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The Application of Technology in Hospital Pharmacy Department to Enhance Administrative Services: A Literature Review

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ABSTRACT

The application of technology in hospital pharmacy settings is a crucial aspect in improving the quality of healthcare services, particularly in terms of work efficiency, medication management accuracy, administrative efficiency, and patient safety. The use of technology in pharmacy settings not only supports the performance of healthcare workers in distributing and managing medications but also accelerates administrative processes, minimizes errors, and increases patient satisfaction. The aims of this study is to analyze the application of technology in hospital pharmacy installations, focusing on the types of technology used, the implementation process, and their impact on work efficiency, drug management accuracy, and the quality of pharmaceutical services. This study used a literature study method by reviewing various scientific sources such as journals, books, and reports from relevant institutions over the past ten years. The results show that the application of technology through the integration of Hospital Information Systems (HIS) can improve the efficiency, accuracy, and quality of pharmaceutical services by minimizing human error, accelerating medication distribution, and simplifying reporting and auditing processes. However, the implementation of technology still faces challenges such as limited human resource competency, resistance to change, and suboptimal infrastructure.

1. Introduction

The application of technology in hospital pharmacy installations refers to the utilization of information systems and digital tools to support pharmaceutical services, including drug stock management, ordering systems, distribution, as well as documentation and reporting. In this context, the technologies applied may include pharmacy information systems, barcode systems, automated dispensing, and electronic medical record integration (Zheng et al, 2021). This topic is important to be studied because pharmacy installations play a strategic role in ensuring the quality, safety, and efficiency of hospital healthcare services.

According to the World Health Organization (2022), 50% of medication errors in healthcare facilities occur due to inadequate drug management systems, including the lack of information technology. Support. Furthermore, research by the Indonesian Ministry of Health (2021) showed that only about 38% of hospitals in Indonesia have optimally implemented pharmacy information systems, indicating that the digitalization level in hospital pharmacies remains relatively low.

In pharmacy management practice, inaccuracies in recording and stock management may lead to service delays and even medical risks for patients. The presence of information technology through the implementation of Hospital Information Systems (HIS) allows these processes to be digitized and integrated. HIS in pharmacy installations functions as a support system in real-time monitoring of drug availability, automation of distribution processes, and drug utilization reporting, directly improving efficiency and reducing human error in work processes

This system also accelerates services, where drug requests from service units can be processed automatically through the hospital internal HIS network without going through time-consuming manual procedures. As a result, patient services become faster and more accurate, increasing satisfaction and public trust in hospitals (Emon et al, 2023). In addition, this information system supports cost control through the

optimization of drug inventory management, systematically preventing oversupply or shortages.

Regulatively, hospital operations in Indonesia have been mandated to implement HIS as part of the national health information system. HIS is designed to process and integrate all hospital service activities, including pharmacy, with the objective of providing fast, accurate, and reliable information to support decision-making and public services (Septiani & Sulistiadi, 2023). In other words, HIS is not merely a tool but a foundation for digital transformation across all service units, including pharmacy.

The success of HIS implementation largely depends on the positive interaction of three main elements: technology used, human resource readiness, and institutional support. These elements must align to ensure effective and sustainable system operations. Educational and competency development in information technology also serve as important enablers for pharmacy units to manage HIS optimally (Molly & Itaar, 2021). Furthermore, the presence of pharmacy staff familiar with digital systems can improve the smooth execution of routine tasks.

The quality of the HIS system, the information produced, and the services provided are the key factors that determine system effectiveness (Chen et al, 2022). If these aspects are met, HIS utilization will have a positive impact on both individual pharmacy staff and overall organizational performance. With the support of the Hospital Information System (HIS), coordination among work units becomes faster and more efficient, as information access is more open and integrated. However, challenges remain in HIS implementation in pharmacy installations. Common obstacles include server disruptions, system mismatches, and limited technical skills among hospital staff in operating the system. Therefore, hospital management must maximize training, system maintenance, and positive perceptions toward technology to optimize system use (Putra et al., 2020). Properly managed, HIS can be a strategic tool in supporting complex and dynamic hospital governance.

