

The Role of Artificial Intelligence in Developing Hospital Information Management Systems

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ABSTRACT

Hospital information management systems (HIMS) play significant roles in improving clients' health by applying developed technologies, one of which is artificial intelligence (AI). This study aims to explore the roles of AI in order to support the development of HIMS. We conducted a literature review by extracting the articles from PubMed, ProQuest, and Google Scholar in the past 5 years (January 2019-August 2023) using specific keywords. The full text of relevant articles then thematically synthesized and to be presented. Our findings revealed eight themes that represent the role of AI in supporting the hospital information management system and its implementation in healthcare settings. The themes identified include Diagnosis and Medical Imaging, Health Data Management, Risks Prediction and Disease Progression, Inventory and Procurement Management, Telemedicine and Remote Consultation, Patient Care Management, Drug Development and Clinical Research, and Hospital Data Security System. The AI implementation brings the potential to improve efficiency, accuracy, and quality of care in hospitals. However, it should be noted that the development and implementation of AI need to consider the ethical aspects and proper integration through existing health systems.

Kata kunci:

Artificial Intelligence;
Sistem Informasi
Manajemen Rumah Sakit;
Pelayanan Kesehatan;
Pelayanan Rumah Sakit;
Teknologi

Sistem Manajemen Informasi Rumah Sakit memainkan peran penting dalam meningkatkan kesehatan klien dengan menerapkan teknologi yang dikembangkan, salah satunya adalah Kecerdasan Buatan. Penelitian ini bertujuan untuk mengeksplorasi peran kecerdasan buatan dalam rangka mendukung pengembangan Sistem Manajemen Informasi Rumah Sakit. Penelitian ini menerapkan tinjauan literatur dengan mengekstraksi artikel dari PubMed, ProQuest, dan Google Scholars dalam 5 tahun terakhir (Januari 2019-Agustus 2023) menggunakan kata kunci tertentu. Teks lengkap artikel yang relevan kemudian disintesis secara tematis dan disajikan. Temuan kami mendapatkan delapan tema yang mampu merepresentasikan peran Kecerdasan Buatan dalam rangka mendukung Sistem Manajemen Informasi Rumah Sakit serta implementasinya dalam Pengaturan Perawatan Kesehatan yakni Diagnosis dan Pencitraan Medis, Manajemen Data Kesehatan, Prediksi Risiko dan Perkembangan Penyakit, Manajemen Inventaris dan Pengadaan, Tele-medisin dan Konsultasi Jarak Jauh, Manajemen Perawatan Pasien, Pengembangan Obat dan Penelitian Klinis, Sistem Keamanan Data Rumah Sakit. Implementasi Kecerdasan Buatan membawa potensi untuk meningkatkan efisiensi, akurasi, dan kualitas perawatan Rumah Sakit. Namun, perlu dicatat bahwa pengembangan dan implementasi AI perlu mempertimbangkan aspek etika, dan integrasi yang tepat melalui sistem kesehatan yang ada.

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INTRODUCTION

Hospitals play significant roles in providing health services in order to improve the health status of both individuals and groups (Gjærde et al., 2021). The services provided by the hospital focus on improving the client's health and functionality and are aimed at the wider community (Wartiningih et al., 2020).



Hospital health services are certainly developing in line with current technological developments. In providing excellent and quality service, hospitals have to be well-taken care of by the latest trends or developments, as simple as applying information technology (Chen et al., 2021). The application of information technology is expected to help hospitals achieve efficiency and effectiveness in health services (Prandana et al., 2019; Sjaaf et al., 2020). A recent study stated that the implementation of technologies such as digital marketing could improve patient visit intention (Hariyanti et al., 2023).

The use of technologies in hospitals could potentially improve the degree of individual health and functionality as well as the performance of healthcare providers and minimize costs, which can improve hospital quality (Khalifa & Alswailem, 2015). Hospital information management Systems are considered important in the health industry as they support specialized health activities and services with a wide scope (Ahmadi et al., 2017).

Hospital information management systems can be seen by optimizing the use of technology. The implementation of AI can be seen in previous studies. Several studies state that the application of AI has a significant impact on the progress of health services provided to patients (Lee & Yoon, 2021; Marlon et al., 2020). Recently, integrated technologies have also contributed to the client's loyalty and improved service quality (Aripin & Paramarta, 2023).

The research focusing on AI has been published extensively. Despite this extensive research on AI in many sectors, there's a research gap in terms of understanding the role of AI in the health sectors, especially in the hospital information management system. Therefore, the research regarding the role of AI in the scope of health services, especially in the form of hospital information systems, still needs to be identified.

This Literature review provides some insights regarding the role of AI in supporting the HIMS. This study aims to review the relevant literature correlated to AI and identify its roles in order to develop the HIMS. This study ought to address one major objective, which is to identify the roles of AI in supporting HIMS.

