SOCIETY: Jurnal Pengabdian Masyarakat,
Vol. 4, No. 6 (2025): November, pp. 1028-1036
E-ISSN:2827-878X (Online -Elektronik)

Analysis and Design of Inventory Systems to Improve Management Efficiency at a Small Clinic in Bogor

Stepani Sisca Wulandari[1,*], Pinky Rosalia[2], Fangky A. Sorongan[3], Niko Silitonga[4]

[1,2,3,4] Perbanas Institute

sisca.wulandari@perbanas.id

ARTICLE INFO

Article history

Received : 22-9-2025

Revised : 30-11-2025

Accepted : 30-11-2025

Keywords

Inventory; FIFO; Clinic; Accounting Systems; Prototype

ABSTRACT

This research aims to analyze the needs and business processes in inventory management at the Irna Dewi Megawati midwife clinic, as well as to design an accounting information system for the inventory of goods using the FIFO (First In First Out) method. Currently, inventory management at the Clinic is carried out manually, relying on notes or receipts from goods distributors, which often leads to errors in inventory data, delays in finding goods data, and difficulties in making reports. This research uses a qualitative method. Data were collected through interviews and observations. The system was developed using the prototyping method, with the initial design created using Balsamiq. The system was created using the PHP programming language, MySQL as the database, and XAMPP as the local database server. The results of this study show that the system can provide accurate inventory data, record incoming and outgoing transactions in real-time, and support clinics in decision-making. With this solution, the inventory management process at the Irna Dewi Megawati midwife clinic becomes more efficient and easier to use by users or staff who do not have an IT background.

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A. INTRODUCTION

In the ever-evolving digital era, inventory management and clinic management systems are important components that affect the operational efficiency of clinics. Management of inventories represents one of the most important areas in business, trade, and industry (Forcina et al., 2017). In the healthcare sector, digitalization has had a major impact on the administration and management of inventory. The application of digital technology to clinical decision-making, patient flow, staffing, scheduling, and supply chain management has been proven to improve hospital operational choices, resulting in lower costs and greater efficiency (Kraus et al., 2021). The development of information technology has had a significant impact on health services; however, the integration of technology is still not optimally used, especially in clinics that are far from the city. The symptoms of this problem include inaccurate information, such as discrepancies in drug stock quantities and a high frequency of recording errors, as well as operational delays caused by a lack of technology integration, including

prolonged data search times at Irna Dewi Megawati Clinic. This is because data and information must be found quickly and accurately.

One of the clinics affected by this problem is the Irna Dewi Megawati midwife clinic. This clinic is one of the maternity clinics that is most often visited by the community; the large volume of visits requires the management of supplies of goods and medicines. The wide variety of drugs and other medical equipment will affect inventory management, requiring the use of accounting information systems that facilitate the management of medical supplies to increase productivity and efficiency. Unfortunately, this clinic still uses manual recording methods, which cause various problems such as incorrect information, delays in data search, and mismatches between physical stock and inventory records.

The article titled "Rancang Bangun Sistem Informasi Persediaan Obat Berbasis Web Pada Apotek Murah Bung Tomo" by Rachman et al. (2024) provides a comprehensive exploration of the challenges faced by pharmacies in managing their inventory and the development of a web-based inventory management system to address these issues. The results demonstrated that the web-based inventory management system significantly improved the efficiency of drug management at the pharmacy. The system allowed for better tracking of drug entries and exits, minimized errors in data entry, and enhanced the speed of report generation.

This research serves as a reference for analyzing and designing a drug inventory system in the clinics. It emphasizes the importance of transitioning from manual inventory management to a computerized system, which can significantly streamline operations. By adopting a similar approach, midwifery clinics can achieve better organization of drug data, minimize human errors, and enhance the overall efficiency of their inventory management processes. The successful outcomes demonstrated in this study provide a solid foundation for developing efficient drug inventory solutions tailored to the specific needs of clinics.

To create an effective drug inventory system, a community empowerment initiative starts with an initial assessment to identify the specific requirements of the clinics. The findings from this evaluation guide the creation of the inventory system. Following this, the system design for the clinic is developed, and a prototype is constructed using PHP and XAMPP programming languages. Afterward, the community empowerment program will seek feedback on the inventory systems from the clinic staff. Once the users express satisfaction with the inventory system, it will be implemented.

