

Review Article : Evaluation of Drug Storage Systems in Indonesian Hospital Pharmacy Installations Based on the Minister of Health No.72 of 2016

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In hospital-based pharmaceutical care, the Hospital Pharmacy Installation (HPI) is responsible for maintaining appropriate drug-storage conditions and supporting the safety of pharmaceutical services. Proper storage practices are necessary to preserve medication quality and ensure patient safety and availability. This review was conducted to examine drug storage practices in Indonesian hospital pharmacy installations based on previous studies, with particular emphasis on compliance with pharmaceutical service standards, FIFO and FEFO implementation, High-Alert and LASA medication management, environmental controls, and storage infrastructure. A comparative review was conducted using 10 research articles selected from 25 potentially relevant articles identified through Google Scholar. The articles were screened based on their relevance to drug storage systems in Indonesian hospital pharmacy installations and selected according to predetermined inclusion and exclusion criteria. The findings indicate that most hospitals have implemented FIFO and FEFO principles, organized medications according to their type and dosage form, and applied appropriate storage practices for High-Alert and LASA medications. However, several gaps remain, particularly in storage facilities, temperature and humidity monitoring, storage security, and inventory documentation. Overall, effective drug storage management requires not only compliance with established procedures but also adequate infrastructure, environmental monitoring, security systems, and continuous supervision. Periodic evaluation and staff adherence to standard operating procedures are therefore needed to support consistent compliance with pharmaceutical service standards and patient safety.



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The Hospital Pharmacy Installation (HPI) manages pharmaceutical activities and supports medication services within hospitals. It has an important function in supporting the safe and

appropriate use of medications across hospital services. Hospitals provide healthcare through inpatient, outpatient, and emergency services. It also serves as a healthcare facility that implements

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various health promotion and medical care activities aimed at maintaining and improving public health to achieve optimal health outcomes. One of the essential departments within a hospital is the Hospital Pharmacy Installation (HPI), which is responsible for medication management, clinical pharmacy services, as well as pharmaceutical education and quality assurance [1].

Pharmaceutical management in hospitals aims to ensure that the medications required by healthcare professionals are consistently available in a timely manner, in sufficient quantities, and with assured quality to support high-quality healthcare services. One of the primary objectives of hospital pharmaceutical management is to select medications based on prevailing disease patterns and patients' therapeutic needs. Medication management encompasses a series of activities, including selection, planning, procurement, receiving, storage, distribution, disposal, and recall of pharmaceutical products. The storage of pharmaceutical products is intended to preserve their quality, prevent inappropriate or unauthorized use, ensure their availability, and facilitate efficient retrieval and inventory control.

Pharmaceutical services constitute one of the most critical components of the hospital healthcare system, serving as the final safeguard before medications are dispensed to patients. This role extends beyond administrative responsibilities, as it has a direct and substantial impact on patient safety, the overall quality of healthcare services, and the efficient utilization of limited healthcare resources. Errors occurring within the pharmaceutical service process may lead to therapeutic failure, drug toxicity, or even death, while also damaging the institution's reputation and potentially resulting in serious legal consequences. In this context, the Hospital Pharmacy Installation (HPI) plays a pivotal role. It is responsible for ensuring that every stage of medication management, from selection to distribution to patient care units, complies with established standards of quality, safety, and effectiveness. Among these processes, proper drug storage is a key

determinant of the overall quality of pharmaceutical services. Even minor errors or deviations during the storage process can result in substantial cumulative consequences, both clinically, by compromising patient safety, and economically, through unnecessary waste of healthcare resources [2].

Drug storage is a fundamental aspect of all pharmaceutical activities, both in hospital settings and within the community. It involves the proper placement and maintenance of pharmaceutical products in secure storage areas to prevent theft while preserving their quality and stability. The implementation of an effective and efficient storage system is one of the key factors influencing the quality of medicines supplied to patients. Inappropriate or inefficient storage practices may result in expired medications remaining undetected, leading to financial losses for hospitals and increasing the risk of medication-related problems. Therefore, the selection and implementation of an appropriate storage system are essential. Drug deterioration and the accumulation of unusable or expired medications can reduce inventory turnover and compromise the efficiency of pharmaceutical supply management. These issues can be minimized through effective pharmaceutical inventory management, particularly by optimizing storage practices. In Indonesia, the storage of pharmaceutical products is regulated under the Indonesian Ministry of Health Regulation (Permenkes RI) No. 72 of 2016 concerning Standards for Pharmaceutical Services in Hospitals.

