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Digitalization practices, data analytics, and artificial intelligence among public hospitals: Basis for smarter hospital management system framework

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Abstract

The application and innovation of new technologies have injected strong impetus into all areas of society and have also brought profound impact on the healthcare industry. With the aim of adapting to the developmental needs and strengthening the central role of public hospitals in securing and improving the living standards of the population, the General Office of the State Council of the People's Republic of China, the National Health Commission, and the State Administration of Traditional Chinese jointly issued the Opinions of GOSC on Propelling the advancement of public hospitals towards high-quality growth. This study adopted descriptive research design. The results of the study revealed that digitalization is sometimes practiced in terms of process optimization, data automation, and patient management; data analytics is often applied in cost-benefit analysis, risk management and predictive analysis; and the application of AI is sometimes utilized in document management, task management automation and clinical decision support. There is a significant relationship between digitalization practices and digital analytics, digitalization practices and artificial intelligence, and digital analytics and artificial intelligence. A Smarter Hospital Management system framework is proposed.

Keywords: digitalization practices, data analytics, artificial intelligence, smarter hospital management system framework

Digitalization practices, data analytics, and artificial intelligence among public hospitals: Basis for smarter hospital management system framework

1. Introduction

Recent years, by the technology rapidly developing, we are in an era of unprecedented transformation. The application and innovation of new technologies have injected strong impetus into all areas of society, and have also brought profound impact on the healthcare industry. With the aim of adapting to the developmental needs and strengthening the central role of public hospitals in securing and improving the living standards of the population, General Office of the State Council of the People's Republic of China, the National Health Commission and the State Administration of Traditional Chinese jointly issued the Opinions of GOSC on Propelling the advancement of public hospitals towards high-quality growth, and propel the advancement of public hospitals towards high-quality growth. These significant documents provide a clear strategy for the future of public hospitals, with objectives focused on equitable medical resource allocation, improving healthcare service quality, and advancing the sustainable, high-quality growth of the healthcare system.

According to the plan of action, by 2025, the regional balance of national medical services will be significantly enhanced, and important breakthroughs will be made in the construction of smart hospitals. Through the comprehensive application of technologies like electronic medical records, intelligent services, and smart management, the hospital will progressively transform from a decentralized to a more precise management model, enhancing its operational capabilities and overall service standards, thus offering the community more efficient, fair, and high-quality healthcare services.

At present, there is no consensus on the concept of a smart hospital at home and abroad. According to Kwon et al (2022) a smart hospital is a healthcare facility that leverages advanced information and communication technologies to enhance patient safety, improve medical quality, optimize cost-effectiveness, and deliver patient-centered care, all while providing measurable benefits to both patients and medical staff. Understanding a smart hospital in China was first formally proposed in The Guidelines for Advancing the Healthy Development of Smart Cities in 2014, which initiative was intended to standardize and supported the healthy evolution of smart cities, creating the foundation for a new urban landscape in the Innovation 2.0 era (Jiang et. al.,2022). Wang et. al.,(2022) considered smart hospital construction refers to the patient-centered, relying on information technology means, and the application of emerging technologies, including the Internet of Things, cloud computing, and 5G communication, seeks to enable "smart medicine" for healthcare providers, "smart services" for patients, and "smart management" for hospital leadership. Based on domestic and foreign research on the definition of smart hospital combined with China's policy requirements, Yuan et. al.,(2024) believed that smart hospital should be a medical institution that uses the big data shared within the system to provide medical, patient, management and other personnel with the optimal solution of accurate decision-making efficiency after the intelligent comprehensive analysis and judgment of the system.

The emergence of digital practices, data analytics, and artificial intelligence is significantly contributing to the high-quality evolution of public hospitals (Xiao et. al.,2024), fundamentally changing the way hospitals are managed and operated, and providing unprecedented opportunities for public hospitals to transform. Public hospitals must actively conform to the trend of The Times, implement the requirements of "No. 18 Document" and "Action Plan", bravely and actively embrace digital and intelligent changes, and actively promote the construction of smart hospitals. This is not only a response to the national policy call, is to enhance their own competitiveness, to achieve long-term sustainable development of the inevitable choice, but also the hospital transformation and upgrading of the only way (Liu et al., 2024) to bring win-win value for patients and medical workers. Through the dual drive of government policy guidance and technology empowerment, public hospitals have defined the construction goal of smart hospitals. Under the guarantee provided by powerful technology and

policy system for the improvement of public hospitals, the design of smart hospitals has moved from concept to practice, fulfilling its mission of serving the society more efficiently while meeting the growing diversified and personalized health needs of the people. Gradually become the core of the transformation and upgrading of medical services.

