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Design of Medicine Inventory System

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ABSTRACT

The efficient management of medicine inventory is crucial for the smooth operation of pharmacies, ensuring the availability of essential medications while minimizing excess stock and wastage. This research presents the design of a Medicine Inventory System which is recommended to be implemented at Yasmin Raya Pharmacy, aimed at optimizing inventory tracking, stock replenishment, and overall operational efficiency. The proposed system integrates real-time inventory monitoring, automated stock updates, and alerts for medication expiry, addressing common challenges faced by the pharmacy in managing its stock manually. The methodology used is the use case diagram, sequence diagram and prototype model.

1. INTRODUCTION

An effective inventory management system for medicine is crucial for several key reasons, particularly in healthcare settings like pharmacies, hospitals, and clinics. Pharmacies deal with a high volume of medications, each with its own set of requirements, and ensuring accurate and efficient management of these medicines directly impacts patient care, operational efficiency, and business sustainability. Pharmacies must always have the right medicines available for patients. An efficient inventory management system tracks stock levels in real-time and helps avoid situations where critical medicines run out, ensuring that patients receive the medications they need without delay (Goh and Ang, 2015). This is especially crucial for chronic conditions or emergency medications that patients rely on regularly. By accurately monitoring stock levels, expiration dates, and usage patterns, an inventory management system helps balance stock levels. It prevents the overstocking of medications, which ties up financial resources and storage space, and prevents stockouts, which could result in treatment delays or suboptimal patient care.

Managing inventory manually can be time-consuming and prone to error. A pharmacy's inventory management system automates the ordering process by tracking medication usage, predicting future needs, and automatically placing orders when stock falls below a pre-set threshold. This streamlines the supply chain, ensuring that medications are restocked in a timely manner, preventing both shortages and excess. Expired or unused medications are a significant financial burden for pharmacies. The inventory management system helps identify slow-moving products, allowing pharmacies to avoid over-purchasing or holding large quantities of medications that may not be sold before their expiration. By optimizing stock levels and reducing wastage, pharmacies can significantly improve profitability.

An organized inventory system also improves workflow within the pharmacy. The results by Han and Yang (2015) research showed by tracking medication locations, quantities, and expiry dates digitally, the system saves staff time on manual stock checks and makes it quicker and easier to find products. This allows pharmacy staff to focus more on customer service and less on managing inventory. Zhang and Liu (2016) also said in their research that with access to historical data on medication usage, sales trends, and seasonal variations, the inventory management system helps pharmacies forecast future demand more accurately. This allows pharmacies to plan better for the number of medications they need, anticipate seasonal spikes (e.g., flu season), and adjust orders accordingly to ensure they have the right stock at the right time.

This research uses a case study method at the Yasmin Raya Bogor Pharmacy which is experiencing problems in managing medicine supplies. The lack of medicine supply system results in not maximizing the services provided due the pharmacy often experiences stock-outs for certain types of medicines. On the other side, the weak of inventory management caused the financial loss for the pharmacy. The data showed, in 2021 the pharmacy experienced loss more than 10 million Rupiah from medicines disposed of due to expiration. Considering many types of medicines to be provided and different time in expiration date, so it's very important to develop a medicine management information system at Yasmin Raya Bogor pharmacy in order the management can run the business properly. This research aims to provide recommendations to the business owner of Apotek Yasmin Raya to implement a medicine inventory system.

2. METHODOLOGY

This research uses the methodology of descriptive qualitative. Descriptive qualitative research is a type of research that aims to explore and provide an in-depth understanding of a phenomenon, situation, or experience through detailed descriptions and insights. The focus of this approach is to describe the characteristics, attributes, or experiences of a specific group, event, or issue without manipulating the environment or controlling variables, as would be done in quantitative research. Rather than testing hypotheses, descriptive qualitative research seeks to capture the richness of people's experiences, perceptions, and behaviors in natural settings (Denzin and Lincoln, 2018).