RESEARCH METHOD

Design

We conducted a literature review using a reliable and replicable research protocol, which allowed the researchers to extract the articles from PubMed, ProQuest, and Google Scholar.

Study selection and data extraction

We have searched for the original peer-reviewed articles regarding AI and HIMS by using keywords such as 'Hospital Information Management System,' 'artificial intelligence,' 'AI,' 'HIMS,'; 'Hospital Management.' The articles should meet the eligibility criteria, such as full-text articles published between January 2019 and August 2023, written in English or Indonesian languages, available online, and accessible. Study types were limited to intervention studies, such as RCTs, case-control studies, quasi-experimental studies, and pre-post-design studies.

We identified 298 from a thousand articles shown based on the keywords. The Reviewers independently screened titles and abstracts, reviewed the full text of relevant

articles, and excluded 179 based on the relevancies; 36 articles were books and proceedings, and 46 were excluded based on duplication. Therefore, 37 potential articles were obtained to be reviewed, and thematically synthesized data to be presented as shown in Diagram 1.

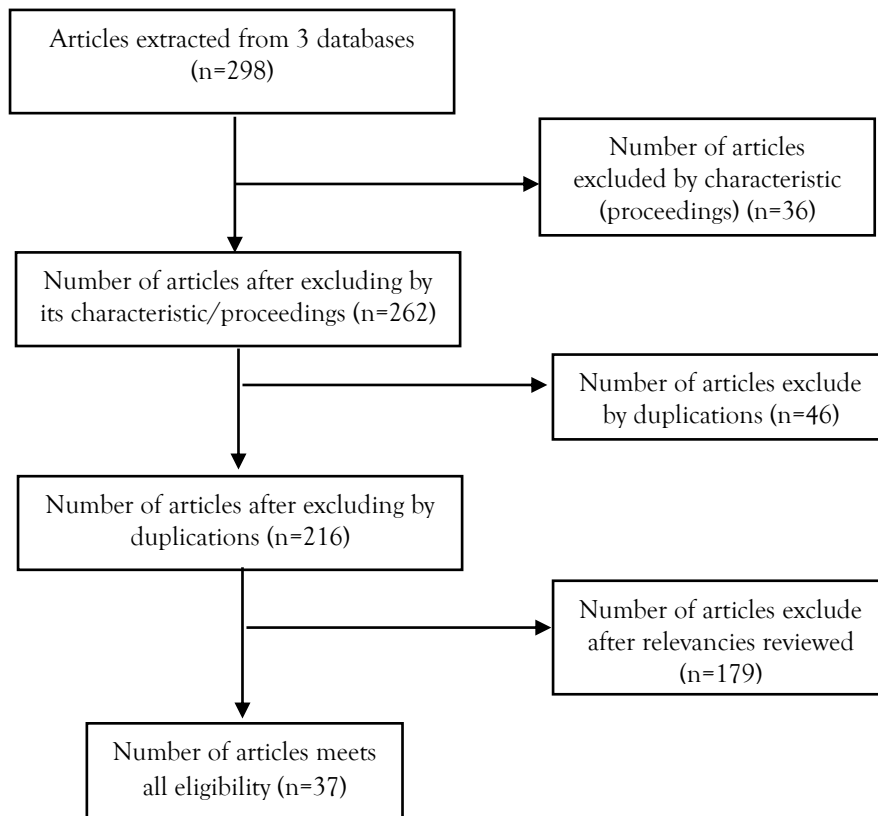


Diagram 1. Research Flow Diagram

RESULTS AND DISCUSSION

AI in health services, especially in hospitals, has been the focus of many studies. We identified the 8 themes as our findings based on the related published articles.

1. Diagnosis dan Medical Imaging

Several research studies highlighted the success of AI implementation in diagnosing chronic diseases such as cancers, heart diseases, and other disorders through medical imaging. CT scans, MRIs, and radiography represent this medical imaging. AI is capable of processing and analyzing medical images with high accuracy, assisting healthcare providers in making faster and more accurate diagnoses. Based on the recent AI revolution, several significant points were made in improving the prediction of accuracy, speed, and efficiency regarding the diagnostic process through the application of more advanced algorithms, which means that disease identification and diagnosis become more accurate and faster, as well as effective (Hanifudin et al., 2023).

The use of AI in the medical diagnosis and imaging process is superior in analyzing large quantities of data and running them all at once. Therefore, it is becoming more efficient (Al-Antari, 2023). The study implied that these large quantities include 2D/3D

medical imaging, bio-signals (e.g., ECG, EEG, EMG, and EHR), vital signs (e.g., body temperature, pulse, respiratory rate, and blood pressure), demographic information, medical history, and laboratory examination (Al-Antari, 2023). AI indicates a more complete picture of the patient's health, reduces the possibility of diagnostic errors, and increases the accuracy of diagnosis (Al-Antari, 2023).