The design of smart hospital is motivated by technology, and digitalization, datafication and intelligence constitute the core elements of smart medical construction (Wang et al., 2024). Optimize resource allocation and process management through digital means. Decision support tools based on data analysis and artificial intelligence can help hospitals more accurately predict patient needs, rationally allocate beds and medical resources, and improve the quality of medical services. In addition, the application of intelligent service platform further improves the patient experience and scientific research process, realizing the convenience of the whole process from registration, consultation to post-diagnosis follow-up, from pre-diagnosis appointment, follow-up to post-diagnosis satisfaction evaluation, from scientific research sample selection, scientific research promotion to scientific research results transformation. The deep integration of digital practice, data analysis and artificial intelligence not only provides hospital managers with management tools (Tang et. al.,2024) to accommodate new trends, frameworks, and obstacles , but also brings significant changes in several key aspects such as the improvement of operational efficiency (Chen et. al.,2024), the optimization of resource allocation (Huang, 2024), personalized medical services (Liu et al., 2024) and patient experience improvement. Intelligent management system through the effective integration of hospital internal resources, to achieve automation process and intelligent scheduling; Data analysis technology can monitor the use of resources in real time, help hospitals achieve data-enabled hospital operations in bed management, drug inventory, personnel deployment and emergency scheduling, provide a "cockpit" for hospital management, help managers make scientific decisions, promote the scientific scheduling and optimization of medical resources, reduce waste, and improve resource utilization (Xie et al., 2024). The AI-based diagnosis and treatment assistance system can use big data to assess the patients' health condition, provide them with accurate and personalized diagnosis and treatment plans, and greatly improve the diagnosis and treatment effect (Dlamini et. al.,2020). Intelligent service technology (such as online consultation, automatic registration system, health management application) allows patients to enjoy more convenient medical services (Chang et. al.,2022) and enhance their trust and satisfaction with the hospital. Vision of the future, building smart hospitals has become a key measure for hospitals to cope with complex challenges in medical industry, push on the construction of healthy China, and achieve sustainable development. The future smart hospital will be more patient-centered, build personalized health files by integrating patients' health data and diagnosis and treatment records, use artificial intelligence technology to focus on the health needs of patients throughout the life cycle (Zeydan et. al.,2024) customize diagnosis and treatment plans for patients, provide comprehensive and precise medical services, and make every step of patients from registration to discharge more convenient and transparent. This not only improves the treatment outcome, but also significantly improves the patient's medical experience. The wide application of telemedicine and health management platform is conducive to extend high-quality medical resources to local healthcare systems (Li et. al.,2024), achieving seamless connection of health services inside and outside hospitals, covering all aspects of patients from prevention to rehabilitation, and further strengthening the linkage between superior medical institutions and community medical institutions. Telemedicine plays a crucial role in public emergencies by quickly consolidating a wide range of high-quality medical resources at the scene, helping to protect lives and deliver timely care to the injured in various complex environments (Zhang, 2023). In the future, public hospitals should continue to play an exemplary leading role, take the construction of smart hospitals as an opportunity to deepen the integration of technology and medical care, accelerate the digital transformation of the whole industry, and make new and further contributions to the achievement of the goal of national health.

Objectives of the Study - The study aimed to explore the digitalization practices, data analytics, and artificial intelligence among public hospitals and establish a framework for a smarter hospital management system. Specifically, it sought to assess the digitalization practices in terms of process optimization, data automation, and patient management; evaluate the usage of data analytics in terms of cost-benefit analysis, risk management, and

predictive analysis; assess artificial intelligence implementation in terms of records management, administrative tasks automation, and clinical decision support; determine the significant relationship among digitalization practices, data analytics, and artificial intelligence; and propose a smarter hospital management system framework.

2. Methods

Research Design - This study adopted a descriptive research design to explore digitalization practices, data analytics, and artificial intelligence among public hospitals and establish a framework for a smarter hospital management system. According to Siedlecki (2020), descriptive research is a scientific approach that involves observing and detailing individuals, events, or conditions in their natural state. Data was gathered through a data-gathering instrument designed to assess the digitalization practices, data analytics, and artificial intelligence of the target respondents.