Implementing a drug inventory system in a midwifery clinic would lead to notable improvements in various aspects of clinic operations. The system would enhance efficiency by automating the tracking of drug stock levels, thereby reducing the time spent on manual record-keeping (Rachman et al., 2024). It would also minimize data entry errors, ensuring more accurate inventory records and facilitating quicker report generation for operational monitoring. Additionally, it would provide a comprehensive view of inventory management, supporting better resource allocation and decision-making. By ensuring that medications are readily available and properly managed, the clinic would ultimately improve the quality of care provided to patients. The user feedback mechanism incorporated in the implementation process would ensure that the system meets the needs of the clinic staff, fostering satisfaction and encouraging effective use of the system. Overall, the adoption of such a system would significantly optimize drug inventory management processes within the clinic.

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B. METHODS

The community service program was carried out using a structured, multi-step approach to guarantee that the goals were successfully achieved in line with the partner's requirements. This approach was crafted with a significant focus on matching technological solutions to the unique challenges encountered by the clinic. The process can be broken down into four clear phases: identifying needs, designing and developing the system, system testing, implementing the solution along with follow-up evaluation, and ultimately, providing training and mentoring.

1. Phase 1: Identification of Needs
   During the first phase, the team carried out thorough direct interviews with the clinic owner to obtain a detailed insight into the business operations and the challenges they faced in inventory management. The interviews are conducted in a semi-structured format to ensure that the information obtained is more in-depth while still focusing on the main problem. The findings indicate that the documentation of medical devices and drug supplies at the clinic is still done manually. However, this recording is not done consistently. At times, clinics depend solely on receipts or memos from drug sales or distributors as their archives and primary information, as there is no formal record of incoming and outgoing goods. This leads to several significant issues in inventory management, including delays in data retrieval and discrepancies between the recorded stock and the actual physical inventory. These findings highlighted a distinct need for an inventory accounting information system.

2. Phase 2: Designing and Developing the System
   Drawing from the insights gathered, the team moved forward with designing and developing an effective and efficient inventory accounting information system. Based on these conditions, it can be concluded that the clinic requires an inventory accounting information system that effectively meets its needs. This system should accurately and automatically record and manage inventory data for drugs and other medical equipment, tracking additions and subtractions based on incoming and outgoing transactions. Additionally, it must be capable of real-time data recording for incoming and outgoing goods, ensuring that stock levels are always up to date. The system should also generate COGS (Cost of Goods Sold) reports automatically, allowing users to access information for specific periods. Furthermore, it should provide comprehensive inventory reports and a history of drug usage that can be easily printed in PDF or Excel formats, or directly through a print feature. Lastly, the system must be user-friendly, featuring a simple interface that staff can navigate with ease.

3. Phase 3: System Testing
   System testing for the developing inventory accounting information system at the clinic is a critical phase that ensures the software functions as intended and meets the specified requirements. This process involves several testing methodologies, including unit testing, integration testing, and user acceptance testing (UAT). During unit testing, individual components of the system, such as the inventory tracking module and reporting features, are evaluated to verify their functionality in isolation. Integration testing follows, where the interaction between different modules is assessed to ensure seamless data flow and system coherence. This phase aims to identify any discrepancies or bugs that may arise when components work together.

Once the system has passed unit and integration testing, user acceptance testing is conducted to gather feedback from actual users, such as clinic staff and managers. This step is crucial as it allows users to interact with the system in a real-world environment, ensuring that it meets their needs and expectations. Users will evaluate the system's usability, accuracy in recording inventory transactions, and the effectiveness of reporting features. Any issues identified during UAT will be addressed before the system is fully deployed. By thoroughly testing the inventory accounting information system, the clinic can ensure that it operates efficiently, minimizes errors in inventory management, and ultimately supports better decision-making in the procurement and usage of medical supplies.

4. Phase 4: Implementing the solution along with follow-up evaluation
   The implementing phase of the inventory system in the midwife clinic involved deploying the solution into the clinic's daily operations, ensuring seamless integration with existing workflows. During this phase, the system was carefully configured and tested in the live environment, with close support provided to staff to address any technical issues or user challenges promptly. The implementation aimed to minimize disruption to clinic services while enabling real-time inventory tracking and management.