Currently, nearly all hospitals in Indonesia have implemented HIS due to regulatory requirements mandating its use as part of healthcare digitalization efforts (Pratiwi & Effendy, 2024). HIS implementation has brought positive changes in pharmacy installations, particularly in work efficiency, administrative transparency, accuracy of drug management, and improved inter-unit coordination. This system enables more integrated and real-time accessible information, optimizing both pharmacy staff and overall hospital performance.

Nevertheless, aside from its benefits, challenges remain in HIS implementation within pharmacy units. Common issues include server disruptions, application incompatibility with operational needs, and limited staff technical capacity in system operation. These challenges may hinder service delivery if not properly anticipated through training, maintenance, and building positive perceptions toward technology.

In conclusion, the advantages of HIS adoption include increased administrative efficiency, faster prescription services, reduced error risks, and strengthened drug governance. Therefore, the primary objective of this study is to identify the changes that occurred before and after HIS implementation in pharmacy installations while also examining the challenges that remain in its application.

Technological advancements also open opportunities for developing more advanced pharmacy systems, such as barcode-based drug distribution, electronic prescribing systems, and mobile applications for drug ordering (Williams et al, 2022). These innovations enable pharmacy services to become more transparent, faster, and accountable, while also facilitating monitoring by hospital management. In the long term, such technologies contribute to budget efficiency and reduced medical errors caused by improper drug management. However, financing remains the primary obstacle in technology adoption, as HIS procurement, technology devices, and staff training require substantial funding. Hospitals with limited budgets must develop careful, needs-based technology investment plans. Regular evaluations are also required to ensure that implemented technologies align with pharmacy needs and are not merely ceremonial.

The aims of this study is to analyze the application of technology in hospital pharmacy installations, focusing on the types of technology used, the implementation process, and their impact on work efficiency, drug management accuracy, and the quality of pharmaceutical services. This study also aims to identify challenges in technology utilization and provide strategic recommendations to optimize hospital pharmacy information systems

2. Theory

2.1. Techonology Acceptance Model (TAM)

The Technology Acceptance Model (TAM) was first introduced by Davis in 1989 as a framework to explain the factors influencing individuals in accepting and using technology. This model is rooted in behavioral psychology, particularly the Theory of Reasoned Action (TRA), which emphasizes that attitudes and intentions are closely related to actual behavior. In the hospital context, TAM can provide insights into why pharmacists or administrative staff are willing or reluctant to adopt new technologies in their work.

The main components of TAM are perceived usefulness (PU) and perceived ease of use (PEOU). Perceived usefulness refers to the extent to which an individual believes that using a particular technology will enhance their performance, while perceived ease of use refers to the degree to which the technology is believed to be easy to understand and operate. These two factors influence users' attitudes toward technology, which ultimately affect behavioral intentions and actual implementation. In the adoption of technology within hospital pharmacy installations, TAM can be employed

to assess whether the implemented system is perceived by users as beneficial and easy to use

2.2. Diffusion of Innovation Theory

The Diffusion of Innovation Theory was introduced by Everett M. Rogers in 1962 and subsequently revised through its fifth edition in 2003. This theory explains how an innovation or new technology is introduced, disseminated, and ultimately adopted by individuals or organizations within a society. According to Hudmon (2022), diffusion of innovations can be understood as a process of disseminating innovation through various communication channels over a specific period of time among members of a social system. This process not only involves the delivery of information regarding the existence of an innovation but also encompasses how the innovation is understood, accepted, and eventually adopted by individuals or groups. Diffusion thus entails not only the spread of information but also the acceptance, comprehension, and actual utilization of the innovation. In the context of hospital pharmacy installations, this theory provides an explanation of how pharmaceutical technologies are introduced and eventually adopted broadly by healthcare professionals

2.3. Hospital Information System (HIS)

A Hospital Information System (HIS) is an integrated information management system designed to manage the administrative, financial, and clinical aspects of a hospital (World Health Organization, 2021). HIS connects various hospital departments, including pharmacy, laboratory, finance, and medical records, through a centralized database that facilitates the flow of information (Alotaibi & Federico, 2017).

The key elements of the Hospital Information System (HIS) include several integrated components such as Electronic Medical Records (EMR), Pharmacy Information Systems (PIS), Billing and Financial Modules, and Inventory and Supply Chain Management. These elements work together to streamline hospital operations and enhance communication across departments. In the pharmacy department, HIS plays a crucial role in ensuring efficient drug dispensing, maintaining real-time stock control, and reducing errors in medication orders (Kumar et al., 2020).

