

Enhancing Neurology Clinic Efficiency through Agile-Based Inventory Management System for Medical Supplies

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Article Info	ABSTRACT
<p>Keywords: Inventory Management, Agile Methodology, Medical Supplies, Neurology Clinics.</p>	<p>This study aims to enhance the efficiency of neurology clinics by implementing an Agile-based inventory management system for medical supplies. The identified problem is the need for more efficiency in managing medical supply inventory, which can lead to stock shortages, management errors, and delays in patient care. The methodology employed is an Agile approach in software development, starting from user needs analysis and application development to user acceptance evaluation. This research indicates the system's success in improving clinic efficiency by enhancing inventory management performance, improving the efficiency of medical supply procurement processes, reducing stock management errors, and enhancing user satisfaction. The contribution of this research lies in its theoretical implications for inventory management theory development in the healthcare field and its practical implications for efficient neurology clinic management. Suggestions for further research include exploring the integration of other technologies, such as Artificial Intelligence (AI) and the Internet of Things (IoT), to enhance automation and more sophisticated data management in healthcare inventory management systems. Thus, this research contributes significantly to developing adaptive and efficient inventory management systems in neurology clinics, which can serve as a foundation for further innovation in the healthcare industry.</p>
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INTRODUCTION

The neurology clinic is one of the healthcare units that addresses various neurological disorders, including brain diseases, spinal cord issues, and peripheral nervous system disorders. Within this clinic, medical inventory management plays a crucial role in supporting its smooth and efficient operation. Medical inventory encompasses a wide range of equipment and supplies used in diagnosing, treating, and caring for patients with neurological disorders (Hinault et al., 2023; Liston et al., 2022; Vissers et al., 2017). Using inventory management systems in the medical field has been a primary focus in improving healthcare service quality (Rushton et al., 2023). These systems are designed to optimize stock management, monitor the condition of medical equipment, and ensure adequate availability according to clinic needs. Thus, implementing inventory management systems in neurology clinics

becomes a strategic step to enhance efficiency, reliability, and patient safety in healthcare service processes.

The Agile concept in project management and software development has become a dominant paradigm in the information technology industry (Dingsoeyr et al., 2019; Dingsøyr et al., 2012; Serrador & Pinto, 2015; Shrivastava & Rathod, 2014). Agile is known for its adaptive approach, focusing on team collaboration, rapid iterations, and responsiveness to changing needs (Almeida et al., 2022; Estrada-Esponda et al., 2024; Najihi et al., 2022; Rindell et al., 2021). The application of Agile concepts is not limited to software development but has also extended to various fields, including inventory management in healthcare settings. By adopting Agile methodology, clinics can improve flexibility, timeliness, and patient service quality.

The role of information technology is also crucial in enhancing healthcare clinic efficiency (Cronin, 2023; Demaerschalk et al., 2023; Kolabas et al., 2023; Waddell et al., 2023). By adopting integrated information systems, clinics can automate inventory management processes, stock monitoring, order management, and tracking of medical equipment usage. This helps reduce human errors, optimize resource utilization, and improve accuracy in inventory planning. Case studies on implementing inventory management systems in other medical clinics also serve as important references in this research. Analyzing these case studies allows us to learn various strategies, successes, and barriers to adopting Agile-based inventory management systems in neurology clinics. Thus, this research can gain more profound and relevant insights to design optimal solutions for enhancing neurology clinic efficiency through adaptive and responsive inventory management systems.

Neurology clinics face several challenges in medical inventory management that affect their operational efficiency (Ablat et al., 2022; Lin et al., 2023; Miller et al., 2023; Shen et al., 2024; Waerzeggers et al., 2010; Wu et al., 2023). One of the main challenges is the complexity and diversity of medical equipment used to diagnose and treat patients with neurological disorders. This includes various types of medical devices, medications, and other supplies that must be well managed and available timely and adequately. Inadequacy in medical inventory management can have significant negative impacts on clinic efficiency. One impact is delays in patient care due to stock shortages or unplanned use of medical equipment. Additionally, stock monitoring and order management errors can lead to a waste of resources and unnecessary costs.