The Indonesian Ministry of Health Regulation (Permenkes RI) No. 72 of 2016 concerning Standards for Pharmaceutical Services in Hospitals serves as a guideline for hospitals improving the quality of pharmaceutical services. The regulation establishes standards for the management of pharmaceutical products, medical devices, medical consumables, and clinical pharmacy services. The management of pharmaceutical products, medical devices, and medical consumables encompasses medication selection, needs planning, procurement, receipt, storage, distribution, disposal, recall, monitoring, and administrative management. Meanwhile, clinical

pharmacy services include prescription review and dispensing, medication history assessment, medication reconciliation, drug information services, ward rounds, patient counseling, ward visits, patient counseling, therapeutic drug monitoring, monitoring of adverse drug reactions, and evaluation of drug store, preparation of sterile pharmaceutical products, and monitoring of drug concentrations in the blood. Overall, this regulation serves as the principal reference for the implementation of pharmaceutical services in Indonesia[3].

Drug storage within the Hospital Pharmacy Installation (HPI) is an essential measure to ensure that medications remain in good condition from the time they are received by the hospital until they are dispensed to patients. As patient safety is the foremost priority in healthcare services, hospital pharmacy installations must be equipped with adequate facilities and effective drug storage systems to maintain medication quality and safety before distribution [4]. The storage of pharmaceutical supplies involves placing medications in secure locations that protect them from theft and other physical conditions that may compromise their quality. The primary objectives of proper storage are to maintain medication quality, prevent misuse, ensure product availability, and facilitate efficient retrieval and inventory control. In accordance with pharmaceutical standards, appropriate storage conditions are required to maintain the integrity of medicines, medical devices, and disposable medical supplies throughout the storage period. Pharmaceutical products should be organized according to their therapeutic class, dosage form, and the First Expired, First Out (FEFO) and First In, First Out (FIFO) principles with an appropriate information management system. To minimize dispensing errors, different categories of medications should be stored separately and clearly identified. Hospitals should also provide designated storage areas for emergency medications that are intended for use only under specific circumstances. In addition, dedicated storage facilities should be available for emergency drugs required in life-threatening situations. Storage areas should be readily accessible to authorized personnel

while remaining adequately secured against theft and unauthorized access or misuse[5].

Hospital service quality can affect the institution's reputation as well as patients' satisfaction. The overall standard of hospital services is strongly supported by proper medication management. Effective medication management is essential to prevent stockouts, overstocking, and emergency drug procurement. Frequent medication shortages that prevent patients from receiving appropriate treatment may lead to patient dissatisfaction and adversely affect the hospital's reputation[6].

Previous studies have evaluated drug storage systems in various hospital pharmacy installations in Indonesia and reported different levels of compliance with the standards outlined in Permenkes RI No 72 of 2016. However, these studies have generally focused on individual hospital settings, resulting in findings that remain fragmented and have not yet provided a comprehensive comparison of drug storage practices across different hospital pharmacy installations.

Therefore, this review aimed to evaluate and synthesize drug storage practices in hospital pharmacy installations across Indonesia based on the available literature, with particular emphasis on compliance with pharmaceutical service standards, FIFO and FEFO implementation, High-Alert and LASA medication management, environmental controls, and storage infrastructure. This review also aimed to identify recurring gaps in drug storage practices and provide practical considerations for improving pharmaceutical storage management in hospitals.