The flow of this research is as follow:

1. Problem identification and research focus. The objective of this step is to understand the current state of the medicine inventory management system, identify challenges, and explore the specific needs of the users. The focus is on collecting data about the current manual or digital processes, existing gaps, and potential areas of improvement. Some research questions should be addresses at this stage, such as a) What are the current challenges faced by pharmacy staff in managing the inventory? b) How do users track and manage medicine stock levels, and what are the pain points in this process? c) What information is essential for managing the medicine inventory efficiently? and d) How can an automated system improve the inventory management process?
2. Literature review. The approach taken in the literature study was by analyzing academic papers, reports, and articles on medicine inventory management, specifically on systems implemented in healthcare facilities.
3. Data collection techniques used in this research included:
    a) In-depth interviews with stakeholders such as business owners, pharmacists, staff and also medicine suppliers. Interviews were semi-structured, allowing for flexibility while ensuring that key areas of interest (such as stock tracking, ordering processes, and inventory control challenges) were covered. Interviews were conducted to explore the constraints faced in managing pharmaceutical supplies as well as what users need in the system to be designed.
    b) Observations are made on the daily operations and workflow of the pharmacy. This may include observing staff as they manage inventory, refill medicines, check expiration dates, or conduct stock audits.
    c) Document Review is conducted by analyze existing inventory logs, records, or reports, both in paper and digital formats such as purchase invoices, stock card, inventory list, sales report etc.
4. Analyzing the system through UML (Unified Modeling Language) modeling to describe the functionality of the system to be developed in a way that is easily understood by various parties, such as system analysts, developers, and users. This diagram describes the interaction between users (actors) and the proposed system in the form of use cases. Alpandi and Devitra (2019) described the steps of use case diagram is as follows:
    a) Determine initial planning and design what kind of activities will be carried out and the time required for each activity.
    b) Conduct business process analysis
    c) Analyzing the information system used today

Jurnal Logistik Indonesia Vol. 8, No. 2, Oktober 2024, pp. 122-131

d) Modeling information systems using UML (Unified Modeling Language) modeling using use case diagram and sequence diagram.
e) Building an information system prototype

5. System design using the prototype model. Phases of the prototype model are (Pressman, 2014):

1) Communication. In this context, communication refers to the early stage where developers communicate with stakeholders (users or clients) to gather the essential requirements for the prototype;
2) Quick plan. The quick plan stage involves the creation of a simplified plan or design for the prototype based on the initial requirements gathered in the communication stage;
3) Modeling quick design. The quick modeling design stage refers to the creation of a rapid and simplified design for the prototype, based on the requirements and plan established in the previous phases;
4) Construction of prototype. This is a critical step in the process of iteratively refining the system based on user feedback;
5) Deployment delivery and feedback. This phase is where the prototype is provided to the users, and their feedback is gathered to refine the system further. This phase is become critical in ensuring that the prototype accurately reflects the user's needs and expectations (Iqbal, J., & Chauhan, M., 2017).

