications, and smart hospital construction. Through thematic summarization and comparative analysis of the literature, common conclusions and points of debate regarding AI applications in hospital management are extracted, providing a theoretical basis for constructing the research framework.

The literature analysis method is chosen because it aids in comprehensively grasping the developmental trajectory of the research field during the initial stages, avoiding duplication of existing research, and laying the foundation for proposing new research perspectives and analytical frameworks.

3.4 Normative Analysis Method

Building upon the literature analysis, this paper further employs a normative analysis method to explore the appropriate positioning and mechanism of AI in hospital KPI performance management from an

"ought to be" perspective. By analyzing the goals, management logic, and decision-making processes of hospital performance management, it argues how AI can be embedded within the performance governance system to play an empowering role.

Normative analysis is adopted because the research objective is not to validate specific technical effects but to address the managerial and policy question of "how AI should support hospital managers in improving KPI performance," a question more suitably explored through normative analysis.

3.5 Framework Construction and Conceptual Model Analysis

Based on the aforementioned methods, this paper employs framework construction and conceptual model analysis to systematically integrate research findings, constructing a conceptual model of AI-empowered hospital KPI performance management based on "Data — Analysis — Decision — Feedback." Through analyzing the components of the model and their interrelationships, the internal mechanism through which AI promotes the transformation of hospital KPI management from outcome assessment to process governance is revealed.

This method helps systematically integrate scattered research conclusions, enhancing the structured nature of the research outcomes and the clarity of theoretical expression.

4. Research Results

(I) AI Drives the Transformation of Hospital KPI Management from "Outcome Assessment" to "Process Governance"

The research results indicate that the introduction of Artificial Intelligence significantly alters the governance logic of hospital KPI management, shifting performance management from an assessment mechanism centered on outcome evaluation to a process governance model characterized by continuous monitoring, dynamic intervention, and shared responsibility.

Under the traditional KPI management model, performance assessment primarily focused on monthly or annual outcome indicators, such as service volume, revenue structure, and completion rates of quality indicators. Managers typically evaluated and held accountability after results were formed, with management interventions exhibiting significant lag, making it difficult to correct operational deviations promptly. In contrast, process governance supported by AI pays more attention to the entire process of performance formation, emphasizing continuous management and dynamic regulation during indicator changes.

Firstly, AI shifts KPI management from "periodic statistics" to "continuous monitoring." Through real-time or near-real-time analysis of key indicators such as outpatient volume, hospitalization rate, bed occupancy rate, and medical quality risks, managers can continuously grasp the hospital's operational status, preventing performance issues from being discovered only after the assessment cycle ends. This continuous monitoring mechanism forms the foundation of process governance.

Secondly, AI strengthens the functions of risk warning and

preemptive intervention in performance management. Under the process governance model, AI not only displays current indicator levels but also provides early warnings of potential performance risks through trend analysis and anomaly detection. For example, when the average length of stay in a department continuously increases or medical quality indicators exhibit abnormal fluctuations, the system can automatically issue alerts, prompting managers to intervene before problems escalate. This mechanism shifts performance management from "post-hoc correction" to "pre-emptive prevention."

Thirdly, AI shifts performance accountability from "outcome attribution" to "process collaboration." Traditional outcome assessments often focus solely on final indicator completion, potentially triggering simplistic blame attribution. Process governance emphasizes analyzing the pathways of performance formation. Through AI's tracking of processes, resource allocation, and behavioral patterns, managers can identify systemic issues rather than merely attributing outcomes to individuals or departments. This helps build a more rational and collaborative performance governance environment.

Furthermore, process governance supported by AI also enhances the interpretability and sustainability of management decisions. Through quantitative analysis of the performance change process, managers can clearly understand the connection between intervention measures and performance outcomes, providing a basis for continuous improvement. This evidence-based management approach helps avoid short-term behaviors and indicator-oriented biases in performance management.

In summary, AI's role in driving the transformation of hospital KPI management from outcome assessment to process governance essentially represents an upgrade of performance management from an "evaluation tool" to a "governance mechanism." This transformation not only enhances the forward-looking and refined nature of KPI management but also lays a managerial foundation for hospitals to achieve high-quality, sustainable development.