Results and Discussion

Table 1. Drug Storage Data in Hospitals Based on Pharmacy Units and Standard Operating Procedures (SOPs)

No	References	Methods	Result	Standard	Compliance Percentage (%)
1.	Fadhilah, Y. N [7].	A qualitative descriptive research design was used in the study. Data were collected through observations, interviews, and document review conducted at the Hospital Pharmacy Installation (HPI) to evaluate the storage system for High-Alert Medications (HAM).	The findings indicated that the storage of High-Alert Medications (HAM) in the Hospital Pharmacy Installation (HPI) had been implemented using a dedicated storage system. This system included the use of special labels and warning signs, the segregation of Look-Alike, Sound-Alike (LASA) medications, and the separate storage placement of concentrated electrolytes as a measure to reduce medication errors. In addition, medications were stored under appropriate temperature and security conditions to maintain their quality and stability.	Indonesian Ministry of Health Regulation (Permenkes RI) No. 72 of 2016 concerning Standards for Pharmaceutical Services in Hospitals.	NR (Not Reported)
2.	Pertiwi, Y., Latifani, Z., & Swandari, M. T. K. [8]	A qualitative descriptive research design was used. Data were collected through observations, interviews, and a drug storage checklist at the Pharmacy Installation of the Inpatient Primary Clinic, Rumkitban 04.08.01 Cilacap. The collected data were compared with the hospital's Standard Operating Procedures (SOPs) and the Indonesian Ministry of Health Regulation (Permenkes RI) No. 72 of 2016 concerning Standards for Pharmaceutical Services in Hospitals.	The findings indicated that the drug storage system at the Pharmacy Installation of the Inpatient Primary Clinic, Rumkitban 04.08.01 Cilacap, had not yet fully complied with the established standards. Non-compliance was identified in several aspects, including storage temperature and security, the storage of Look-Alike, Sound-Alike (LASA) and High-Alert medications, inadequate storage equipment, and the lack of routine documentation of incoming and outgoing medications. Nevertheless, the facility had applied the First In, First Out (FIFO) and First Expired, First Out (FEFO) methods in its drug storage system.	Indonesian Ministry of Health Regulation (Permenkes RI) No. 72 of 2016 concerning Standards for Pharmaceutical Services in Hospitals.	NR (Not Reported)
3.	Annisa Primadhamanti, Gusti Ayu Rai Saputri, Destri Lina Sari [9].	A descriptive observational study with an evaluative approach was conducted to assess the drug storage and distribution systems in the hospital pharmacy installation based on the Standards for Pharmaceutical Services in Hospitals.	The result showed that pharmaceutical products stored at the Hospital Pharmacy Installation of Mutiara Bunda Tulang Bawang Hospital was largely in compliance with the Indonesian Ministry of Health Regulation (Permenkes RI) No. 72 of 2016 concerning Standards for Pharmaceutical Services in Hospitals. The medication distribution system utilized a combination of the unit-dose dispensing system and the individual prescription dispensing system, enabling more effective medication distribution while minimizing the risk of medication errors.	Indonesian Ministry of Health Regulation (Permenkes RI) No. 72 of 2016 concerning Standards for Pharmaceutical Services in Hospitals.	NR (Not Reported)