Despite its important role in diagnosis and medical imaging, AI implementation in medical decision-making may raise ethical concerns regarding responsibility and accountability. Fully automated decision-making without human involvement can introduce risks and confusion associated with medical decisions (Tang et al., 2023).

2. Health Data Management

AI is used to manage and analyze large as well as complex medical data, such as electronic medical records, disease histories, and patient information. It helps healthcare providers make good decisions and provide care tailored to each patient. Although there is not much explanation regarding the role of AI in Electronic Health Records (EHR), it is known that AI technology can indeed be considered to help information systems, especially EHR, but vigilance regarding the level of security must also be taken into account to prevent data leaks (Overman, 2022).

The implementation of AI in health data management should be considered in the existing hospital information system. The implementation and integration of those systems might require technological adjustments, additional costs, and a significant amount of time (Vuong et al., 2019).

3. Risk Prediction and Disease Progression

AI is used to predict the risk of developing certain diseases based on certain factors, such as the risk of heart disease, based on medical history and lifestyle. It allows early intervention to prevent disease progression. Several studies stated that AI as a technological intervention could help hospitals predict diabetes mellitus (Choi et al., 2019; Nomura et al., 2020), hypertension (Ye et al., 2018), thyroid disease (Somnay et al., 2017)., to preventive measures to prevent heart disease failure (Kwon et al., 2020; Segar et al., 2019). In fact, a literature review conducted explained that AI was able to contribute significantly to the follow-up program of patient disease progression after medical procedures (Fan et al., 2020).

AI, as a modern technology, has entered the mainstream of clinical medicine. Diagnostics has traditionally been one of the main areas of AI in the context of medicine. AI is predicted to vastly change diagnostic and medical image analysis in the coming years through increasingly advanced technologies.

Through research by Cahyo & Astuti, 2023, it is known that AI technology is useful in predicting disease diagnoses and can analyze medical images to identify certain diseases, meaning that it can differentiate between benign and malignant diseases. AI could also help identify the risk of mental illnesses and identify the risk of suicide among patients with psychiatric disorders or certain populations, such as prisoners and soldiers. It helps doctors quickly obtain disease information and provide more accurate disease diagnoses, thereby saving time in disease treatment.

While AI has shown great promise in predicting risks and disease progression, its implementation has to consider the comprehensive and diverse datasets that can be challenging due to issues such as incomplete medical records, data silos, and privacy concerns (Hlávka, 2020).

4. Inventory and Procurement Management

Several systematic research reviews highlight AI in inventory management and procurement in hospitals. AI has revolutionized Inventory and Procurement Management by introducing predictive analytics, automation, and optimization techniques. AI can predict equipment and inventory needs, help optimize procurement, and reduce waste and costs. Eldi & Syaputra (2020) found that the implementation of AI through the application of Chatbots has been proven to significantly help hospital effectiveness and efficiency through a good order management or procurement system that meets hospital needs. Management or procurement is explained through patient requests according to treatment needs.

The implementation of AI in inventory and procurement processes may require a shift in the Hospital culture and workflows. Employees need to be trained to work with AI systems, and resistance to change can be a barrier to successful implementation (Merhi, 2023). Therefore, AI systems also need to be adaptable to changes in the hospital environment and scalable to ensure the system is well operated. Ensuring that the AI solution can evolve with the hospital's needs is essential (Greenspan et al., 2020).

5. Telemedicine and Remote Consultation

Information technology, through AI in the medical industry, can effectively improve the quality, effectiveness, and efficiency of hospital services. The effective use of AI has resulted in telemedicine projects being implemented in many countries. It is known that the use of telemedicine has been widely carried out through AI optimization by applying the TAM method (Kamal et al., 2020). A study by Hidayat et al. (2022) through their research found that the application of AI-based telemedicine technology has made a significant contribution to the development of patient health. Similarly, another study stated that Hospital Telemedicine programs contributed significantly to patient experiences while receiving hospital services (Antonio & Wuisan, 2023) and increased their satisfaction and loyalty (Sudarwati et al., 2023).

Telemedicine health services initiated through AI can be obtained by patients through receiving self-care education anywhere and at any time (Banerjee et al., 2020; Berg et al., 2020). The use of AI allows patients to get information 24 hours a day. For example, the use of AI in telemedicine applications provides benefits for diabetic foot patients to get information to diabetic foot patients regarding complaints they feel and can carry out initial treatment or care at home guided by the AI system (Corbett et al., 2020; Gogia, 2020; Kindle et al., 2019).

Implementing AI in telemedicine and remote consultation holds great potential. However, there is a lack of standardized protocols and interoperability in telemedicine platforms, leading to challenges in integrating AI solutions seamlessly into different telemedicine systems and sharing information across platforms (Lamprinakos et al., 2015).