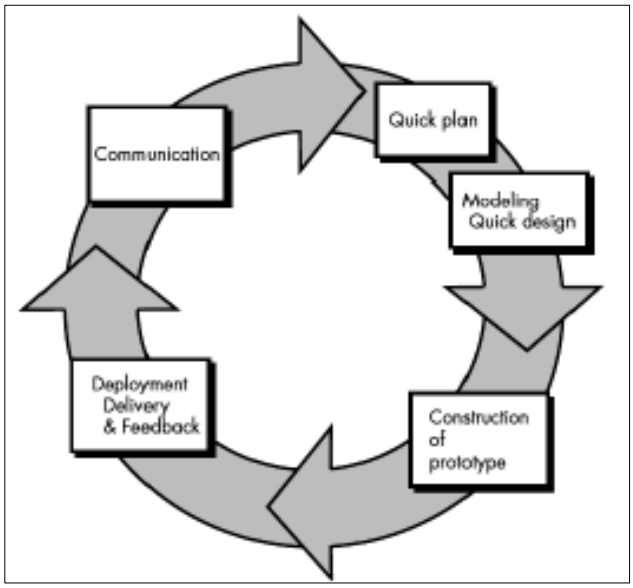

Fig 1. Prototype Model

The programming language used are Hyper Text Markup Language (HTML), Cascading Style Sheet (CSS), JavaScript, Hypertext Preprocessor (PHP) and database MYSQL. The HTML, CSS, JavaScript, PHP, and MySQL are often used together to build dynamic, interactive, and data-driven web applications. Similar with Smith & Brown (2020) which uses the HTML to develop the web structure and provides the basic framework for a web page, including headings, paragraphs, images, links, and tables. CSS is used by Lee & Wang (2019) to visually organize and present HTML content. CSS is used to control the layout, colors, fonts, and overall appearance of the page. CSS can improve the visual presentation of HTML content, making pages more user-friendly and visually appealing. While JavaScript is a programming language that allows developers to create dynamic and interactive elements on a webpage. Davis (2018) said in his research, unlike HTML and CSS, which are static, JavaScript adds interactivity to the web page (e.g., validating forms, handling button clicks, or creating animations). PHP is a server-side scripting language used to build dynamic, data-driven web pages. It is embedded in HTML and executes on the server to generate content that is sent to the client's browser. While MySQL is a relational database management system (RDBMS) that stores data in tables and allows it to be accessed and manipulated via SQL (Structured Query Language). Both PHP and My

SQL are commonly used in web applications to store data like user information, products, transactions, etc. MySQL acts as the data storage layer of the application. It stores and retrieves data based on requests made by PHP scripts. When a user submits a form, for example, PHP can send the form data to MySQL, where it's stored in a database. PHP serves as the backend scripting language to process data and interact with databases and MySQL is the database system that stores, retrieves, and manipulates data. This combination allows developers to build interactive, data-driven, and responsive web applications. This is also in line with research conducted by Kumar & Patel (2021) and Zhang & Chen (2017).

3. RESULTS AND DISCUSSION

Problem identification

There are several problems in managing the medicine supply at Yasmin Raya Bogor Pharmacy:

1) Manually data recording and has not been digitized. Staff are not provided with proper data processing technology facilities so that manual recording often causes errors in writing and calculations.
2) Document storage is not well organized. Manual recording requires a lot of space for physical storage, this is due to different forms required for each activity. Unorganized document storage can risk damage or loss of the document, thus affecting the accuracy of the reporting and timely presentation of reports.
3) Expiration date is not monitored. This is due to the absence of a lack system for medicine expirations which causing losses as the amount of medicine waste disposed of due to expiration is quite large.
4) Medicine stocks are not monitored and the pharmacy experiences stockout very often. This could have been avoided by providing a system that integrates between incoming medicine and release stock data.

Current system analysis

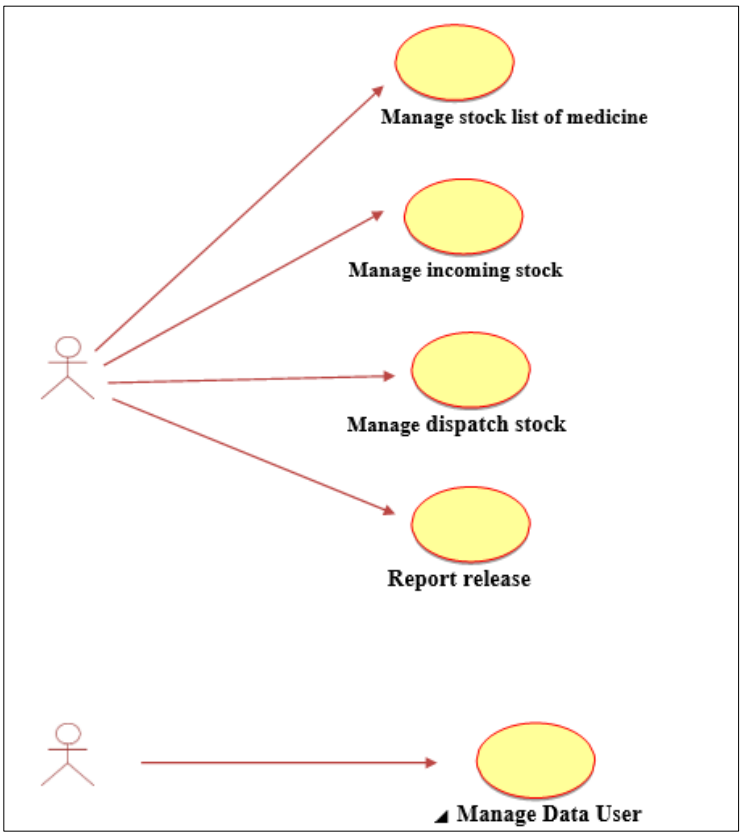

Fig 2. Use Case Diagram

The procedures for managing medicine supplies at Yasmin Raya Bogor Pharmacy are as follows:

a. Medicine Procurement

The medicine procurement process is an activity to increase the stock level of medicine or add a wide selection of brands and types of certain medicines, both generic and prescription medicines. The medicine procurement process involves the participation of the pharmacy owner in decision making. The procedures as follows:

1. The warehouse staff conduct regular medicine inventory checks and record the stock taking. The staff will release the order request form for medicines at the minimum stock level and send it to the pharmacist. Pharmacists with the owner then proceeds the monthly of medicine requirements refer to the order request received.
2. The list of medicines included in an order request letter should state the name of the distributor, name of the medicine, type of packaging, quantity and price. Then the order letter will be signed by the pharmacist and the owner. The letter consists of two copies to be sent to the distributor or PBF (Pharmaceutical Wholesaler).
3. The pharmacist will release purchase order (PO) and submit the PO to the supplier/ pharmaceutical wholesalers
4. Generally, suppliers will process orders within 3-7 days. When the goods is delivered by the supplier, the warehouse staff need to check the goods to ensure the type and quantity are as stated in the PO.
5. The accepted goods will be recorded into the medicine receipt form and the pharmacist will sign off the form to process the payment.
6. The rejected goods will be returned to the supplier. Goods that are rejected usually due to it not meet the type ordered or the expiration period is too short. The pharmacist will then sign the return letter and hand it back to the supplier.
7. Warehouse staff will update the number of medicine stock in the inventory book and create an inventory report based on the invoices received.

b. Medicine Sales

The procedure of medicine sales as follows:

1. The staff receives the prescription or information on the medicine to be purchased from the customer.
2. The staff gives the prescription to the pharmacist and the pharmacist prepares the medicine.
3. For generic medicines, the staff will immediately give the medicine to the customer according to the availability of stock in the display cabinet.
4. The staff makes 2 copies of sales notes to be handed over to the customer and the warehouse staff as a record.
5. The warehouse staff updates the stock data refer to the sales notes.
6. At the end of the month, the staff will recap the sales data and submits the sales report to the owner.

c. Reporting

1. The warehouse staff will obtain the updated inventory list which includes all medicines in stock, gather all records of medicine purchased during the month, collect data on medicines dispensed or sold and checking on the expired stock or damaged products.
2. Generate the inventory report and present the data into the inventory movement table which consist of opening stock, received stock/purchases, quantity sold, adjustment (expired, damaged or returned stock) and closing stock.
3. Generate the sales report refer to the sales note which consist of medicine name, quantity, and value.
4. The report should be reviewed by the pharmacist and approved by the owner.

Problem Solving Solution

1. Real-Time Inventory Tracking

   The system should update stock levels automatically as transactions occur (e.g., when medicines are sold, dispensed, or received). The system also should provide a real-time view of inventory, showing current stock levels, quantities of each medicine, and status updates (e.g., whether they are low, at optimal levels, or out of stock).

2. Accurate and Comprehensive Data Management

   The system should require detail information for each medicine, such as: medicine name (generic and brand), batch number, expiry date, unit cost and selling price, manufacturer or supplier information. The system will not allow if there are empty or unfilled fields to avoid the incomplete data. The system also requires large memory capacity to maintain historical data of purchases, sales, returns, and inventory adjustments for analysis and compliance purposes.

3. Inventory Alerts and Notifications

   The system should automatically notify staff when stock levels fall below a predetermined threshold, triggering an order to replenish the stock. The system should also flag items that are nearing expiration (e.g., within 3-6 months) so that it can be sold, used, or disposed of before it become unusable. Last, the system should send notifications for stockouts, discrepancies, or damaged goods to prevent shortages or overstocking.

4. Integration with Other Systems

   The inventory system should be integrated with sales and procurement systems to synchronize purchase orders, sales orders, and stock levels.

5. Inventory Reporting and Analytics

   The system should be able to generate various reports, including inventory turnover rate, stock value and cost analysis, sales trends and performance by medicine and expiry reports for medicines nearing the end of their shelf life.