No	References	Methods	Result	Standard	Compliance Percentage (%)
4.	Hasibuan, I. D., Tarigan, A. R., Pratama, A., Br. Sk, D. A., Septian, M. R., & Siregar, N. A. [10]	A descriptive evaluation was conducted through direct observation of the drug storage warehouse based on the Hospital Pharmaceutical Supply Management Guidelines and the Indonesian Ministry of Health Regulation (Permenkes RI) No. 72 of 2016 concerning Standards for Pharmaceutical Services in Hospitals.	The findings indicated that the physical conditions of the drug storage warehouse at the Pharmacy Installation of the Regional Technical Implementation Unit (UPTD) of the North Sumatra Provincial Special Pulmonary Hospital complied with most of the required standards for drug storage. These standards included adequate ventilation, lighting, storage racks, refrigeration facilities, and other storage equipment. The drug storage system implemented the First In, First Out (FIFO) and First Expired, First Out (FEFO) principles, with medications organized according to alphabetical order and therapeutic class to maintain their quality and stability throughout the storage period.	Hospital Pharmaceutical Supply Management Guidelines and the Indonesian Ministry of Health Regulation (Permenkes RI) No. 72 of 2016 concerning Standards for Pharmaceutical Services in Hospitals.	NR (Not Reported)
5.	Atma Rulin Dewi Nugrahaini & Pipit Rarasati [11].	The researchers used a descriptive observational design with a cross-sectional approach. Data were collected using a checklist and direct interviews with pharmacists.	At Dr. MP Hospital, the drug storage system had implemented standard operating procedures (SOPs) for drug storage, temperature and humidity control, dedicated storage cabinets for narcotics and psychotropic drugs, as well as the First In, First Out (FIFO) and First Expired, First Out (FEFO) principles. Medications were also organized according to dosage form and alphabetical order. However, non-compliance was identified in the warehouse locking system and the distance between pallets and the warehouse walls. The evaluation results showed that the standard operating procedures (SOPs), facilities and infrastructure, and storage practices achieved compliance rates of 100%, 92%, and 87%, respectively, with an overall compliance rate of 93%, which was categorized as good.	Indonesian Ministry of Health Regulation (Permenkes RI) No. 72 of 2016 concerning Standards for Pharmaceutical Services in Hospitals.	93%
6.	Yoga Dwi Saputra et, al. [2]	The study employed a qualitative analytical descriptive observational design. Data were collected retrospectively using a cross-sectional approach through a checklist and direct interviews.	The drug storage system at the Hospital Pharmacy Installation of Patut Patuh Patju Regional General Hospital had implemented drug quality inspection, medication labeling, temperature monitoring, and the First In, First Out (FIFO) and First Expired, First Out (FEFO) principles. The storage of special categories of medications, including High-Alert Medications (HAM) and Look-Alike, Sound-Alike (LASA) medications, had also been implemented. However, several shortcomings were identified, including the absence of a closed-circuit television (CCTV) surveillance system and limited storage racks and pallets. Based	Technical Guidelines for Standards of Pharmaceutical Services in Hospitals, Ministry of Health of the Republic of Indonesia, 2019.	91%

No	References	Methods	Result	Standard	Compliance Percentage (%)
			on the evaluation, the medication receiving process achieved a compliance rate of 100%, while the drug storage process achieved a compliance rate of 91%, indicating that the overall performance was categorized as good.		
7.	Ayu Rahmawati, Edi Suhardiana. [12]	A non-experimental quantitative descriptive study was conducted using observational and interview methods to collect data on pharmaceutical preparation storage processes. The compliance of the storage system was evaluated based on the Regulation of the Minister of Health of the Republic of Indonesia Number 72 of 2016, the 2010 Guidelines of the Directorate General of Pharmaceutical and Health Service Development, and drug storage indicator analysis.	The drug storage system in the Pharmacy Warehouse of RSUD dr. Soekardjo Tasikmalaya City has implemented the First In First Out (FIFO) and First Expired First Out (FEFO) systems, along with an adequate storage management system. The evaluation results showed compliance with the Regulation of the Minister of Health of the Republic of Indonesia Number 72 of 2016 at 86% and compliance with the 2010 Directorate General of Pharmaceutical and Health Service Development (Dirjen Binfar) guidelines at 93%, categorized as highly compliant. However, several deficiencies were identified, including the absence of a freezer and security alarm system, room humidity levels that did not meet the required standards, a high stock-out percentage of 92%, and the presence of dead stock.	Regulation of the Minister of Health of the Republic of Indonesia Number 72 of 2016 concerning Pharmaceutical Service Standards in Hospitals.	86%
8.	Tesalonika, Guntur Satrio Pratomo, Syahrda Dian Ardhany [13].	A descriptive study with a qualitative approach was conducted through direct observation using an evaluation checklist to assess the compliance of High Alert medication storage in the Pharmacy Warehouse of RSUD Dr. Murjani Sampit. The data were analyzed by calculating the percentage of storage compliance for High Alert medication categories, including Look-Alike Sound-Alike (LASA) medications, high-concentration electrolytes, and cytotoxic drugs.	The storage of High Alert medications in the Pharmacy Warehouse of RSUD Dr. Murjani Sampit has complied with storage standards, with a 100% compliance rate in the categories of Look-Alike Sound-Alike (LASA) medications, high-concentration electrolytes, and cytotoxic drugs. The storage system has implemented "HIGH ALERT" labeling, the Tall Man Lettering method, separate storage areas, restricted access areas, as well as the First In First Out (FIFO) and First Expired First Out (FEFO) systems in accordance with hospital pharmaceutical service standards.	Regulation of the Minister of Health of the Republic of Indonesia (Permenkes RI) Number 72 of 2016 concerning Pharmaceutical Service Standards in Hospitals.	100%
9.	Hariyani, Dian Mustofani, Agung Louissada [14].	Data collection was conducted in the hospital pharmacy warehouse in September 2022, along with interview results obtained from the pharmacist and the head of the drug warehouse at Aisyiyah Islamic Hospital.	The storage and distribution of drugs in the Pharmacy Installation Warehouse of Aisyiyah Islamic Hospital Nganjuk have complied with hospital pharmaceutical service standards based on the Regulation of the Minister of Health Number 72 of 2016.	Minister of Health of the Republic of Indonesia. Regulation of the Minister of Health Number 72 of 2016 concerning Pharmaceutical	NR (Not Reported)