(II) AI Forms a Synergistic Empowering Effect Across Multi-Dimensional KPI Domains

The research results indicate that AI's contribution to improving hospital KPI performance exhibits distinct multi-dimensional synergistic characteristics, primarily manifested in the following four areas:

1.Medical Quality KPIs: AI-assisted quality control systems can automatically identify medical record defects, deviations in clinical pathways, and medication risks, providing managers with objective, quantifiable bases for quality evaluation, thereby enhancing the standardization and consistency of medical quality management.

2.Operational Efficiency KPIs: Through analysis and prediction of historical operational data, AI supports optimized resource allocation in key processes such as outpatient, inpatient, and surgical services, contributing to

shortening the average length of stay, increasing bed turnover rates, and improving equipment utilization efficiency.

3.Cost Control KPIs: The application of AI in analyzing pharmaceutical, consumable, and medical insurance data helps managers identify cost anomalies and unreasonable expenditures, promoting a shift in cost control from post-hoc accounting to pre-emptive warning and process control.

4. Service Experience KPIs: AI-powered intelligent guidance, customer service, and follow-up systems effectively alleviate congestion issues in patient (medical treatment processes), enhance patient satisfaction, and provide technical support for improving service-related KPIs.

The above results demonstrate that AI does not act in isolation on single KPI indicators but holistically enhances hospital performance levels through a multi-dimensional linkage mechanism.

(III) The Management Framework for AI-Empowered KPI Performance Improvement is Gradually Clarified

Based on comprehensive analysis, the research further synthesizes a four-stage AI-empowered KPI management framework: "Data — Analysis — Decision — Feedback":

Data Layer: Integrate multi-source data from HIS, EMR, medical insurance, equipment, etc., to form a unified data foundation.

Analysis Layer: Utilize AI algorithms for trend analysis, risk identification, and predictive evaluation.

Decision Layer: Provide managers with quantified, interpretable decision support.

Feedback Layer: Achieve a management closed-loop through performance assessment and continuous monitoring.

This framework reveals the inherent logic of AI's evolution in hospital KPI management from "tool application" to "governance capability enhancement."

Table 1. Core Architecture: AI-Empowered KPI Management System

Layer	Core Functions	Manifestations of AI Enablement
Data Layer	Integration of HIS, EMR, integrated platforms, financial systems, and medical insurance data	Automated data cleaning, heterogeneous data mapping, and feature engineering extraction
Analysis Layer	Risk identification, indicator prediction, and intelligent quality control	Machine learning algorithms for overspending risk prediction; NLP-based automatic extraction of electronic medical record deficiencies
Decision Layer	Real-time alerts, optimization pathway recommendations, and dynamic resource allocation	Knowledge graph–supported management strategy recommendations; multi-objective optimization decision models
Feedback Layer	Performance result dissemination and improvement plan tracking	Automated generation of analytical reports; intelligent management

tracking based on the PDCA cycle

(IV) The Implementation of AI-Empowered KPI Performance Management Exhibits Stage-Specific Characteristics

The research results indicate that AI-empowering hospital KPI performance management is not a one-time accomplishment. Instead, it exhibits stage-specific characteristics of progressing from shallow to deep, evolving gradually alongside improvements in hospital informatization infrastructure, management needs, and organizational capabilities. The application goals, technological focus, and management emphasis differ significantly across stages.

1. Initial Stage: Data Integration and Performance Visualization

In the initial stage of AI-empowered KPI management, the primary goal for hospitals is to address issues of data fragmentation and information lag. This stage centers on integrating multi-source data from HIS, EMR, operational management, and medical insurance settlement, achieving centralized display of KPI indicators through basic data cleansing and visual analysis.

At the management level, AI applications in this stage primarily support managers in "seeing clearly"—enabling them to quickly and intuitively grasp the status and trends of core hospital performance indicators. Although intelligent analysis capabilities are limited at this stage, it lays the data foundation for subsequent in-depth applications and is a necessary starting point for achieving digitization of performance management.

2. Development Stage: Intelligent Analysis and Decision Support

In the development stage, hospitals gradually introduce machine learning and predictive analysis technologies, with AI beginning to participate in the analysis and judgment processes of KPI management. Through modeling and analysis of historical performance data, AI can achieve trend forecasting, anomaly detection, and risk warning.