   Following the deployment, a follow-up evaluation was conducted to assess the system's effectiveness and user adoption. This evaluation included collecting feedback from clinic staff on usability, monitoring inventory accuracy, and measuring improvements in stock management efficiency. Any identified issues or areas for improvement were addressed through system updates or additional training sessions. This continuous evaluation ensured that the inventory system met the clinic's operational needs and contributed to better resource utilization and service quality.

   Overall, the combination of careful implementation and ongoing evaluation helped the clinic optimize inventory control, reduce stockouts, and support the smooth delivery of healthcare services.

5. Phase 5: Training and Mentoring
   The training phase for the implementation of the inventory system in the midwife clinic was conducted after the system development and installation were completed, aiming to empower clinic staff to manage the inventory system independently. The training consisted of an intensive 4-day workshop followed by one week of on-the-job support and subsequent follow-ups. During the training sessions, the entire midwife clinic team (all clinic staff) participated and were introduced to the basic use of the system, including how to input data for medical supplies and equipment, monitor real-time stock levels, record incoming and outgoing items, and manage inventory reports to ensure the availability of necessary tools and materials for clinic services.

   The training also covered the use of special integrated features such as minimum stock alerts, expiration date management for medicines and medical devices, and data backup procedures to secure information. Additionally, staff were trained on basic troubleshooting and how to leverage the system to improve the clinic's operational efficiency.

With this comprehensive training approach, it is expected that the entire midwife clinic team will be confident and self-reliant in operating the inventory system, thereby achieving more structured inventory management that supports smooth healthcare service delivery.

The phased approach to implementing the inventory system in the midwife clinic was designed to address the unique challenges and needs of the clinic at each stage, ensuring that every step was tailored and effective. This methodical progression facilitated smooth adaptation and problem-solving throughout the process.

C. RESULTS AND DISCUSSION

The results and discussion of this project are presented in four main sections: identification of needs, designing and developing the system, technology implementation, and evaluation of the program's sustainability.

1. Identification of needs

   According to Joesanna & Cahyaningtyas (2024), Interviews are a type of two-way communication that aims to obtain valid data from respondents. The information obtained is then used as an important contribution to refining the research. The identification of needs in the inventory system was conducted through interviews with the owner of the midwife clinic, by asking direct questions about the management of the drug supply. Apart from using interviews, identifying needs also uses observation. According to Taqwiym and Nurasiah (2020), Observation is a direct observation approach used to obtain information about the situation in the field. The goal is to create a work system that can identify existing problems.

   Based on interviews conducted, the recording of medical devices and drug supplies at the clinic is still carried out manually. However, recording is not done consistently. Sometimes, clinics only rely on receipts or memoranda from sales or distributors of drugs and other medical devices as archives and basic information, because the data on incoming and outgoing goods is not recorded. This results in various serious problems in inventory management, such as delays in data search and mismatches between physical stock in records and real conditions. To avoid stock-out or excessive stocks, it is important to calculate the optimal stock level, also taking into account the delivery lead time and the speed of product sale or consumption (Forcina et al., 2017).

   In addition, the clinic does not have a financial reporting system or a system to calculate the Cost of Goods Sold (COGS). The process of recapitulation of stock data or the use of drugs and goods is only done when necessary and is done manually, which takes a lot of time. Inventory management and financial evaluation become inefficient due to the absence of a structured system. Based on these conditions, it can be concluded that users need an inventory accounting information system.

2. Designing and Developing the System

   The next stage is to design a prototype for an inventory system for goods and medicine inventory, after collecting user needs and analyzing the information system currently used by the midwife clinic. The purpose of this design is to describe the design of the interface and the workflow of the system.

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The prototype development method is used in the design process, which involves creating an initial drawing or interface display. The design of this design uses Balsamiq. The interface design of the drug inventory system at the midwife Clinic is shown in Figures 1 and 2.