No	References	Methods	Result	Standard	Compliance Percentage (%)
				Service Standards in Hospitals. (2016).	
10.	Aji Tetuko, Andini Nurbudiyanti, Melia Eka Rosita, Eni Kartika Sari, Diesty Anita Nugraheni [15].	A descriptive observational method with direct observation.	The evaluation of drug storage conducted in the Pharmacy Warehouse of RSU PKU Muhammadiyah Bantul showed very good results, with a compliance percentage of 92%, while the non-compliance percentage was 7.6%. The drug storage system was found to use the First In First Out (FIFO) and First Expired First Out (FEFO) methods, with storage arrangements based on alphabetical order, drug type, and dosage form. Meanwhile, the drug storage method based on therapeutic class was not applied in the pharmacy warehouse but was implemented in service units, such as outpatient and inpatient pharmacy services. The evaluation of stock card recording showed an 80% compliance between the recorded hospital stock quantity and the actual physical stock.	Minister of Health of the Republic of Indonesia.	92%

The findings from the ten reviewed studies indicate that the application of drug storage systems in hospital pharmacy installations in Indonesia generally refers to the Indonesian Ministry of Health Regulation (Permenkes RI) No. 72 of 2016. However, the level of compliance varies among hospitals. Several studies reported good compliance with pharmaceutical service standards, including those conducted by Annisa Primadhamanti et al., Hasibuan et al., Hariyani et al., Nugrahaini and Rarasati, Yoga Dwi Saputra et al., and Aji Tetuko et al. Conversely, Pertiwi et al. reported that several aspects of drug storage had not yet met the required standards, indicating that the implementation of drug storage systems remains inconsistent across healthcare facilities. This variation suggests that while regulatory standards have been widely adopted, differences in infrastructure, monitoring systems, and management practices continue to influence the quality of implementation [9 & 14].

One of the most consistently implemented aspects identified across the reviewed studies was the application of the First In First Out (FIFO) and First Expired First Out (FEFO) methods. These methods were reported by Pertiwi et al., Hasibuan et al., Nugrahaini and Rarasati, Yoga Dwi Saputra et al., Ayu Rahmawati and Edi Suhardiana, Tesalonika et al., and Aji Tetuko et al. The consistent application of FIFO and FEFO demonstrates a shared commitment among hospitals to reducing drug expiration, minimizing wastage, and maintaining medication quality. In addition, several hospitals arranged medications according to alphabetical order, dosage form, drug type, or therapeutic class, facilitating more efficient inventory management and retrieval processes [10,16, 17].

Drug arrangement practices varied slightly among healthcare facilities. Hasibuan et al. reported that medications were organized according to alphabetical order and therapeutic class, while Nugrahaini and Rarasati found that drugs were arranged based on dosage form and alphabetical order. Similarly, Aji Tetuko et al. reported storage arrangements according to alphabetical order, dosage form, and drug type, although therapeutic classification was only implemented in service units rather than the central pharmacy warehouse. These findings indicate that although FIFO and FEFO have become common standards, hospitals continue to adapt storage arrangements according to their operational needs and available facilities [10&15].

The management of High-Alert Medications (HAM) and Look-Alike Sound-Alike (LASA) medications was another important aspect identified in the reviewed studies. Fadhilah reported that HAM storage was supported by special labels, warning signs, separate storage areas, and segregation of concentrated electrolytes. Similar findings were reported by Tesalonika et al., who found 100% compliance in the storage of LASA medications, high-concentration electrolytes, and cytotoxic drugs. Their study also identified the use of "HIGH ALERT" labeling, Tall Man Lettering, restricted-access storage areas, and the implementation of FIFO and FEFO systems. These measures are important for minimizing medication errors and promoting patient safety [7&13].