In management practice, the core value of this stage lies in supporting managers to "see early." For example, AI can identify potential risks such as declining bed occupancy rates,prolonged hospital stays, or medical quality fluctuations in advance, allowing managers to take intervention measures before problems become apparent. This stage marks the transition of performance management from static monitoring to dynamic regulation.

3. Maturity Stage: Closed-Loop Governance and Intelligent Collaboration

In the maturity stage, AI is deeply embedded in the entire process of hospital KPI performance management, forming a data-driven closed-loop governance system. At this point, AI not only supports analysis and warning but can also provide optimization suggestions and strategy adjustment plansfor managers by incorporating management rules and historical feedback.

At this stage, performance management transitions from "tool assistance" to "governance capability enhancement." AI fosters the organic

integration of performance goal setting, process monitoring, performance evaluation, and outcome feedback, promoting the evolution of hospital performance management from departmental segmentation to systemic collaboration, providing continuous support for high-quality development.

4. Managerial Implications of Stage-Specific Evolution

The research results further indicate that when promoting AI-empowered KPI performance management, hospitals should fully recognize its stage-specific characteristics, avoiding the simplistic pursuit of "advanced intelligence" while neglecting foundational construction. Different development stages should be matched with corresponding management objectives, technological investment, and organizational capacity building. Advancing AI applications progressively is key to achieving continuous improvement in performance management efficacy.

5.Discussion

5.1 Main Findings of the Research

This study, from the perspective of hospital managers, systematically analyzes the mechanism through which Artificial Intelligence enhances hospital KPI performance management. The research results indicate that AI does not simply improve single performance indicators. Instead, through data integration, intelligent analysis, and closed-loop feedback, it promotes the transformation of hospital KPI management models from outcome-oriented to process-oriented. The constructed conceptual model of the "Data — Analysis — Decision — Feedback" management mechanism reveals the systemic value of AI in hospital performance governance.

5.2 Comparative Analysis with Existing Research

Compared with existing research on hospital KPI management, the findings of this paper align with previous studies on certain conclusions. Existing research generally agrees that KPIs help enhance the standardization and performance transparency of hospital management (Meysam Fallahnezhad et al., 2024; Kaplan, 2009). This paper also validates the foundational role of KPIs in hospital performance management.

Regarding AI applications, existing research often focuses on specific application scenarios such as intelligent quality control, resource allocation, or smart hospital construction (Chen & Ho, 2023; Gao et al., 2024). The findings of this paper are consistent with the judgment in the aforementioned research that "AI can enhance management efficiency and risk identification capabilities."

However, differing from previous research, this paper does not treat AI as an independent technological tool. Instead, from the manager's perspective, it systematically embeds AI into the entire process of KPI performance management, emphasizing its role in reshaping management logic and governance models. Compared to research oriented towards technology or single scenarios, this paper highlights the holistic empowering effect of AI at the level of the performance management system.

5.3 Theoretical Contributions

This study offers the following theoretical contributions to the fields of hospital performance management and AI application research.

First, it expands the theoretical boundaries of hospital performance management research. Existing hospital performance management research often focuses on KPI indicator system construction, performance evaluation methods, or incentive mechanism design, emphasizing the rationality of performance "evaluation results (Amos, 2022; Hadian et al., 2024)," while paying insufficient attention to the performance formation process and its governance mechanisms. By introducing Artificial Intelligence into the research framework of hospital KPI performance management, this paper explores the logic of performance governance from a process perspective, expanding the research boundaries of traditional performance management theory.

Second, it proposes a process governance theoretical perspective for AI-empowered hospital KPI performance management. Different from technology-oriented research viewing AI as an informatization tool, this paper emphasizes AI's role in reshaping the governance logic within performance management. It proposes that AI promotes the transformation of hospital performance management from outcome assessment to process governance through continuous monitoring, risk warning, and dynamic intervention. This perspective provides a new theoretical explanatory path for understanding how digital technologies influence organizational governance mechanisms.

Third, it constructs a conceptual model for AI-empowered hospital KPI performance management, enriching theories related to digital governance. The "Data — Analysis — Decision — Feedback" management mechanism model proposed in this paper organically integrates AI technology, management decisions, and performance outcomes, providing a systematic theoretical tool for analyzing how digital technologies empower organizational governance. This helps address the insufficiency of fragmented analysis in existing research.