Participants of the Study - A total of 417 questionnaires were distributed via WeChat. The respondents are employees from public tertiary comprehensive hospitals in Chengdu, Dazhou, Luzhou, Panzhihua, and Mianyang in Sichuan Province. These five hospitals are tertiary comprehensive hospitals in different regions, and their EMR ratings have all reached level 4 of the EMR System Application Level Grading. This allows the data for this study to cover tertiary comprehensive hospitals in different regions, making the research more comprehensive and reliable. The questionnaires primarily gathered information on the management systems of tertiary hospitals from three dimensions, digitalization practices, data analytics, and artificial intelligence, to propose a framework of intelligent hospital management systems.

Instruments of the Study - This study used questionnaires on digitalization practices, data analytics, and artificial intelligence to survey the selected five tertiary comprehensive hospitals. This study applied digitalization practices, data analytics, and AI questionnaires to the five selected tertiary grade A general hospitals. Through the review of previous literature, this study understands the application scenarios of digitalization practices, data analytics, and artificial intelligence in hospital management.

Table 1

The Cronbach Alpha of the Survey Questionaire

Indicators	No. of Items	Cronbach Alpha	Remarks
Process Optimization	5	0.911	Excellent
Data Automation	5	0.935	Excellent
Patient Management	5	0.917	Excellent
Cost Benefit Analysis	5	0.950	Excellent
Risk Management	5	0.943	Excellent
Predictive Analytics	5	0.983	Excellent
Records Management	5	0.924	Excellent
Administrative Task Au-tomation	5	0.948	Excellent
Clinical Decision Supp-ort	5	0.954	Excellent

George and Mallery (2003) provide the following rules of thumb: "_ > .9 – Excellent, _ > .8 – Good, _ > .7 – Acceptable, _ > .6 – Questionable, _ > .5 – Poor, and _ < .5 – Unacceptable"

Table 1 presents the pilot test undertaken to determine the survey questionnaire's efficacy. The Cronbach Alpha of each indicator was greater than 0.9 approving the questionnaire is highly reliable, and the results can be used for subsequent research analysis. According to the actual situation, the technical practice is divided into three parts: process optimization (Zhou et al., 2024; Yu et al., 2023), data automation (Kedziora et. al.,2022; Tai, 2022) and patient participation (Ma et al., 2024; Zhang et. al.,2024); the data analysis is divided into three aspects: cost-benefit analysis (Nguemeleu et al., 2020), risk identification (Mahmoudi et al., 2020; Escobar et al., 2020) and prediction evaluation (Ali et al., 2021); and the artificial intelligence is divided into three parts including record management (Abràmoff et al., 2020), management task automation (Huang et al., 2021; Rayhan et al., 2023) and clinical decision (Giordano et al., 2021). We discuss and study the above data one by one, mine their correlation, and construct the basic framework of hospital intelligent management system. This research

will obtain first-hand data through questionnaires.

Data Gathering Procedure - This study involved key steps. First, clarify the research background, including the current challenges and opportunities faced by hospital management. After proposing the research objectives, the researcher conducted a literature review to collect and organize theories, research findings, and practical cases in the fields of digitalization practices, data analytics, and artificial intelligence. Based on the research objectives, the data-gathering instrument was designed followed by the ethical review and reliability test. After the actual data gathering and statistical treatment, data analysis and interpretation followed. Finally, a framework was proposed.

Data Analysis - Weighted mean and rank were used to assess the digitalization practices in terms of process optimization, data automation, and patient management; to evaluate the usage of data analytics in terms of cost-benefit analysis, risk management, and predictive analysis; and to assess the Artificial Intelligence implementation in terms of records management, administrative tasks automation, and clinical decision support. The outcome of the Shapiro-Wilk Test revealed p-values for all variables lower than 0.05, indicating that the data did not conform to a normal distribution. Consequently, Spearman's rho was employed as part of the non-parametric tests to evaluate significant relationships. All statistical analyses were carried out using SPSS version 28.

Ethical Considerations - In order to ensure the authenticity of the collected information, the entire research process must comply with ethical standards. To this end, the researchers have taken the following measures: Participant's right to know and autonomy: Each participant voluntarily agrees to participate in the survey after fully understanding the purpose, process, possible risks and benefits of the survey, and can withdraw from the survey at any stage. Privacy and Confidentiality of participants: The questionnaire promises and takes measures to protect the privacy and data of participants and ensure that personal information will not be disclosed or used for purposes without consent. All data are anonymized or pseudo-anonymized. Avoid harm: The questionnaire content will not cause any psychological, physical or social harm to the participants. Handle sensitive issues carefully to avoid causing discomfort or anxiety. Fairness: Ensure that the questionnaire is not discriminatory or biased in any way and that all participants are treated equally.

