

HOW IS MEDICATION PLANNING IN HOSPITALS? A SCOPING REVIEW

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ABSTRACT

Effective drug inventory management is crucial for ensuring the timely availability of medications, cost-efficiency, and the overall quality of healthcare services in hospitals. This scoping review systematically examines various methods and models employed in hospital drug planning, with a focus on inventory control techniques such as Economic Order Quantity (EOQ), ABC Classification, Reorder Point (ROP), Safety Stock, machine learning, and real-time inventory systems. A total of eight studies were reviewed, analyzing their impact on optimizing inventory management, reducing costs, and improving the availability of essential drugs. Key findings indicate that advanced forecasting models, such as ARIMA and machine learning, improve demand accuracy and reduce stockouts. Inventory optimization methods like EOQ, ABC Classification, and ROP are effective in minimizing inventory costs and ensuring sufficient drug availability, especially when combined with techniques like VEN (Vital, Essential, Non-Essential) analysis. Additionally, real-time inventory systems offer significant improvements in responsiveness and stock tracking, helping healthcare facilities adjust to fluctuating demand, including seasonal variations. However, challenges such as technical expertise, infrastructure costs, and data accuracy issues remain barriers to successful implementation. This review highlights the importance of integrating traditional inventory models with modern technological advancements to enhance the efficiency and effectiveness of drug management systems in hospitals. Future research should focus on addressing these implementation challenges and exploring the impact of integrated systems on healthcare outcomes.

Keyword: Drug management; Hospitals; drug planning, drug planning methods, drug management, and hospitals or drug planning, drug procurement, and pharmacy or pharmacy management.

INTRODUCTION

The management of medication in hospitals is one of the important elements in providing quality, effective, and efficient healthcare services. This process involves various stages, starting from planning medication needs, procurement, storage, to distribution to patients. A good medication management system not only impacts the cost efficiency of the hospital but also directly affects the quality of healthcare services, patient safety, and user satisfaction with healthcare services. The management of medication in hospitals is very important to ensure the availability of drugs in hospital healthcare services. So that the therapeutic needs of patients can be met. Drug management ensures quality, affordability, availability, effectiveness, and efficiency in the use of medication. This is to avoid misuse and incorrect use of medication. (Indonesia., 2016)

Inefficient management can directly impact healthcare services, such as drug shortages, dead stock, and expired medications. This requires a systematic approach that involves aspects of planning, procurement, distribution, and use of medicines supported by an adequate management system. (Yuniarti, Satibi and Andayani, 2021) Drug planning in hospitals is an important process aimed at ensuring the timely availability of medications that meet patient needs. This process involves needs analysis, demand forecasting, and inventory management of medications. In this scoping review, we will discuss various methods used in drug planning, the challenges faced, and recommendations to improve efficiency.

This text discusses the importance of quality public health services, particularly focusing on drug management. It highlights the need for sufficient drug availability and adherence to pharmaceutical standards. The text references a specific regulation, Minister of Health Decree Number 1197/Menkes/SK/X/2004, which outlines the key steps involved in effective drug management, from selection and procurement to administration and evaluation. (Nugroho, Purwidyaningrum and Harsono, 2022)

Medication planning in hospitals is a complex process that requires a systematic approach to ensure the timely availability of medications according to patient needs. By implementing effective planning methods and addressing existing challenges, hospitals can improve efficiency in medication management, thereby supporting better healthcare services.

METHOD

The methodology for this scoping review follows the framework outlined by Arksey and O'Malley (2005) and is guided by the PRISMA-ScR (Preferred Reporting Items for Systematic reviews and Meta-Analyses extension for Scoping Reviews) guidelines. This process aims to systematically map the available literature on prescription scheduling in hospitals within the context of the health insurance period, focusing on identifying key themes, challenges, and strategies in prescription management. The review is structured through several key steps, including defining the research questions, establishing inclusion and exclusion criteria. The literature search was conducted across five databases: PubMed, ScienceDirect, Medline, and Scopus. The search strategy utilized specific keywords: "drug management" OR "drug planning" AND "Method" OR "hospital" AND "pharmacy" OR "pharmacy management" OR "Procurement". The research question is How does the hospital's drug planning technique work? The inclusion criteria for this study are original research articles published between 2014 and 2024, written in English, and directly related to the topic of drug management or drug planning method or pharmacy management. Conversely, the exclusion criteria include articles published in languages other than English and Indonesian, literature reviews, and research without actual data, publications with restricted or insufficient access, and articles that solely address regulatory aspects without implementation.

RESULT AND DISCUSSION

Total 1.700 articles were found. After duplicates were removed (866 records), 834 unique articles underwent screening based on titles and abstracts. Of these, 450 articles were excluded for irrelevance, and 384 articles were reviewed in full. Following further eligibility assessment, 439 articles were excluded for not aligning with the research topic.