3. Research Method

This study employed a literature review method by examining various relevant scientific sources concerning the application of technology in hospital pharmacy installations. The literature review was selected as it provides a comprehensive understanding of the concepts, implementation, and challenges of technology in supporting hospital administrative services. The literature sources included scientific journals, reference books, and official institutional reports addressing topics related to pharmacy management, hospital information systems, and healthcare technology innovations.

The process of literature collection was carried out by selecting publications published within the last ten years to ensure the relevance and timeliness of the data. Literature searches were conducted using academic databases such as Google Scholar, PubMed, ScienceDirect, as well as institutional and healthcare repositories. The inclusion criteria consisted of literature that directly discussed the application of technology in pharmacy installations, examined its impact on hospital administrative services, and demonstrated credibility in terms of both authorship and publication.

The inclusion criteria comprised articles published between 2015 and 2025, written in English, and directly discussing the application or impact of technology in hospital pharmacy departments or administrative processes. Only studies presenting empirical findings, systematic reviews, or conceptual analyses with clear methodological explanations were included. Meanwhile, the exclusion criteria involved non-peer-reviewed sources, conference abstracts without full texts, duplicated publications, and studies unrelated to hospital or pharmacy contexts.

The article selection process followed a multi-step screening approach. Initially, all identified records were collected and duplicates removed. Titles and abstracts were then reviewed to determine their relevance to the research topic. Subsequently, the full-text articles that met the inclusion criteria were thoroughly analyzed to extract essential data regarding the type of technology applied, its benefits, challenges, and outcomes related to administrative services in hospital pharmacy departments.

The selection process followed three main stages: (1) title and abstract screening to assess initial relevance; (2) full-text review to confirm eligibility based on inclusion criteria; and (3) data extraction from selected studies. Out of an initial pool of approximately 100 identified publications, a total of 10 studies met all inclusion criteria and were included in the final synthesis.

To ensure methodological rigor, the extracted data were analyzed using a thematic analysis approach, allowing the identification of recurring themes, patterns, and relationships across studies. The themes were grouped into categories such as types of technology applied, administrative efficiency outcomes, accuracy in drug management, and quality of pharmaceutical services. This analytical process enabled a structured synthesis of findings, thereby enhancing the transparency and validity of the review.

4. Results

4.1 Technology Implementation

Hospital Pharmacy Installations (HPI) are responsible for managing pharmaceutical supplies, including planning, procurement, storage, distribution, and prescription services (Kesehatan, 2016). The implementation of HIS serves as a strategic step to improve service efficiency and quality. With this system, drug recording and management that were previously manual can be automated, reducing human errors. Furthermore, integration between service units enables faster and more accurate prescription recording, inventory management, and administrative reporting (Polii et al., 2023).

According to the Indonesian Ministry of Health Regulation No. 82 of 2013, HIS is an information technology system that integrates hospital services, coordination, reporting, and administration to produce accurate information. This regulation also mandates all hospitals to implement HIS as the main support for effective and efficient healthcare services (Merita et al., 2023).

In drug procurement management, the pharmacy module within HIS enables real-time stock monitoring, inter-unit request processing, and automatic inventory reporting (Yasrizal & Darmawan, 2022; Pramestutie et al., 2021). This technological integration also accelerates drug distribution since requests from service units are digitally received by the pharmacy. Automated verification mechanisms help ensure prescription accuracy, prevent duplication, and support patient-specific dispensing that considers dosage, allergy history, and drug interactions (Sholistiyawati et al., 2020).

For drug and medical consumable administration, HIS includes comprehensive documentation such as prescriptions, purchase orders, and invoices. Specifically for narcotics and psychotropics, the Narcotics and Psychotropics Reporting System (SIPNAP) is used to record every drug movement in detail, reported via the official website (sipnap.kemenkes.go.id) (Adelia & Sari, 2024).

In addition, Electronic Medical Records (EMRs) are also implemented as computerized methods for collecting, storing, and transmitting medical record data with integration into e-prescribing systems. This integration allows doctors' prescriptions to automatically enter the pharmacy system, making the process faster, safer, and improving healthcare worker coordination (Koten et al., 2020; Salim et al., 2022).