3. Results and discussion

Table 2

Summary Table on Digitalization Practice

Key Result Areas	Composite Mean	VI	Rank
Process Optimization	2.07	Sometimes	2
Data Automation	2.03	Sometimes	3
Patient Management	2.10	Sometimes	1
Grand Composite Mean	2.07	Sometimes	

Legend: 3.50 - 4.00 = Always; 2.50 - 3.49 = Often; 1.50 - 2.49 = Sometimes; 1.00 - 1.49 = Never

Table 2 presents the respondents' evaluations of digitalization practices of process optimization, data automation and patient management. The composite mean is 2.07, indicating that the respondents consider that digitalization practices are sometimes embodied in process optimization, data automation and patient management. This means that a small number of respondents believe that the digitalization practices of optimizing process, data automation and patient management is part of the construction of intelligent hospital management system. According to the studies of Mulukuntla et. al.,(2020), Uslu et al. (2020) and Senbekov et al. (2020), optimizing the telemedicine education process, the IoT for data automation and ensuring patient safety are all part of digitalization practices in smart hospital management.

Patient Management is ranked first with a weighted mean score of 2.10 points, and the verbal explanation is "sometimes". This means that the respondents believe that patient management in digitalization practices is more common in the construction of intelligent hospitals than process optimization and data automation. According to

the studies of Kraus et al. (2021) and Leo et al. (2022), digitalization practices have enhanced patient management and reduced mortality by transforming operational efficiency, adopting patient-focused strategies, and enhancing workforce practices and socioeconomic aspects. The statements "Process Optimization", ranked second with weighted means of 2.07 respectively and all with a verbal interpretation of sometimes.

Data Automation got the lowest rank with a weighted mean score of 2.03, and a verbal interpretation of "sometimes". This could mean that data automation reduces manual intervention to a certain extent and ensure the accuracy, real-time and integrity of data by automatic data collection, storage and processing, and data automation is reflected in the construction of intelligent hospitals by digitalization practices. According to the studies of Uslu et al. (2020) and Delice et al. (2023), the efficient operation of IoT is based on the automation of massive amounts of data.

Table 3

Summary Table on Usage of Data Analytics

Key Result Areas	Composite Mean	VI	Rank
Cost-benefit Analysis	2.60	Often	2
Risk Management	2.78	Often	1
Predictive Analysis	2.44	Sometimes	3
Grand Composite Mean	2.61	Often	

Legend: 3.50 - 4.00 = Always; 2.50 - 3.49 = Often; 1.50 - 2.49 = Sometimes; 1.00 - 1.49 = Never

Table 3 presents the respondents' evaluations of summary table on usage of data analytics. The composite mean is 2.61, indicating that the respondents consider that data analytics are often embodied in cost-benefit analysis, risk management and predictive analysis. This means that the vast majority of respondents believe that the application of data analysis in cost-benefit analysis, risk management and predictive analysis is an important element in the construction of intelligent hospitals. According to the study of Kwon et al. (2022), cost-benefit analysis, risk management and predictive analysis are integral parts of smart medical services in a real medical environment. Risk Management is ranked the first with a weighted mean score of 2.78 points, and the verbal explanation is "often". This could mean that the vast majority of respondents consider that data analysis has a notable function in risk identification and management. This can be related to the studies of Mahmoudi et al. (2020) and Escobar et al. (2020), after data analysis of patients' health data information, signs of patient's condition changes being found in time, reminding medical staff or patients themselves, and giving corresponding early intervention measures to reduce the risk of readmission and death.

Cost-benefit Analysis ranked second with weighted means of 2.60 respectively with a verbal interpretation of often. Predictive Analysis got the lowest rank with a weighted mean score of 2.44, and a verbal interpretation of "often". This could mean that the vast majority of respondents believe that although data analysis has the lowest weight in predictive analysis management, it is also very important to build a basic intelligent hospital management system. According to the studies of Koti et. al.,(2019) and Giordano et al. (2021), smart hospital management system uses data analysis to make predictive analysis for appropriate diagnosis and appropriate treatment of patients with certain diseases.

Table 4 presents the respondents' evaluations of summary table on artificial intelligence implementation. The composite mean is 2.46, indicating that the respondents consider that artificial intelligence are sometimes embodied in records management, administrative tasks automation and clinical decision support. This means that a small number of respondents believe that AI plays an important role in records management, the application of administrative tasks automation and clinical decision support which is an important element of building an intelligent hospital. According to the studies of Huang et al. (2021) and Ramgopal et al. (2023), AI is a requirement for the construction of intelligent hospital management system.