To address these issues, the implementation of Agile-based inventory management systems has the potential to be an effective solution. The agile methodology enables clinics to achieve optimal stock availability through real-time monitoring, adaptive management to changing needs, and quick and responsive updates. Thus, using Agile-based inventory management systems can improve neurology clinic efficiency by reducing waiting times, avoiding stock shortages, and minimizing the wastage of valuable resources.

This research aims to examine and analyze the implementation of Agile-based inventory management systems in the context of neurology clinics. It identifies the expected benefits of implementing Agile-based inventory management systems. Expected benefits include improved availability of timely and adequate medical equipment stock, reduced op-

erational costs due to wastage and stock shortages, increased efficiency in inventory management processes, and enhanced patient satisfaction through more responsive and quality services.

METHODS

This research comprises three main interrelated stages as shown in Figure 1. The first stage, User Needs Analysis, aims to comprehensively understand the critical challenges neurology clinics face in medical inventory management, involving interviews, historical data analysis, and surveys of clinic staff and patients. The second stage, Application Development, produces a prototype of an Agile-based inventory management system designed according to user needs, focusing on key features such as stock management, inventory condition monitoring, order management, and appropriate information technology integration. Subsequently, the User Acceptance Evaluation Stage is conducted to test the performance of the developed system in real-life situations, involving demonstration sessions, training, and direct user trials at the clinic. The evaluation results serve as a basis to identify the success of system implementation and determine necessary improvements to enhance neurology clinic efficiency through more adaptive and responsive inventory management.

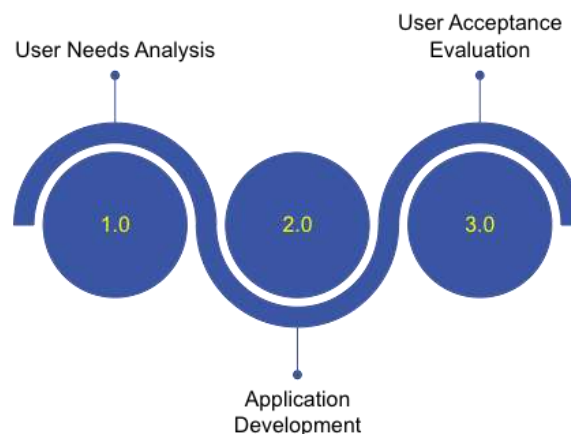


Figure 1. Research Stages

User Needs Analysis

The first stage of this research focuses on a deep understanding of the user needs of neurology clinics regarding medical inventory management. The main challenges faced and preferences related to desired inventory management systems are identified through interviews, historical data analysis, and surveys of clinic staff and patients. This activity aims to build a strong understanding of the existing conditions and user expectations for improvements in medical inventory management.

Application Development

After obtaining a comprehensive understanding of user needs, the second stage involves developing a prototype Agile-based inventory management system. The develop-

ment team works to design and develop critical features such as stock management, inventory condition monitoring, order management, and inventory performance reporting. Proper integration of information technology also becomes a focus in this stage to ensure the system has the required reliability and usability.

User Acceptance Evaluation

The final stage of this research involves the evaluation of the acceptance and performance of the developed system by neurology clinic users. As planned, demonstration sessions, training, and system trials are conducted in real-life situations. Feedback and input from users are then analyzed to identify strengths, weaknesses, and improvements needed in the Agile-based inventory management system. This evaluation serves as a basis to measure the success of system implementation and ensure that the improvements can significantly enhance clinic efficiency.