4.2 Benefit of Technology Implementation

The implementation of information technology has been proven to enhance efficiency and transparency in hospital pharmacy management. Through HIS, pharmacy installations can anticipate shortages or oversupply, prevent drug expiration, and optimize budgets (Yasrizal & Darmawan, 2022; Pramestutie et al., 2021).

The integration of HIS in drug distribution accelerates service flow, supports automated prescription verification, and enables real-time monitoring of drug use per patient. Transparent distribution records also facilitate both internal and external audits (Sholistiyawati et al., 2020). The use of SIPNAP results in higher transparency, reduces the risk of misuse or loss of drugs, and ensures compliance with government regulations (Adelia & Sari, 2024). Information technology also facilitates inventory and internal audits through detailed digital documentation, making it easier to meet hospital accreditation standards (Mayasari et al., 2023).

Another benefit is observed in EMR implementation, which improves documentation accuracy, reduces clinical errors, accelerates patient data access, and enhances healthcare quality and patient satisfaction (Salim et al., 2022). Integration of EMRs with e-prescribing provides early warnings of potential drug interactions or allergies, thus improving medication safety (Koten et al., 2020).

The impact of technology adoption is also evident in patient satisfaction levels. Through hospital applications or patient portals, patients can track prescription status, receive medication-ready notifications, and reorder without visiting directly, thereby reducing queues and increasing convenience (Anggraeni & Gultom, 2021). In the long term, technology implementation helps hospitals optimize budgets, reduce waste, improve work efficiency, and encourage faster, more accurate, and higher-standard pharmaceutical services (Mokoagow et al., 2024).

4.3 Challenge in Technology Utilization

Despite its many benefits, technology implementation also faces various challenges. In terms of hardware, internet or server disruptions can hinder service continuity. Regarding software, mismatches between applications and operational needs are often found, requiring further adjustments (Polii et al., 2023).

From a human resource (HR) perspective, limited technical skills among staff in operating the system remain a major challenge, particularly for pharmacy personnel accustomed to manual methods. Resistance to change among staff is also a barrier. Thus, the success of HIS implementation depends greatly on HR readiness, training, and continuous system maintenance (Mayasari et al., 2023).

In stock monitoring, network or server disruptions may hinder real-time data access. In inter-unit requests, delays in data input often reduce system accuracy. Meanwhile, limited staff skills in preparing reports remain an obstacle, requiring continuous training (Yasrizal & Darmawan, 2022).

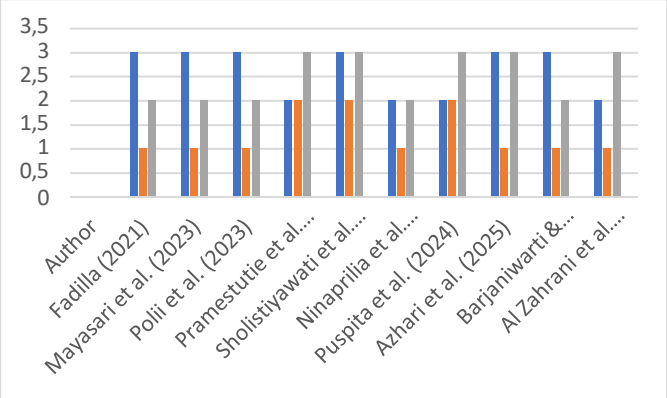
In automatic prescription verification, challenges arise when patient data are incomplete or input errors occur. The implementation of patient-specific dispensing also requires high accuracy, meaning limited trained personnel can decrease system effectiveness (Sholistiyawati et al., 2020).

Furthermore, infrastructure factors such as adequate hardware, stable internet networks, and proper system maintenance determine successful technology implementation. Without these, optimal system performance is difficult to achieve. Another important aspect is data security, as pharmaceutical data form part of sensitive medical records. Therefore, systems must be equipped with firewalls, data encryption, and multi-layer authentication to protect sensitive information from leakage or unauthorized access (Mayasari et al., 2023).