Despite these positive findings, not all hospitals demonstrated optimal implementation of HAM and LASA management. Pertiwi et al. reported that the storage of LASA and High-Alert medications had not fully complied with applicable standards. This finding suggests that the availability of written procedures alone is insufficient to ensure safe medication storage. Continuous monitoring, staff awareness, and regular evaluation remain necessary to maintain compliance and reduce the risk of medication errors [8&13].

Environmental control and storage infrastructure were among the most frequently

reported challenges. Hasibuan et al. reported adequate ventilation, lighting, storage racks, and refrigeration facilities, while Nugrahaini and Rarasati found that temperature and humidity monitoring systems had been implemented effectively. However, several studies identified deficiencies related to storage facilities. Yoga Dwi Saputra et al. reported insufficient storage racks and pallets as well as the absence of CCTV monitoring systems. Likewise, Ayu Rahmawati and Edi Suhardiana identified the absence of a freezer and security alarm system, while humidity levels exceeded the recommended standards [11&12].

Similar infrastructure-related problems were also identified by Pertiwi et al., who reported shortcomings in temperature control, storage security, storage equipment, and documentation of incoming and outgoing medicines. Nugrahaini and Rarasati additionally found non-compliance regarding warehouse locking systems and pallet-to-wall distances. These findings indicate that environmental control, security systems, and infrastructure remain major determinants of compliance with pharmaceutical storage standards [1&6].

Differences in overall compliance rates further illustrate variations in implementation quality among hospitals. Nugrahaini and Rarasati reported an overall compliance rate of 93%, while Aji Tetuko et al. reported 92% and Yoga Dwi Saputra et al. reported 91%, all categorized as good compliance. Ayu Rahmawati and Edi Suhardiana reported compliance of 86%, while Tesalonika et al. achieved 100% compliance specifically in HAM and LASA storage. These findings demonstrate that hospitals generally perform well in implementing drug storage procedures, although compliance may differ depending on the evaluated aspect and the availability of supporting facilities [2&15].

Overall, the ten reviewed studies indicate that hospital drug storage systems in Indonesia have generally complied with the requirements of Permenkes RI No. 72 of 2016, particularly regarding FIFO and FEFO application, medication organization,

and HAM/LASA management. Nevertheless, recurring challenges remain in environmental control, infrastructure adequacy, security systems, documentation practices, and inventory management. Therefore, continuous evaluation, improved storage facilities, routine monitoring of temperature and humidity, strengthened security measures, and consistent implementation of standard operating procedures are necessary to further improve pharmaceutical service quality and patient safety[18,19,20].

The findings of this review indicate several practical measures can be considered by the Head of Pharmacy Installation to improve drug storage management. Routine internal evaluations should be conducted to monitor compliance with FIFO and FEFO principles, storage organization, and documentation practices. Particular attention should also be given to the management of High-Alert and LASA medications through appropriate labeling, segregation, restricted access, and regular monitoring. In addition, temperature and humidity monitoring should be performed consistently, while deficiencies in storage racks, pallets, security systems, and other supporting infrastructure should be addressed according to the needs of the pharmacy installation. Periodic audits and staff training are also important to ensure that established standard operating procedures are consistently implemented.

Conclusion

The finding from the ten reviewed studies indicate that medication storage practices in Indonesian hospital pharmacy installations have generally followed the requirements of Permenkes RI No. 72 of 2016. The most consistently applied practices include the implementation of FIFO and FEFO principles, medication organization according to storage requirements, and the segregation of High-Alert and LASA medications. These practices contribute to maintaining drug quality, reducing medication errors, and supporting patient safety.

Despite the generally good level of compliance, several challenges remain. Common

deficiencies include inadequate storage infrastructure, suboptimal temperature and humidity control, limited security systems, insufficient documentation, and inventory management issues. Variations in compliance among hospitals indicate that the implementation of storage standards is not yet uniform across healthcare facilities.