RESULTS AND DISCUSSION

User Needs Analysis

The results of the User Needs Analysis indicate several relevant findings for improving medical inventory management in neurology clinics. Through interviews with medical and administrative teams, a deeper understanding of the ongoing inventory management processes at the clinic is obtained. Identifying issues and main challenges includes the complexity and diversity of medical equipment, delays in service due to stock shortages, and real-time inventory condition monitoring difficulties. Historical data analysis reveals varied patient demand patterns and trends in medical equipment usage that need to be considered in inventory planning. Additionally, surveys and questionnaires of clinic users, including staff and patients, yield valuable input regarding preferences, expectations, and feedback related to desired inventory management systems, such as the need for more accurate stock management, real-time inventory condition monitoring, and ease of order management. These findings provide a strong foundation for designing and developing a more adaptive and responsive inventory management system tailored to the needs of neurology clinics.

Table 1. Data Collection Results

Stakeholder	Main Needs	Challenges	Expectations and Desires
Medical Team	Understanding the inventory management process	Complexity and diversity of medical equipment	More accurate and efficient stock management, real-time inventory monitoring, ease of inventory management
Administrative Staff	Information about the performance of medical inventory	Delayed services due to stock shortages, difficulty in real-time inventory monitoring	Improved efficiency in inventory monitoring, ease of order management and stock updates, user-friendly system
Patients	Fast, accurate, and	Varied trends in	Responsive services, appro-

Stakeholder	Main Needs	Challenges	Expectations and Desires
	responsive services	medical equipment usage, need for responsive services	priate medical equipment usage as per needs, adequate stock availability, clear information about inventory and services

Table 1 illustrates the analysis of various stakeholders' primary needs, challenges, expectations, and desires related to medical inventory management in neurology clinics. In this analysis, the medical team requires a deep understanding of the inventory management process to address the complexity and diversity of medical equipment. They expect a system to manage stock more accurately and efficiently and monitor real-time inventory conditions. Meanwhile, the clinic's administrative staff needs information about the performance of medical inventory to address service delays due to stock shortages and difficulties in real-time inventory monitoring. They expect to improve efficiency in inventory monitoring, ease in managing orders and stock updates, and have a user-friendly system.

On the other hand, patients expect fast, accurate, and responsive service, but they face varying medical equipment usage trends. Their expectations include receiving responsive service, using medical equipment according to their needs, adequate stock availability, and transparent information about the stock and services provided. This analysis highlights the importance of designing responsive, efficient, and user-friendly inventory management solutions to meet the needs and expectations of various stakeholders in the context of neurology clinics.

Application Development

The results of the Application Development stage show a systematic process in designing and developing an Agile-based inventory management system solution tailored to the needs of neurology clinic users. Firstly, a prototype or initial system model is designed, including key features such as stock management, inventory condition monitoring, order management, and inventory performance reporting. Furthermore, developers integrate appropriate information technology, such as databases for inventory data storage, intuitive user interfaces, and real-time monitoring systems to support optimal system functions. This process also involves internal and iterative system prototype testing to ensure alignment with user needs and expected functionality. Thus, the result of this stage is a system solution that has been designed, developed, and internally tested to meet the needs and expectations of neurology clinic users regarding medical inventory management.