Table 0.1 Synthesis of Literature on The Application of Technology in Hospital Pharmacy Department

No	Author	Year	Types of HIS / SIM RS	Pharmacy Service	Before Implementation	After Implementation	Challenges
1	Nadifa Maulani Fadilla	2021	Hospital Information System	Stock management, distribution, administration, reporting	Manual process, many recording errors, slow distribution	Automated process, efficient, accurate, and transparent	Server/network disruptions may slow down access and data input
2	Mayasari, O., Karisma, A. D., Al Iskandari, A. F., & Insani, M. E.	2023	HIS	Medical record completion and clinical administration	Piled-up physical documents, slow recording	Faster documentation, more efficient, minimized archive space	Staff still accustomed to physical documents, requiring adaptation
3	Polii, S. V., Ratag, G. A., & Fatimawali, F.	2023	HIS at RSU GMIM Siloam Sonder	Drug, consumables, and medical equipment management	Delays in distribution and drug procurement	More efficient, transparent, and well-documented process	Delayed data input may still hinder distribution
4	Pramestutie, H. R., Illahi, R. K., Hariadini, A. L., Ebtavanny, T. G., & Savira, M	2021	HIS	Disposal of expired, damaged, and leftover drugs	Staff knowledge 59% good, poor practice	No practice improvement, insignificant knowledge–practice correlation	Lack of evaluation and follow-up
5	Sholistiyawati, A., Mawarni, A., & Dharmawan, Y.	2020	Pharmacy Information System (SIMFAR) at Bhakti Wira Tamtama Hospital	Pharmacy Information Management	Frequent disruptions, inaccurate drug stocks	Recommendations to improve SIM features (stock & data editing)	Features not fully optimized, prone to data errors
6	Ninaprilia, Z., Mutiara, R., & Mulyani, E. Y.	2024	SIM-Pharmacy at Gladish Medical Center	Inventory management and pharmacy performance	Low staff knowledge, only 35% of features used, incomplete reports	Significant knowledge improvement, increased SIM use, improved indicators	Some features rarely used due to limited socialization
7	Puspita, M., Maruapey, E. R., Qalbi, F. W., & Wardani, R.	2024	HIS – EMR System (Electronic Medical Record)	EMR-based pharmacy management	HIS menu did not fully support pharmacy, legacy data not integrated, lack of SOP socialization	SOP and workflow prepared, staff more prepared for EMR	Legacy data integration remains incomplete
8	Azhari, M., Setiawan, A., & Darmanto, E.	2025	Supply Chain Management-based HIS	Pharmacy Installation of Kudus District Health Office	Manual stock/distribution, frequent mismatches and delays	Real-time system improved accuracy, speed, and logistics efficiency	High dependency on system, errors disrupt distribution
9	Barjaniwarti, B., & Suryaningrat, D.	2022	e-Purchasing in SIM-Pharmacy	Drug procurement in pharmacy installation	Slow process, coordination barriers, delays in drug orders	More transparent, effective, efficient, controlled spending	Coordination barriers remain if service unit input is delayed
10	Al Zahrani et al	2024	HIS	Radiopharmacy and nursing integration	Not integrated, delayed services	More efficient collaboration, personalized therapy and molecular imaging support	Full integration requires significant time and cost

Figure 4.1. Summary of HIS Implementation, Impacts, and Challenges in Hospital Pharmacy Departments (2020–2025)



5. Discussion and Conclusion

The implementation of technology within hospital pharmacy departments reflects a transformative shift from manual operations toward integrated digital systems that emphasize efficiency, accuracy, and accountability. The adoption of Hospital Information Systems (HIS) and supporting technologies such as Electronic Medical Records (EMRs) and specialized modules for drug management has redefined how pharmaceutical services are managed in hospitals. This transformation aligns with the concept of healthcare digitalization, where automation and data integration become central to optimizing resource use and improving service quality (Samal et al, 2021).

One key implication of this digital integration lies in its ability to streamline complex pharmaceutical workflows. The transition from manual to automated systems minimizes human error and accelerates administrative processes, particularly in areas such as procurement, inventory control, and prescription verification. These changes do not merely represent technological progress but also an organizational restructuring of hospital pharmacy operations, where data-driven decision-making replaces intuition-based management. Consistent with the findings of Liu (2025) automation within HIS significantly enhances efficiency, especially through real-time monitoring and cross-departmental coordination.