Table 4

Summary Table on Artificial Intelligence Implementation

Key Result Areas	Composite Mean	VI	Rank
Records Management	2.34	Sometimes	3
Administrative Tasks Automation	2.42	Sometimes	2
Clinical Decision Support	2.61	Often	1
Grand Composite Mean	2.46	Sometimes	

Legend: 3.50 - 4.00 = Always; 2.50 - 3.49 = Often; 1.50 - 2.49 = Sometimes; 1.00 - 1.49 = Never

Clinical Decision Support is ranked the first with a weighted mean score of 2.61 points, and the verbal explanation is "often". This could mean that respondents overwhelmingly believe that AI is important for clinical decision support. This can be related to the study of Loftus et al. (2023), AI plays an important role in clinical decision not only support in surgery but also sepsis management, where they can assist in prediction, diagnosis, and treatment optimization (Wu et al., 2021). Administrative Tasks Automation and Digitalization practices makes sharing of medical information more convenient ranked second with weighted means of 2.42 with a verbal interpretation of sometimes. Records Management got the lowest rank with a weighted mean score of 2.34, and a verbal interpretation of "sometimes". This could mean that a few interviewees believe that although AI has the lowest weight in archives management, it is also important for building a basic intelligent hospital management system. The evolution of medical records from ancient times to modern electronic formats reflects the development of Health systems, with AI algorithms streamlining medical services and improving patient management (Lorkowski et al., 2022). According to the study of Kaswan et al. (2021), AI can automatically, efficiently and accurately process massive health information, thus providing data basis for the operation of intelligent hospitals.

Table 5

Relationship Between Digitalization Practices and Data Analytics

Variables	rho	p-value	Interpretation
Process Optimization			
Cost-benefit Analysis	0.469**	<.001	Highly Significant
Risk Management	0.474**	<.001	Highly Significant
Predictive Analysis	0.259**	<.001	Highly Significant
Data Automation			
Cost-benefit Analysis	0.509**	<.001	Highly Significant
Risk Management	0.624**	<.001	Highly Significant
Predictive Analysis	0.312**	<.001	Highly Significant
Patient Management			
Cost-benefit Analysis	0.529**	<.001	Highly Significant
Risk Management	0.595**	<.001	Highly Significant
Predictive Analysis	0.265**	<.001	Highly Significant

***. Correlation is significant at the 0.01 level*

Table 5 shows the relationship between digitalization practices (Process Optimization, Data Automation, and Patient Management) and data analytics usage (Cost-Benefit Analysis, Risk Management, and Predictive Analysis). Across all variables, the correlation coefficients (*rho*) are positive and significant at the 0.01 level, indicating a weak to strong relationship. Specifically, Data Automation has the highest correlations with Risk Management (*rho* = 0.624) and Cost-Benefit Analysis (*rho* = 0.509), suggesting that increased digitalization in automating data is closely associated with improved analytical outcomes in these areas. Similarly, Patient Management shows significant relationships, particularly with Cost-Benefit Analysis (*rho* = 0.529) and Risk Management (*rho* = 0.595). Overall, the results highlight the importance of Digitalization Practices in enhancing data analytics capabilities, especially in terms of Risk Management and Cost-Benefit Analysis.

The Data Automation has the highest correlations with Risk Management (*rho* = 0.624). The strong correlation suggests that as organizations increase the use of Data Automation, their ability to manage risks effectively also improves. Automated data systems can identify patterns and anomalies faster and more

accurately which helps to detect potential risks early, improve compliance monitoring by automatically flagging deviations from standards or regulations, reduce human error in data handling, and provide real-time data that enables quicker responses to emerging risks. This can be related to the study of Bouami et. al.,(2020) that automated systems can improve safety, efficiency, and performance in critical areas like medication dispensing. Automated risk management systems enable more accurate, structured, and accessible data, leading to improved data-driven decision-making (Zaikovsky et. al.,2021).

The correlations of risk management with patient management, patient management with cost-benefit analysis, cost-benefit analysis with cost-benefit analysis, risk management with process optimization, process optimization with cost-benefit analysis, predictive analysis with data automation, and predictive analysis with patient management are high (*rho* = 0.595, 0.529, 0.509, 0.474, 0.469, 0.312, 0.265).