6. User-Friendly Interface

   The system should be intuitive, allowing users with different levels of expertise (pharmacy staff, inventory managers, etc.) to use it effectively. The system also should have role-based user access, where each user (e.g., pharmacist, manager, inventory staff) has access only to the relevant features and data.

7. Security and Data Integrity

   The system should have robust security features, including encryption, secure login (e.g., multi-factor authentication), and secure data storage to protect sensitive medicine information. Regular backups and disaster recovery processes should be in place to prevent loss of critical inventory data.

Interface Design

1. Login page

   The login page is the stage to enter to the main menu. There are two user options available in accordance to the user needs. Data entry is intended for staff in charge of data input and User is intended for pharmacist to generate report. In this page, users are requiring to fill up the correct username and password to be able to enter the next page.

Jurnal Logistik Indonesia Vol. 8, No. 2, Oktober 2024, pp. 122-131

Fig 3. Login Page

2. Medicine stock detail page

The data details of medicine stock page provide essential information about the inventory status of medicines. The components that included are:

1. Medicine code/ID: a unique identifier or code for the medicine.
2. Medicine name/brand: the name of the medication or the brand name. Generic names are also included in some cases, especially in cases of branded generics.
3. Manufacturer: details of the supplier or manufacturer of the medicine. This includes the name of the company, contact details, and delivery times.
4. Expiry date: the date by which the medicine should be used or consumed. It helps in managing the shelf life and ensuring the stock contains only valid, non-expired medications.
5. Stock quantity: the current amount of the medicine available in stock. This can be expressed as the number of units (e.g., bottles, tablets) or weight (e.g., grams, milliliters).
6. Batch number: a specific batch or lot number assigned to the medicine during manufacturing. This is important for tracking and recalling specific batches if necessary.
7. Shelf location: the physical location of the medicine in the store or warehouse. It could include aisle numbers, shelf codes, or room numbers.
8. Price/cost: the unit price or cost of the medicine, which may include wholesale prices, retail prices, or the cost per unit (e.g., per tablet, bottle).

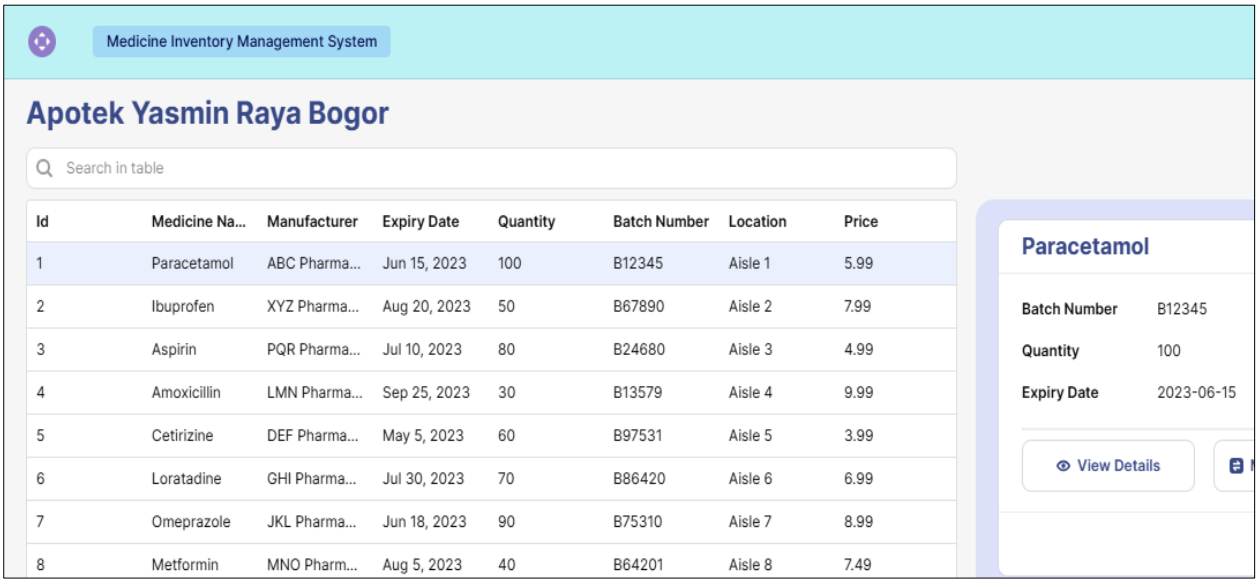

Fig 4. Medicine Stock Detail Page

3. Reporting page

The report page of medicine inventory provides a summary of the inventory status, trends, and key metrics related to the medicines in stock. This report is used by pharmacist and owner to monitor stock levels, plan for future orders, and ensure the availability of medications.