Moreover, technology adoption contributes directly to the enhancement of transparency and governance in hospital pharmacy management. Digital recordkeeping and online reporting platforms, such as SIPNAP, reinforce regulatory compliance and accountability, particularly in the management of controlled substances. This aligns with Donabedian's (1988) structure process outcome model, where technological infrastructure (structure) supports standardized procedures (process) that ultimately improve pharmaceutical service quality (outcome). Hospitals equipped with comprehensive information systems can monitor stock levels, detect irregularities, and facilitate audits more effectively, reflecting a maturing governance framework in healthcare institutions.

The integration of EMRs and e-prescribing systems also underscores the growing emphasis on patient-centered care. Automated prescription input, cross-checking for drug interactions, and patient access to digital portals demonstrate how technology not only benefits administrative efficiency but also directly improves patient safety and satisfaction. This reinforces the notion that digital transformation in healthcare must be viewed not solely as a technical upgrade, but as a structural improvement in the delivery of holistic and responsive patient care.

Nevertheless, the discussion would be incomplete without acknowledging the multidimensional challenges accompanying technology implementation. The barriers identified ranging from limited human resource readiness, infrastructure instability, to cybersecurity risks highlight that digital transformation in hospitals is not merely a technological project but also a socio-technical process. As Mayasari et al. (2023) emphasize, system success depends heavily on user competence, organizational culture, and the availability of continuous training. Therefore, capacity building becomes a crucial determinant of sustainability in HIS adoption.

From a theoretical standpoint, the implementation of HIS and other digital systems in hospital pharmacy departments can also be interpreted through the lens of the Technology Acceptance Model (TAM) and Diffusion of Innovation (DoI) theory. According to TAM, the successful adoption of technology is influenced by two key perceptions: perceived usefulness and perceived ease of use (Davis, 1989). In this context, pharmacy personnel are more likely to accept HIS and EMR systems when they clearly perceive these tools as enhancing efficiency, accuracy, and convenience in daily tasks. Meanwhile, Rogers' (2003) Diffusion of Innovation framework explains the varying levels of adoption across hospitals as a function of organizational readiness, communication channels, and leadership support factors that are particularly relevant in Indonesia's public healthcare context. The Ministry of Health and hospital management thus play a crucial role as change agents in promoting awareness, providing infrastructure, and fostering a culture of technological innovation. Integrating these theoretical perspectives deepens the academic reflection of this study by showing that technological implementation in hospital pharmacies is not only an administrative or operational reform but also a behavioral and organizational transformation process influenced by user perception, institutional policy, and innovation diffusion dynamics.

The application of technology in hospital pharmacy installations, particularly through the integration of Hospital Information Systems (HIS), has been proven to contribute significantly to improving efficiency, accuracy, and the quality of pharmacy services. Automation of administrative processes, real-time drug stock monitoring, and integrated reporting have

minimized human error, accelerated drug distribution, and supported more accurate decision-making. In addition, technology implementation also facilitates auditing, inventory, and special reporting such as SIPNAP for controlled drugs.

However, the success of technology implementation cannot be separated from various challenges, such as limited pharmacy staff competencies in operating the system, resistance to change, and infrastructure as well as data security constraints. Therefore, the sustainability and effectiveness of technology use require full support from hospital management, continuous HR training, and strengthening of technological infrastructure and information security systems. Overall, digital transformation through HIS implementation optimizes the role of pharmacy staff and moves pharmaceutical services toward a more professional, transparent, and patient-safety-oriented standard.

Based on the findings, several recommendations can be provided in both policy and managerial aspects. From a policy perspective, the government, through the Ministry of Health, should accelerate the digitalization of pharmacy services by issuing regulations that strengthen information technology infrastructure and standardize pharmacy information systems across hospitals. These policies should also include data security, interoperability among service units, and incentives for hospitals that implement technology optimally. From the hospital management side, strategic steps include regular training for pharmacy staff to improve competencies in operating information systems, provision of reliable hardware and internet networks, and implementation of strong data security systems. Management should also establish a dedicated team responsible for monitoring, evaluating, and developing pharmacy information systems to ensure continuous alignment with service needs and regulatory developments.

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