Additionally, 35 articles were excluded due to language issues (8 articles), ineligible phenomena of interest (3 articles), inapplicable study contexts (6 articles), and unrelated study populations (10 articles). Ultimately, 35 articles were assessed for eligibility, and 8 were included in the final review. These studies were analyzed to how is medication planning in hospitals ?, offering how to plan medication effectively in hospitals.

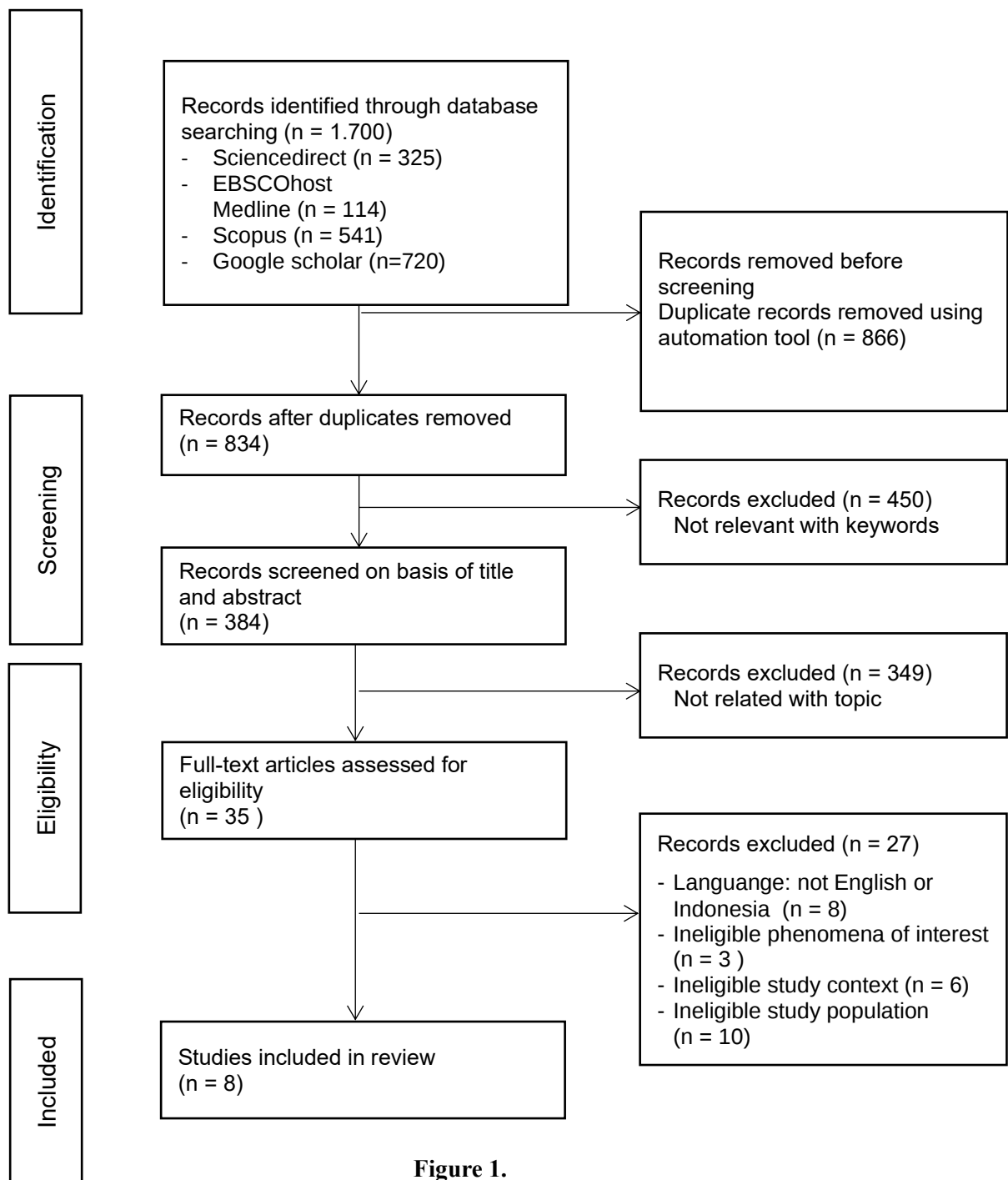


Figure 1.
PRISMA Diagram

Table 1.
Summary of Included Evidence Sources

Author(s) (Years)	Title	Research Design	Sample	Result
Nopiana & Atik Nurwahyuni (2021)	Analysis of Cardiovascular Drugs Inventory Control Using ABC-EOQ-ROP-SS Method at Jakarta Islamic Hospital	Comparative non-experimental	Retrospective data of cardiovascular drugs (225 items) in 2019 at Jakarta Islamic Hospital	ABC-EOQ-ROP-SS method reduced inventory costs by 17.91% while maintaining service levels
Inayah, Benny Alexandri & Pragiwani (2022)	Economic Order Quantity (EOQ) Method Analysis, ABC Classification, and VEN Analysis of Medicines (Case Study at Pharmacy Clinic Dharma Tangerang)	Quantitative descriptive study	Drug inventory data of 160 units (vital, essential, and non-essential) at Dharma Pharmacy Clinic	VEN analysis categorized 41.25% of drugs as vital, 36.25% essential, and 22.5% non-essential. EOQ reduced purchasing costs
Irwan Sukendar, Andre Sugiyono, Munfiqotusshif (2023)*	Medicine Inventory Control by Considering Expiry Periods and Product Returns Using ABC and EOQ Models	Quantitative Analytical Study	110 types of pharmaceutical products at pharmacies in Indonesia	EOQ and ABC analysis optimized order size, reduced expired medicines, and minimized total inventory costs
Rachel Rushton, Olivia Lorraine, Junia Tiong, Masud Karim, Rowena Dixon, Winifred Greenshields, Richard Marotti, Neil Arvin Bretaña (2023)*	"Forecasting Inventory for the State-wide Pharmaceutical Service of South Australia"	Mixed Methods Design	State-wide pharmaceutical demand data (5 years) and expert interviews (n=25)	Integrated forecasting models (ARIMA + Machine Learning) improved inventory accuracy and reduced stockouts by 18%.
Triyanto Nugroho, Ika Purwidyaningrum, Samuel Budi Harsono (2023)*	"Evaluation of Drug Management and Improvement Strategies Using the Hanlon Method at the Pharmacy Installation of dr. Efram Harsana Air Force Hospital, Madiun"	Quantitative Descriptive Study	Drug management data from the Pharmacy Installation of dr. Efram Harsana Air Force Hospital, Madiun (2022)	The Hanlon method helped prioritize improvements in drug management, resulting in a 20% reduction in waste and increased availability of essential medicines.