The predictive analysis has the lowest correlations with process optimization (*rho* = 0.259). The weak correlation is suggests while predictive analysis might provide valuable insights into future trends or outcomes, it doesn't have a strong direct impact on making immediate improvements to how processes are structured or operated. This can be related to the studies of Wamba et al. (2019) and Hu et al. (2020) that although predictive analysis is helpful for long-term planning of hospitals, its direct impact on daily process optimization is small. Digitalization addresses challenges in risk management by enhancing data analysis capabilities (Kumar, 2022). In healthcare, by leveraging big data analytics, risk management practices can be applied, thereby improving service quality. Specifically, risk identification and risk monitoring link big data analytics to the quality of healthcare services (Basile et al., 2024). Overall, the results highlight the importance of digitalization practices in enhancing data analytics capabilities, especially in terms of risk management and cost-benefit analysis.

Table 6

Relationship Between Digitalization Practices and Artificial Intelligence Implementation

Variables	rho	p-value	Interpretation
Process Optimization			
Records Management	0.516**	<.001	Highly Significant
Administrative Tasks Automation	0.493**	<.001	Highly Significant
Clinical Decision Support	0.492**	<.001	Highly Significant
Data Automation			
Records Management	0.491**	<.001	Highly Significant
Administrative Tasks Automation	0.521**	<.001	Highly Significant
Clinical Decision Support	0.509**	<.001	Highly Significant
Patient Management			
Records Management	0.487**	<.001	Highly Significant
Administrative Tasks Automation	0.509**	<.001	Highly Significant
Clinical Decision Support	0.529**	<.001	Highly Significant

***. Correlation is significant at the 0.01 level*

Table 6 illustrates the relationship between Digitalization Practices (Process Optimization, Data Automation, and Patient Management) and the implementation of artificial intelligence (AI) in various areas (Records Management, Administrative Tasks Automation, and Clinical Decision Support). All variables show positive and highly significant correlations ($p < .001$), indicating a moderate relationship between digitalization efforts and AI adoption. Notably, Process Optimization is moderately correlated with Records Management (*rho* = 0.516) and Clinical Decision Support (*rho* = 0.492). Data Automation shows the highest correlation with Administrative Tasks Automation (*rho* = 0.521), suggesting that automating data processes is particularly beneficial for streamlining administrative operations through AI. Similarly, Patient Management has its strongest correlation with Clinical Decision Support (*rho* = 0.529), emphasizing the role of Digitalization in enhancing AI-driven decision-making in clinical settings. Overall, the findings suggest that Digitalization significantly supports the implementation of AI across various operational and clinical functions.

The clinical decision support (CDS) has the highest correlations with Patient Management (*rho* = 0.529).

The strong correlation suggests that when healthcare providers use CDS systems, the quality, accuracy, and efficiency of managing patients improve significantly. CDS systems provide up-to-date medical knowledge and data-driven recommendations, helping clinicians make more informed decisions for patient care, and help manage complex cases by integrating patient information from different sources, ensuring that care is well-coordinated and all relevant data is considered. According to the studies of Patel et. al.,(2021) and Bright et al. (2019) CDS has a significant impact on improving the accuracy of clinical decision making and patient management, reducing medical errors, improving patient outcomes, and promoting continuous care.

The correlations of Administrative Tasks Automation with Data Automation, Records Management with Process Optimization, Clinical Decision Support with Data Automation, Administrative Tasks Automation with Patient Management, Administrative Tasks Automation with Process Optimization, Clinical Decision Support with Process Optimization, and Records Management with Data Automation are high (rho = 0.521, 0.516, 0.509, 0.509, 0.493, 0.492, 0.491).

The Records Management has the lowest correlations with Patient Management (*rho* = 0.487). The weak correlation is suggests although efficient records management is essential for healthcare operations in smart hospital system, it does not significantly affect the real-time, day-to-day decisions made regarding patient care and management. Records Management focuses on data organization, compliance, and storage, rather than directly influencing clinical decision-making or patient outcomes, while actual patient management relies heavily on real-time clinical insights, decision support systems, and clinician-patient interactions. This can be related to the studies of Nwobodo-Anyadiegwu et al. (2022) and Grosman-Rimon et al. (2023) although records management is important for improving data integrity and compliance, it is more used for late-stage data review and has limited direct impact on patient management.