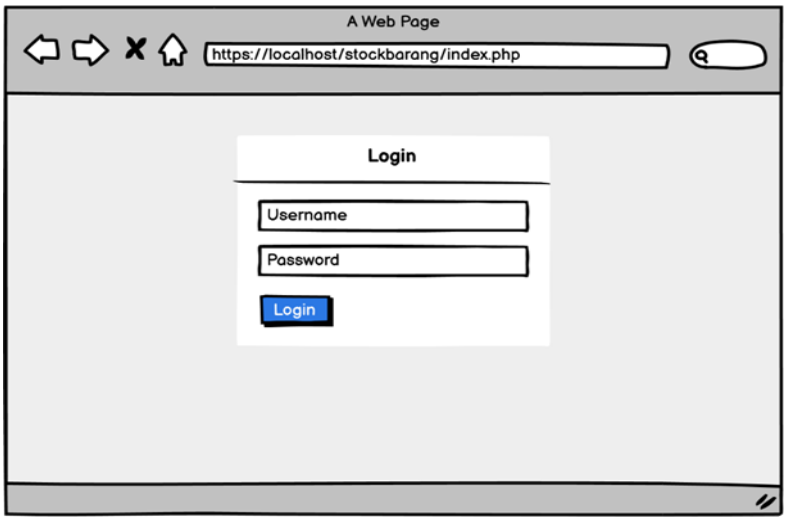

Figure 1. Login input page

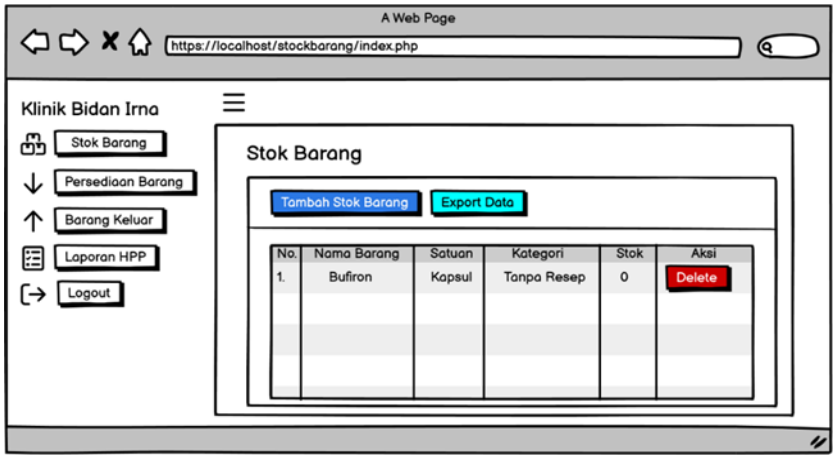

Figure 2. Item Stock Page Design

3. Implementation

At this stage, the prototype is implemented using Visual Studio Code with the programming languages PHP, HTML, and MySQL as the database. In addition, the interface design is done using Balsamiq. The database that has been designed is implemented using MySQL in XAMPP version 3.3.0.

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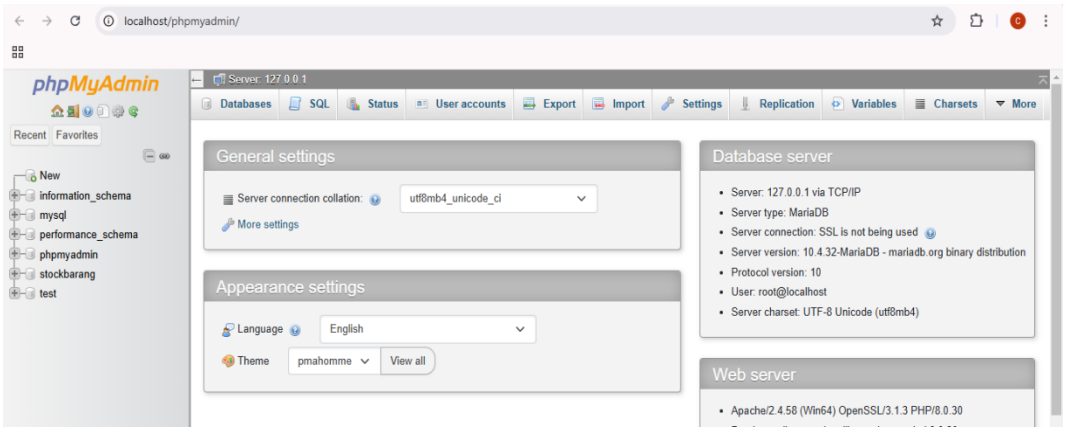