Fourth, it deepens the theoretical connotation of AI healthcare management research from the manager's perspective. Existing AI medical research is often conducted from the perspectives of clinical application or technical implementation (Askin et al., 2023; Hogg et al., 2023), with less attention paid to the role of managers in AI application. This paper takes hospital managers as the core analytical subject, revealing their key role in AI-empowered performance governance, thereby enriching the theoretical expression of AI in the field of healthcare management.

5.4 Practical Implications

At the practical level, this study provides real-world insights for hospital managers promoting AI-empowered performance management. First, the research results help managers recognize the strategic value of AI in performance management, avoiding viewing it merely as an informatization tool. Second, the proposed management mechanism model can serve as a reference for hospitals in formulating AI application

roadmaps, guiding them to progressively advance data integration, intelligent analysis, and performance closed-loop management in stages. Finally, this study contributes to promoting the transformation of hospital performance management from experience-driven to data-driven, enhancing the overall governance capacity of hospitals.

5.5 Research Limitations

This study still has certain limitations. First, it employs a normative research method, lacking quantitative empirical data support from specific hospitals. Second, the research is primarily conducted from the perspective of hospital managers and does not delve into analyzing the behavioral responses of multiple stakeholders such as medical staff and patients. Furthermore, hospitals at different levels and of different types exhibit variations in AI application foundations and management needs; therefore, the applicability of this paper's conclusions requires further verification.

5.6 Future Research Directions

Based on the aforementioned limitations, future research can be further expanded in the following directions:

1. Conduct empirical studies based on multi-center hospitals to examine the actual performance effects of AI-empowered KPI management.

2.Introduce multi-stakeholder perspectives to explore the impact mechanisms of AI on medical staff behavior, performance incentives, and patient experience.

3.Integrate considerations of healthcare payment method reforms and policy environment changes to deeply analyze the long-term role of AI in hospital performance governance.

6. Conclusion

This paper systematically explores the mechanism and practical pathways for AI-empowered KPI performance improvement from the perspective of hospital managers. The study argues that AI contributes to enhancing the real-time nature, scientific rigor, and refined level of hospital KPI management, serving as an important supporting tool for promoting the high-quality development of hospitals. In the future, with technological maturity and deepening management practices, AI will play an even more central role in hospital performance management systems.

7. New Knowledge

Based on existing research on hospital performance management and AI applications, this study proposes the following new understandings and innovative points:

1. From a research perspective, this study introduces Artificial Intelligence into the "managerial perspective" of hospital KPI performance management, breaking through the limitations of previous research often focusing on technical applications or(single business scenarios). Existing research frequently starts from information system construction or specific technical functions, discussing the role of AI in medical quality control or smart hospital construction. This paper, however, emphasizes the core position of hospital managers in performance governance, viewing AI as a key tool supporting

management decisions and enhancing governance capabilities, thereby expanding the analytical perspective of AI healthcare management research.

2.In terms of research content, this paper systematically constructs a conceptual model of the management mechanism for AI-empowered hospital KPI performance improvement, filling the gap of "insufficient overall framework" in related research. Different from previous discussions on the effects of AI in(single-point applications), the closed-loop management model of "Data — Analysis — Decision — Feedback" proposed in this paper organically integrates AI with multi-dimensional KPIs such as medical quality, operational efficiency, cost control, and patient experience, providing a theoretical framework for understanding how AI systematically enhances hospital performance.

3.Regarding theoretical contribution, this paper reveals the internal logic through which AI drives the transformation of hospital KPI management from "outcome assessment" to "process governance," enriching the theoretical connotation of hospital performance management. This research considers Artificial Intelligence as an integral part of the performance governance mechanism, emphasizing its role in enhancing the forward-looking and controllable nature of management, providing a new explanatory path for the expansion of traditional performance management theory in the digital context.

4. At the practical level, this study provides actionable managerial insights for hospital managers advancing AI-empowered performance management. By clarifying the pathways and stage-specific characteristics of AI empowering KPI management, this paper offers practical references for hospitals in formulating AI application roadmaps, optimizing performance management models, and enhancing governance capabilities, holding strong practical guiding significance.

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