Overall, the reviewed studies demonstrate that effective drug storage management requires not only compliance with storage procedures but also adequate infrastructure, environmental monitoring, and continuous supervision. Therefore, periodic evaluation of storage practices, strengthening of security and monitoring systems, and consistent implementation of standard operating procedures are essential to improve pharmaceutical service quality and ensure patient safety in hospitals.

Materials and Methods

This review employed a comparative approach to identify, evaluate, and synthesize research articles concerning drug storage systems in hospital pharmacy installations in Indonesia. The literature search was conducted through Google Scholar using the Indonesian keyword ("penyimpanan obat" OR "sistem penyimpanan obat" OR "evaluasi penyimpanan obat") AND ("instalasi farmasi" OR "gudang farmasi") AND ("rumah sakit" OR "RSUD"). The search was limited to articles published between 2016 and 2026. Google Scholar was selected because it provides broad and accessible coverage of Indonesian pharmaceutical and health-related publications, making it easier to identify relevant articles using specific keywords.

The inclusion criteria were:

1. Research articles evaluating drug storage systems in hospital pharmacy installations
2. Studies conducted in hospitals in Indonesia
3. Articles published between 2016 and 2026
4. Articles available in full text
5. Studies evaluating drug storage based on pharmaceutical service standards or related storage indicators.

Articles were excluded if they were not related to drug storage, were conducted outside hospital pharmacy installations, were not original research articles, were unavailable in full text, or did not provide relevant information regarding drug storage practices or compliance. A total of 25 potentially relevant articles were initially identified through Google Scholar. These articles were screened based on their relevance to the review topic, and 10 articles were selected for further evaluation and supervisor approval. Following approval, the 10 selected research articles were included in the final review.

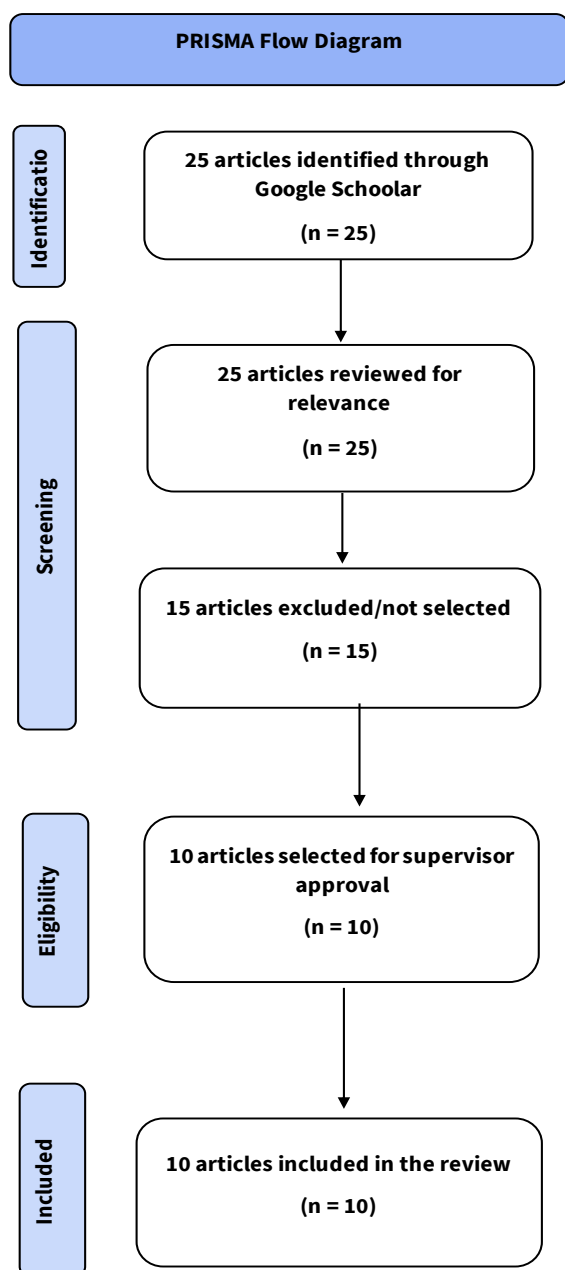


Figure 1. PRISMA 2020 flow diagram of the study selection process

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