1. Customer: provides information on each customer who buys prescription drugs, including name, drug name, dosage, quantity, contact number and order date.
2. Medicine stock: the total amount of each medication currently available in the inventory (e.g., number of units, bottles, or dosage forms).
3. Stock refills: the point at which orders should be placed for medicines that are about to run out.
4. Generate new invoice: feature that used when there is medicine purchase transaction from customer.
5. Add a medical title: feature that used if there is an addition of a new type of medicine.
6. POS invoice: keep a record of invoices that have been issued
7. Sales analytics: a comparison of sales data over different time periods, showing which medicines have high or low sales.
8. Stock analytics, provides information such as:
   a) Top-selling products: identifies which items are performing best in terms of sales volume, revenue, or customer demand.
   b) Slow-moving items: highlights products that aren't selling well, allowing businesses to assess whether to discount, discontinue, or find ways to promote those items.
   c) Stock aging: tracks how long products have been in inventory, identifying items that may be approaching their expiration date or becoming obsolete (important for perishable goods).
9. Automated purchase: automatically generates purchase orders when stock levels of a specific product fall below a predefined threshold or reorder point.

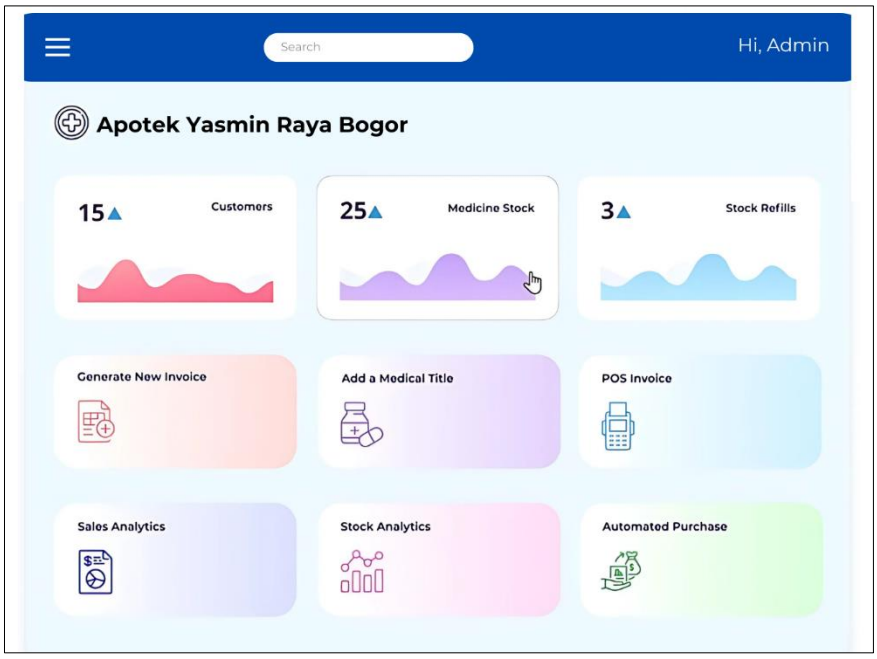

Fig 5. Reporting Page

Discussion

The medicine inventory system is a critical component of modern pharmaceutical operations. A primary function of any inventory system is to ensure that essential medications are always in stock and available when needed. Medicine inventory systems can help track stock levels in real-time and issue

alerts when stock levels fall below critical thresholds. This minimizes the chances of stockouts, ensuring that pharmacy always have the right medicines in hand for customers.

Moreover, the inventory system could minimize waste and cost efficient. The critical issue in medicine product is the expiration date and improper management of expiry dates can lead to wastage. A medicine inventory system helps track expiration dates, and automated alerts ensure that older stock is used first (First In, First Out - FIFO). By rotating stock properly, the system minimizes losses from expired medications. The implementation of inventory system, pharmacy could be more efficient since the automated inventory system will simplifies processes, from receiving orders to stock tracking, labeling, and reporting. This reduces the burden on staff and increases overall operational efficiency. Compared to the earlier system, where the tracking of medicine stocks was manual, and it was very time-consuming and prone to human error.