Digitalization provides stems from the fact that digital platforms create vast amounts of structured and unstructured data, which AI systems rely on for training, learning, and making informed decisions. Without digitalization, AI would lack the necessary infrastructure and data to be effectively implemented across various healthcare functions. According to the studies of Reddy et. al.,(2019) and Wang et. al.,(2019), AI needs a large amount of digital data to function in operations and clinical functions, while digitalization technology is also the core support to drive AI implementation.

Table 7

Relationship Between Data Analytics and Artificial Intelligence Implementation

Variables	rho	p-value	Interpretation
Cost-benefit Analysis			
Records Management	0.333**	<.001	Highly Significant
Administrative Tasks Automation	0.399**	<.001	Highly Significant
Clinical Decision Support	0.411**	<.001	Highly Significant
Risk Management			
Records Management	0.490**	<.001	Highly Significant
Administrative Tasks Automation	0.477**	<.001	Highly Significant
Clinical Decision Support	0.461**	<.001	Highly Significant
Predictive Analysis			
Records Management	0.213**	<.001	Highly Significant
Administrative Tasks Automation	0.233**	<.001	Highly Significant
Clinical Decision Support	0.283**	<.001	Highly Significant

***. Correlation is significant at the 0.01 level*

Table 7 presents the relationship between Data Analytics usage (Cost-Benefit Analysis, Risk Management, and Predictive Analysis) and the implementation of AI in Records Management, Administrative Tasks Automation, and Clinical Decision Support. The correlations are positive and highly significant (p<.001), indicating that greater use of Data Analytics is weak to moderately correlated with AI implementation across various operational and clinical areas.

Risk Management shows the highest correlations with AI, particularly in Records Management (*rho* = 0.490), suggesting that effective Risk Management through Data Analytics is closely tied to AI adoption in handling records. According to the studies of Riaño et al. (2019) and Escobar et al. (2020), AI supports various risk management in medical records, especially when dealing with sensitive data. Data analysis combined with AI technology is data-driven, and plays a risk management role by automating analysis to identify and reduce potential risks.

Cost-Benefit Analysis also has weak to moderate correlations, especially with Clinical Decision Support (*rho* = 0.411) and Administrative Tasks Automation (*rho* = 0.399), highlighting the importance of data-driven decisions in these areas. Predictive Analysis shows lower correlations overall, while still significantly correlated, with its strongest association in Clinical Decision Support (*rho* = 0.283). The Records Management has the lowest correlations with Predictive Analysis (*rho* = 0.213). The weak correlation is suggests while Records Management ensures the integrity and accessibility of data, it does not directly contribute to or benefit from Predictive Analysis techniques, which are more focused on analyzing patterns in data to forecast future outcomes. According to the studies of Wright et. al.,(2021) and Patel et. al.,(2019), although Record Management is essential for storing data, in practical applications in healthcare, the integration between record management systems and predictive analytics systems is difficult, so the direct correlation between the two is low.

The use of Data Analytics in healthcare increases, there is a statistically significant (but not necessarily strong) relationship with the implementation of AI in both operational (e.g., administrative tasks, resource allocation) and clinical (e.g., diagnosis, treatment) areas. Even though the correlations are significant, the strength of the relationship ranges from weak to moderate, suggesting that while Data Analytics supports AI adoption, it is not the sole driver, and other factors may also play important roles. This can be related to the studies of Sendak et al. (2020) and He et al. (2019) that despite the positive impact of Data Analytics on AI implementation and the significant correlation between the combination of the two in clinical and operational functions, the strength varies across applications, showing a weak to moderate correlation overall.