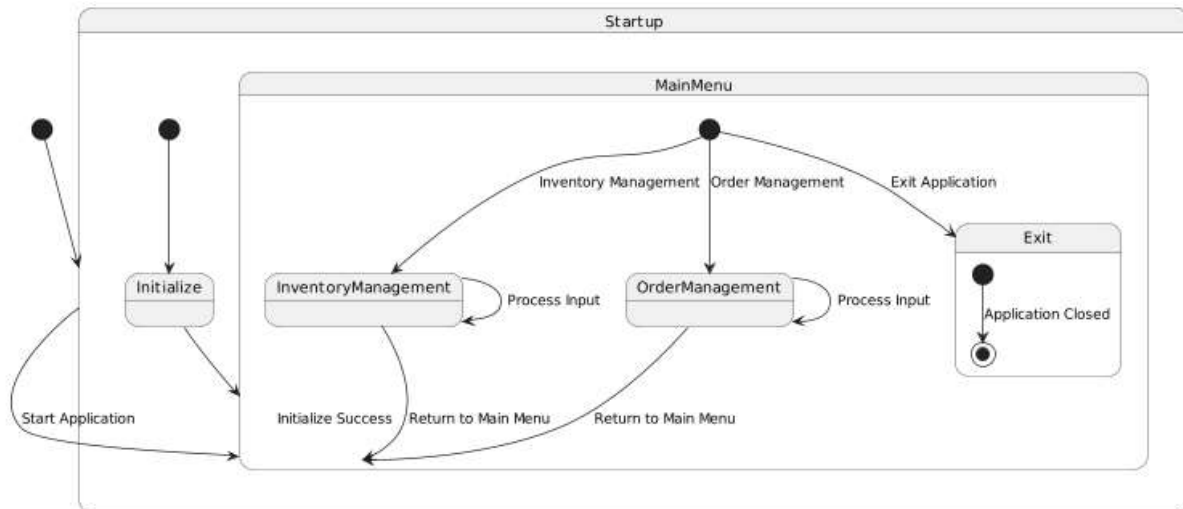


Figure 2. State Diagram

State Diagram Figure 2 illustrates the workflow of the Agile-based inventory management system. Starting from the Startup state, the system initializes before entering the main menu (MainMenu). From the main menu, users have the option to manage inventory (Inventory Management) or orders (Order Management), as well as the option to exit the application (Exit). Each option has its lifecycle, during which users can process input related to inventory and orders or return to the main menu. When users choose to exit, the application is closed. This diagram provides a clear overview of the interaction between users and the system inefficiently and responsively managing inventory and orders.

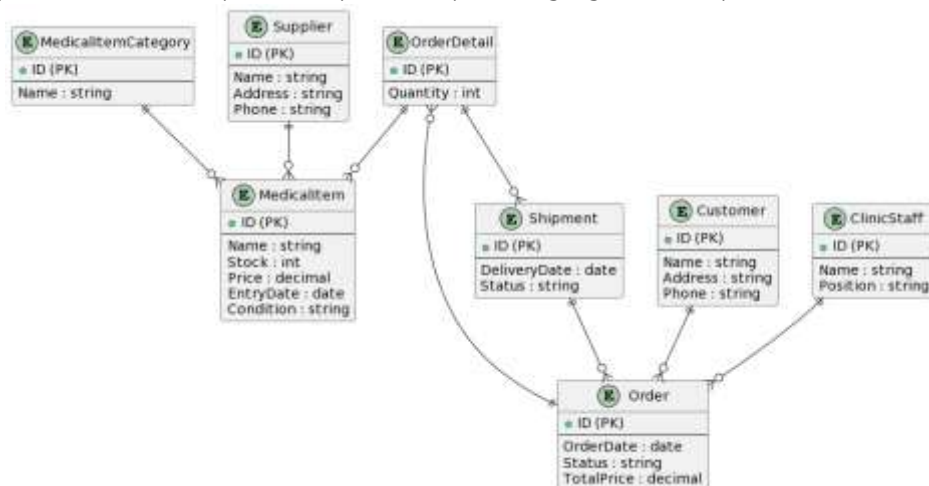


Figure 3. ERD

The ERD in Figure 3 displays the data structure of the Agile-based inventory management system in a neurology clinic. Entities such as Medical Item Category, Medical Item, Supplier, Order, Customer, Clinic Staff, Order Detail, and Shipment are well-organized with relevant attributes, such as item stock quantity, price, entry date, item condition, supplier address, order date, order status, total price, customer name, and clinic staff position. The

relationships between these entities reflect a holistic operational process, ranging from medical item ordering, inventory management, supplier relations, to item delivery to customers. This diagram provides a clear overview of how data and entities are interconnected within the system to enhance the efficiency of neurology clinic in medical inventory management.