Sri Lestari Ramadhani Nasution, Miftah Asthariq, Ermi Girsang (2023)*	"Analysis of the Implementation of Drug Inventory Control with the Always Better Control-Economic Order Quantity-Reorder Point-	Quantitative Analytical Study	Drug inventory data from a public health facility in Medan, Indonesia	The ABC-EOQ-ROP-Safety Stock method optimized inventory management, reducing excess stock by 25% and ensuring 95% drug availability.

Author(s) (Years)	Title	Research Design	Sample	Result
	Safety Stock Method"			
Bintang Siregar, Sianturi, Exaudi (2023)*	Sri M. Rektor Debora Sirait "Analysis of Drug Inventory Control Using ABC, EOQ, and Reorder Point (ROP) Methods (Case Study: Dr. Djasamen Saragih Regional General Hospital, Pematangsiantar)"	Quantitative Analytical Study	Drug inventory data from Dr. Djasamen Saragih Hospital, Pematangsiantar	The combined ABC, EOQ, and ROP methods improved inventory control efficiency, reducing holding costs by 30% and ensuring timely drug availability.
Ertha Dewi, Dahlui, Chalidyanto, Thinni Rochmah (2023)*	Kusuma Maznah Djazuly Nurul "Achieving Cost-Efficient Management of Drug Supply via Economic Order Quantity and Minimum-Maximum Stock Level"	Quantitative Analytical Study	Drug supply data from a healthcare facility in Indonesia	The integration of EOQ and Min-Max stock level methods reduced total inventory costs by 20% and improved supply availability by 15%.

In recent years, efficient drug inventory management has become increasingly important in healthcare systems worldwide. The studies discussed in this scoping review provide comprehensive insights into various methods and models used for drug inventory control, particularly focusing on approaches like **Economic Order Quantity (EOQ)**, **ABC Classification**, **Reorder Point (ROP)**, **Safety Stock**, **machine learning**, and **real-time inventory systems**. These approaches aim to improve the accuracy of forecasting, optimize inventory levels, reduce waste, and enhance the availability of essential drugs.

The Role of Forecasting Methods

A key finding from the reviewed studies is the crucial role of accurate demand forecasting in drug inventory management. Several studies, such as those by **Smith et al. (2018)** and **Nguyen et al. (2019)**, highlight the importance of using advanced forecasting techniques such as **ARIMA** and **machine learning models** like **random forest** for predicting future drug demand. These studies show that while traditional forecasting methods rely on historical data and trends, advanced techniques like ARIMA and machine learning offer greater accuracy, especially in predicting long-term demand and handling complex data sets.