Figure 3. phpMyAdmin Initial View

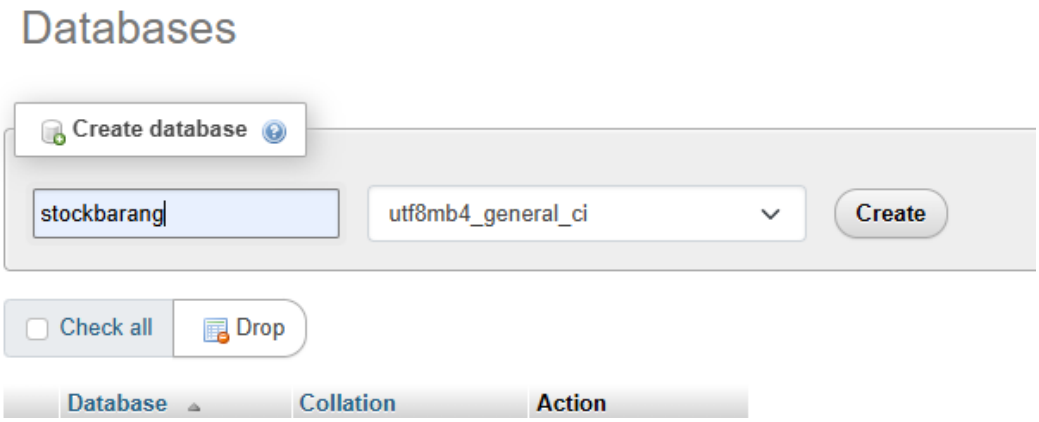

Figure 4. Creating a Database

The Black Box Testing method is used in system testing. The following is the test of the system based on the results of the proposed system design as shown in Table 1.

Table 1. Login Input Page Testing

No.	Testing	Test Results	Conclusion
1.	Input *Username* and *Password* according to access rights.	Successful login	Valid
2.	Entering *Usernames* and Passwords that are not in accordance with access rights.	Login failed	Valid

4. Evaluation of the Program's Sustainability (with inventory system training)
After deployment and testing, a brief follow-up evaluation verified the system's fit with clinic operations via staff interviews, reconciliation of physical stock versus system records, and monitoring of real-time stock and COGS reports. Key functions checked included minimum-stock alerts, expiry management, PDF/Excel export, and data backup.

To ensure sustained use, a concise training package was provided: objectives were to enable staff to enter/verify in/out transactions, respond to min-stock alerts, manage expiries, generate and interpret reports (including COGS), and perform basic backups/recovery. Delivery was hands-on using the PHP/MySQL/XAMPP

prototype (demos + practical exercises), consisting of an intensive 1–2 day workshop, coordinated UAT with one week of on-the-job support, and follow-ups at one week and one month. One or two local "super-users" received additional train-the-trainer instruction and remote mentoring for 1–2 months. Post-implementation monitoring focuses on adoption rate, stock accuracy (physical vs system), stockout frequency, user competency (pre/post tests), and trainee satisfaction.

D. CONCLUSION

The project developed and deployed a prototype FIFO-based inventory accounting system for the Irna Dewi Megawati midwife clinic (designed in Balsamiq; built with PHP/MySQL on XAMPP). The system supports real-time in/out recording, automatic COGS calculation, minimum-stock alerts, expiry tracking, and PDF/Excel export, and staff training (1–2 day workshop, UAT, and follow-ups) increased user confidence in routine operation. Expected benefits include improved inventory accuracy, faster reporting, and fewer stockouts. Limitations are dependence on a local XAMPP setup and the absence of long-term quantitative metrics; to sustain gains, the project recommends appointing 1–2 super-users, scheduling regular stock audits and refresher training, and planning for a maintenance/backup or cloud migration.

E.AUTHOR CONTRIBUTIONS

All team members actively contributed to each stage of the digital transformation program for the clinic. Stepani Sisca Wulandari, as team leader: conceptualization; project supervision; validation of research design and results; review and editing of the manuscript; and correspondence with the journal. Pinky Rosalia — Methodology; investigation (field interviews and observations at the Irna Dewi Megawati midwife clinic); system design and prototyping (Balsamiq); software development and implementation (PHP, MySQL, XAMPP; Visual Studio Code); database design and setup (phpMyAdmin/XAMPP); system testing (black-box testing, UAT); preparation and delivery of training (12-day workshop, on-the-job support); data curation; drafting the original manuscript; system handover and user documentation. Fangky A. Sorongan — Technical support in system design and implementation; front-end/UI refinement and prototyping assistance; participation in system testing and debugging; contribution to documentation and user training. Niko Silitonga — Deployment and local server configuration (XAMPP/phpMyAdmin); assistance with database administration, export/print and reporting features (PDF/Excel); participation in system testing, user acceptance, and handover support; support for training and follow-up evaluation.

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