To run an effective medicine inventory system, it is very important for the pharmacy owner to have a high level of commitment to various aspects of the system, i.e.:

1) Commitment to investment in technology. Pharmacy owners must be willing to invest in robust inventory management software and the necessary hardware. Since technology evolves quickly, so pharmacy owners need to commit to upgrading the system periodically to ensure it remains secure, compliant, and functional. This may involve updating software, replacing outdated hardware, or adding new features (Meyer et al., 2021).
2) Commitment to employee training and development. Pharmacy owners need to commit to regularly training their staff on how to properly use the medicine inventory system. This includes training on how to input data, handle inventory transactions, track expiration dates, and manage stock levels (Dube et al., 2020).
3) Commitment to accurate and timely data entry. Pharmacy owners must ensure that all transactions—whether it's receiving new stock, dispensing medications, or removing expired stock—are entered into the inventory system in real time. This minimizes discrepancies between physical stock and digital records (Leung et al., 2021).

4. CONCLUSION

A good information system for medicine stock should ensure accuracy, real-time updates, and efficiency in managing inventory. With the help of automation and data analytics, it helps in reducing errors, reducing cost, optimizing stock levels, preventing wastage, and ensuring that medicines are always available when needed. Pharmacy owners must make a multifaceted commitment to successfully running a medicine inventory system. This involves investing in technology, training staff, and ensuring the accuracy and timely data entry. Additionally, owners should remain adaptable and committed to ongoing improvement to ensure that their inventory system continues to meet the evolving needs of their business.

REFERENCES

Alpandi, M., & Devitra, J. (2019). Analisis dan Perancangan Sistem Informasi Persediaan Obat-Obatan Pada Puskesmas Mersam Kecamatan Mersam Kabupaten Batanghari. Jurnal Manajemen Informasi, Vol. 4, No. 4, Desember 2019.

Davis, R. L. (2018). Advanced JavaScript techniques for dynamic web applications. *Journal of Programming Languages*, 22(7), 1124-1137.

Denzin, N. K., & Lincoln, Y. S. (2018). The landscape of qualitative research (4th ed.). Sage Publications.

Dube, C., Desai, S., & Singh, A. (2020). *Pharmacy inventory management: Best practices and strategies for improvement*. Journal of Pharmaceutical Sciences, 109(3), 652-659.

Goh, M., & Ang, L. (2015). Efficient inventory management in the healthcare sector. International Journal of Healthcare Management, 8(2), 94-102.

Han, S., & Yang, X. (2016). Improving pharmacy inventory management through automation: A case study. Journal of Healthcare Operations and Logistics, 4(2), 55-63.

Iqbal, J., & Chauhan, M. (2017). Prototyping model for early-stage software development: A systematic review. International Journal of Advanced Computer Science and Applications, 8(7), 290-297.

Kumar, S., & Patel, M. (2021). Leveraging PHP for server-side web applications. *International Journal of Web Development*, 19(2), 91-103.

Lee, K. H., & Wang, X. (2019). The evolution of CSS for responsive web design. *Journal of Web Design and Technology*, 12(4), 50-65.

Leung, W. C., Chu, S. Y., & Chan, P. K. (2021). *Regulatory compliance in pharmaceutical inventory management*. Pharmacy Management Review, 34(4), 289-298.

Meyer, D., Henson, M., & Walker, L. (2021). *Implementing automated systems for drug inventory control in community pharmacies*. Journal of Healthcare Information Systems, 28(1), 42-49.

Pressman, R. S. (2014). Software engineering: A practitioner's approach (8th ed.). McGraw-Hill.

Smith, J., & Brown, A. (2020). Enhancing web accessibility with HTML5. *Journal of Web Development*, 15(3), 225-238.

Zhang, Y., & Chen, L. (2017). MySQL database management in modern web applications. Journal of Database Technologies, 14(5), 300-315.

Zhang, X., & Liu, J. (2017). Predictive analytics for pharmaceutical inventory management: Improving demand forecasting. International Journal of Production Economics, 193, 167-176.