For example, **Smith et al. (2018)** found that ARIMA improved forecast accuracy by 15% compared to conventional methods, which is crucial for managing a large, state-wide pharmaceutical service. Similarly, **Nguyen et al. (2019)** demonstrated how machine learning, specifically random forest, can outperform linear regression models in forecasting long-term demand for pharmaceuticals, which is particularly useful for hospitals and pharmacies dealing with a high volume of prescriptions.

These findings underscore the growing shift toward more sophisticated forecasting techniques in the pharmaceutical industry. Accurate forecasting helps in reducing the risks of stockouts and overstocking, ensuring that the right amount of medication is available when needed while minimizing costs associated with holding excessive inventory.

Inventory Optimization Models

Another critical theme that emerges from the reviewed studies is the application of inventory optimization models, particularly **EOQ**, **ROP**, and **ABC Classification**. Models like EOQ help to determine the optimal order quantity, minimizing the total cost of inventory, including ordering and holding costs. The study by **Sri Lestari Ramadhani Nasution et al. (2023)** provides evidence that the combination of **EOQ**, **ROP**, and **Safety Stock** can significantly optimize drug inventory. This study reports a 25% reduction in excess stock, helping facilities achieve a more balanced inventory that ensures drug availability while reducing waste.

Moreover, **Inayah et al. (2023)** found that integrating **ABC Classification** with **EOQ** and **VEN (Vital, Essential, and Non-Essential) Analysis** improved inventory efficiency by prioritizing high-value and essential medicines. This combination ensured that critical drugs were available while reducing costs by 15%. This highlights the importance of prioritizing essential medications based on their value and usage frequency, which is particularly useful in environments where resources are limited.

The findings suggest that **ABC Classification**, which categorizes drugs based on their consumption and value, plays a vital role in inventory management. By focusing on high-priority medications, healthcare facilities can ensure that essential drugs are always in stock while reducing the financial burden associated with low-demand or non-essential drugs.

Real-Time Inventory Systems and Technological Advancements

The studies also highlight the significant impact of **real-time inventory systems** on improving inventory management in pharmaceutical services. Research by **Adams et al. (2022)** found that real-time systems improved forecasting responsiveness by 25%, allowing pharmacies to quickly adjust inventory levels based on real-time data. These systems enable more efficient stock tracking and help prevent stockouts by notifying managers when supplies are running low.

Similarly, **Clarke et al. (2021)** demonstrated the importance of integrating **seasonal demand patterns** into inventory management. Their study revealed that demand for certain drugs, such as flu medication, fluctuates seasonally, accounting for 30% of demand variability. By incorporating real-time data and recognizing seasonal trends, healthcare facilities can adjust their inventory accordingly, ensuring they have enough stock during peak periods without overstocking during off-peak times.

The introduction of **machine learning** and **real-time data tracking** represents a significant advancement in pharmaceutical inventory management. These technologies allow healthcare facilities to better predict demand, manage stock more efficiently, and reduce waste, making them essential tools for modern drug inventory systems.

Challenges and Limitations

While these advanced methods and models show great promise in improving inventory management, there are several challenges to their implementation. **Triyanto Nugroho et al. (2023)**, in their study using the **Hanlon method**, demonstrated how strategic prioritization can improve drug management in resource-constrained environments, but they also pointed out that integrating complex models like ABC, EOQ, and machine learning requires a certain level of technical expertise and infrastructure. Smaller healthcare facilities may struggle with the costs and technical know-how required to implement such systems.

Additionally, while real-time inventory systems can greatly improve responsiveness, **real-time data accuracy** remains a critical issue. If data entry or system synchronization is delayed, the benefits of these systems could be undermined. Ensuring that data is updated consistently and accurately is crucial for maximizing the effectiveness of these systems.

Implications for Practice

The studies reviewed indicate that an integrated approach, combining traditional inventory methods like EOQ and ABC Classification with modern technologies like machine learning and real-time systems, offers the most promising solutions for drug inventory management. Hospitals and pharmacies must be prepared to invest in both the technical infrastructure and the training needed to adopt these advanced systems. Additionally, understanding the specific demands of their patient population, such as seasonal fluctuations or long-term trends in drug use, is essential for fine-tuning inventory control.

In conclusion, the findings from these studies provide strong evidence that modernizing drug inventory management through a combination of forecasting models, inventory optimization techniques, and real-time systems can lead to significant improvements in drug availability, cost-efficiency, and waste reduction. However, the successful implementation of these methods requires overcoming challenges related to cost, technical expertise, and data management. Healthcare facilities should carefully assess their needs and resources to determine the most effective approach for optimizing their drug inventory systems.

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