Research Output

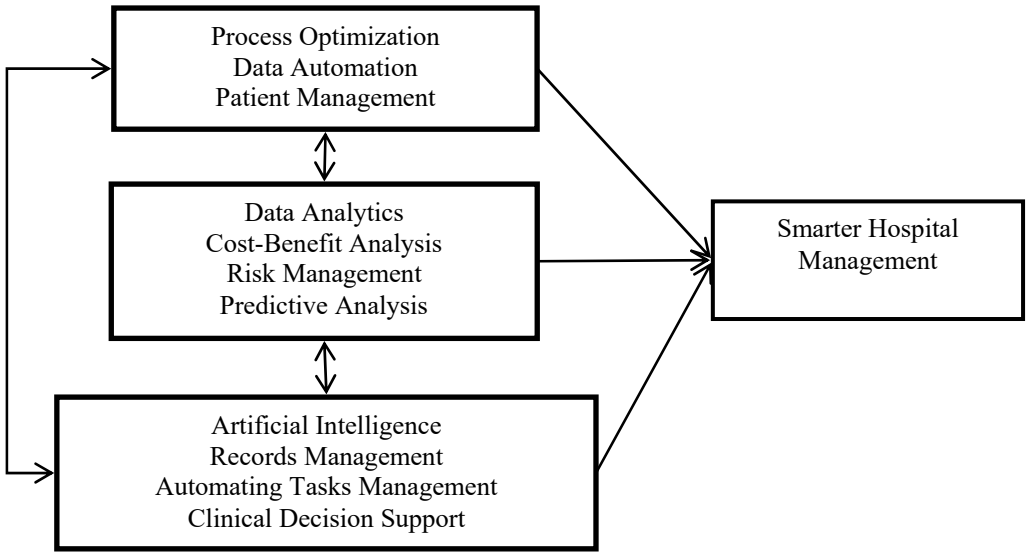

Figure 1. Smarter Hospital Management Framework for Public Hospitals

According to the research results of this paper, we have constructed an intelligent public hospital framework for intelligent and efficient management, whose core elements are digital practice, data analysis and artificial intelligence. First of all, digital practices are the infrastructure of smart hospitals. Through the implementation of process optimization, data automation and patient management, digitalization can optimize various hospital business processes such as appointment registration, bed management, drug distribution, improve operational efficiency, and reduce waste. Collecting and processing data in real time with the help of automation tools such

as sensors and electronic medical record systems ensure accuracy and consistency of data automation. Using technologies such as online appointments to improve patient engagement and enhance the interaction between hospitals and patients, is conducive to patient management. Digitalization practices generate a deal of high-quality structured data, which provides the basis for subsequent data analysis and artificial intelligence models. For example, automated medical records enable data analysis for trend mining, while also providing accurate data input for AI applications.

Second, data analysis connects digital practices with artificial intelligence in smart hospitals. Data analytics extracts value and provides insights with the help of high-quality data generated by digitalization practices. These insights, in turn, provide direction for the training of AI models. Among them, cost-benefit analysis of hospital operation costs and benefits, to provide the basis for resource allocation optimization; The risk management of monitoring and identifying potential risks (such as equipment failure or medical accident) is the guarantee of safe operation of the hospital. Finally, the predictive analysis of predicting patient flow and disease epidemic trend based on historical data provides prospective evaluation for operation and clinical decision-making, and provides data support for the future development of the hospital.

Finally, artificial intelligence is the core driver of smart hospitals. Artificial intelligence relies on data analysis and digital practice to promote hospitals to achieve a higher level of intelligence. AI simplifies medical record management through natural language processing technology, improves data entry and retrieval efficiency, and realizes intelligent document management. Automatically complete administrative tasks such as scheduling and material management through machine learning models to reduce human burden; AI models are used to provide diagnosis and treatment suggestions for doctors, improving medical accuracy and efficiency. AI applications are highly dependent on the support of data analysis and the foundation of digital practices. Without high-quality data and analysis results, AI models will lack sufficient training sets and even lead to wrong decisions. All in all, the three elements of digital practice, data analysis and artificial intelligence form the basic framework of intelligent public hospitals. Through the deep integration of the three elements, intelligent public hospitals can significantly improve operational efficiency, improve patient experience, and achieve the goal of precision and sustainable development. This multi-level synergy is the core driving force of intelligent hospital construction in the future.

4. Conclusion and recommendations

In the smart hospital management system, Digitalization is sometimes practiced in terms of process optimization, data automation, and patient management. Data Analytics is often applied in Cost-Benefit Analysis, Risk Management, and Predictive Analysis. The application of AI is sometimes utilized in Document Management, Task Management Automation and Clinical Decision Support. There is a significant relationship between Digitalization Practices and Digital Analytics, Digitalization Practices and Artificial Intelligence, and Digital Analytics and Artificial Intelligence. A Smarter Hospital Management system framework is proposed. Hospitals may actively use digitalization practice to optimize processes, realize automatic data management, and build efficient patient-centered management systems to improve overall operational efficiency. Make full use of data analysis technology to conduct cost-benefit assessment, risk early warning, and demand forecast, and help hospitals make scientific decisions and allocate resources rationally. Promote the in-depth application of artificial intelligence technology in record management, administrative automation and clinical decision support, and improve service quality and work efficiency. Hospitals in China may review and utilize the proposed framework to build a smarter hospital management system. Future researchers may study the environmental and economic sustainability of smart hospital operations, particularly the impact of digitalization on energy consumption, waste management, and operational costs.

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