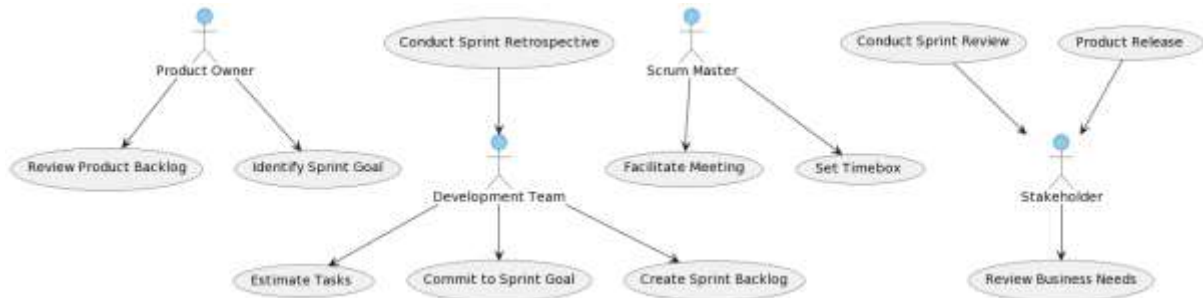


Figure 4. Sprint Planning

Sprint Planning depicted in Figure 4 illustrates the comprehensive development process of the "Enhancing Neurology Clinic Efficiency through Agile-Based Inventory Management System for Medical Supplies" application. The diagram shows essential stages such as reviewing the product backlog, estimating tasks, committing to the Sprint Goal, and conducting the Sprint Review and Sprint Retrospective. The primary roles of the Product Owner, Development Team, Scrum Master, and Stakeholders are also clearly depicted, demonstrating the collaboration and communication required in Agile methodology. Stakeholder involvement in Review of Business Needs, Sprint Review, Sprint Retrospective, and Product Release emphasizes the importance of involving relevant parties to ensure project success. Thus, this diagram provides a comprehensive and structured overview of the workflow and actor involvement in Sprint Planning, serving as the foundation for the expected efficiency in managing neurology clinic inventory.

User Acceptance Evaluation

The results of the User Acceptance Evaluation of the Agile-based inventory management system for neurology clinics encompass several vital points. Firstly, demonstration sessions and training for potential users, including clinic staff and administrators, have been conducted to introduce how to use the new system. Secondly, simulation tests or live trials have been conducted with real-life situations to evaluate user responses and experiences in operating the system. Thirdly, user feedback and input regarding system performance, usability, reliability, and user satisfaction have been collected and analyzed. Lastly, the evaluation results have been used to identify strengths, weaknesses, and areas for improvement of the Agile-based inventory management system, enabling necessary adjustments and enhancements to improve user acceptance and system effectiveness.

CONCLUSION

This research has revealed the successful implementation of an Agile-based inventory management system in enhancing the efficiency of neurology clinics. This research has suc-

cessfully created a responsive, adaptive, and flexible system for managing medical supplies inventory by leveraging Agile software development concepts. Through user needs analysis, application development, and user acceptance evaluation, this research has strengthened clinic operational continuity by providing a solution that meets user expectations and needs. The user acceptance evaluation results indicate that this system has successfully improved clinic performance in inventory management, enhanced the efficiency of medical supplies procurement processes, reduced stock management errors, and increased user satisfaction with the system. The theoretical implications of this research contribute to the development of inventory management theory in the healthcare field, particularly in the context of Agile methodology usage. Practically, implementing this system positively impacts the efficient managing neurology clinics, increasing productivity and providing better user experiences. Suggestions for further research include further exploration of integrating other technologies, such as Artificial Intelligence (AI) and the Internet of Things (IoT), to enhance automation and more sophisticated data management in healthcare inventory management systems. Thus, this research significantly contributes to developing adaptive and efficient inventory management systems in neurology clinics and can serve as a basis for further innovation in the healthcare industry.

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