Despite the obstacles, the ongoing advancements in technology and collaborative efforts between healthcare providers, tech companies, and regulatory bodies are helping overcome challenges and drive the adoption of AI in telemedicine and remote consultation. A thoughtful and patient-centered approach is required to ensure the successful integration of AI technologies into hospital systems.

6. Patient Care Management

AI can help optimize patient care plans, monitor patient progress, provide early warning of changes in conditions that require rapid intervention, and improve care coordination. The next role of AI can be to improve patient safety protocols. There is a significant opportunity to leverage AI and new data sources to reduce the frequency of harm. Suppose the development of patient safety can be more accurate. In that case, it is hoped that the potential for incidents to occur can be reduced, and perhaps the potential dangers can even be identified before they occur so that accurate preventive measures can be taken. The speed of technological development means that health service providers must follow it quickly to catch up with information (Bates et al., 2021). Another study also states that AI is able to help manage the illness of pediatric patients suffering from COVID-19 in hospitals (Shi et al., 2023).

AI models heavily rely on high-quality and reliable data. In the hospital, there could be some issues, one of which is incomplete or inaccurate patient records, which can affect the performance of AI algorithms, leading to erroneous predictions or recommendations (Gianfrancesco et al., 2018). Successful AI implementation in patient care management requires a multidisciplinary approach that addresses technical, ethical, and hospital systems aspects to ensure improved patient outcomes and overall healthcare delivery.

7. Drug Development and Clinical Research

The note of AI implementation, by its high speed and analytical capabilities, has become an invaluable tool in accelerating drug development and research and enabling faster and more efficient discovery of new drugs. AI can assist in the identification of potential drug molecules and clinical trial design and facilitate more efficient drug development (Mirbabaie et al., 2022). AI in drug development has been stated in various research regarding its impact on developing drug screening (Paul et al., 2021), assisting drug discovery (Yang et al., 2019), and predicting bioactivity (Fagerholm et al., 2021) and toxicity (Pu et al., 2019).

Integrating AI into drug development and clinical research has the potential to revolutionize the process, but it comes with several challenges. Successful implementation of AI in drug development requires collaboration between computer scientists, data scientists, biologists, chemists, and healthcare professionals. Bridging the gap between these disciplines and fostering effective communication can be a significant challenge (Blanco-Gonzalez et al., 2023). Addressing this challenge requires a collaborative effort involving many professions and stakeholders. Ongoing research and advancements in AI technologies, along with clear regulatory frameworks, will contribute to overcoming the obstacles and unlocking the full potential of AI in drug development and clinical research.

8. Hospital Data Security System

A literature review shows that AI has many potential benefits in improving data security in hospitals. AI can be used to analyze access patterns to data in hospital systems. If an unusual or suspicious pattern is detected, the AI system can provide a warning or take automatic action to secure the data (Almalawi et al., 2022). AI systems are also known to monitor and analyze network activity, user access, and data transactions to detect potential attacks or fraud attempts. It helps in identifying and preventing unauthorized access to sensitive data (Kim et al., 2021). Other research also states that AI can help optimize the encryption process and data security throughout a hospital's IT infrastructure, including encryption of data while on the device, during transmission, and when stored in databases (Rodriguez et al., 2020). AI in hospital data security is known to be implemented through machine learning. AI can utilize machine learning algorithms to analyze access history and previous security incidents and help hospitals predict and prevent potential future security risks (Sundas et al., 2022).

The implementation of AI could potentially secure hospital data. However, sensitive and personal medical data must be closely guarded. The use of AI to analyze medical data presents security and privacy risks that must be handled carefully to ensure compliance with data privacy regulations such as GDPR or HIPAA (Thapa & Camtepe, 2021).

CONCLUSION

This study highlighted various potential roles and challenges in AI implementation in the HIMS. According to our findings, we concluded that AI played a role in developing Hospital Management Information systems through improving and optimizing service services such as medical diagnosis and imaging, managing health data, prediction of risk and disease progression, inventory management and procurement, telemedicine and remote consultation, patient care management, drug development and clinical research to hospital data security systems.

The AI implementation in HIMS is considered beneficial. AI could be potentially used to revolutionize hospital systems, providing improvements and alleviating hospital efficiency and patient-centeredness. However, despite the potential aspects of each theme, we also found obstacles that should be considered in implementing AI in HIMS, such as ethical issues, data integration, collaborative approach among professions and stakeholders, and confidentiality of hospital data.

Our study has been limited to three databases and only applied five keywords, which could have contributed negatively to missing other relevant studies. Further research might be required by conducting specific methods, especially quality check identification, and involving more databases and more keywords to make the research more comprehensive.

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CONFLICT OF INTEREST

The authors have no conflict of interest related to the study, authorship, and/or article publication to declare.

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