

Development of agile-based quality management system application for pharmacy process optimization

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Article Info	ABSTRACT
Keywords: Quality Management System, Agile Methodology, Pharmacies.	The pharmacy industry faces increasingly complex challenges, including strict regulatory requirements and demands for high-quality services. This research aims to overcome these problems by developing an Agile-based quality management system application. The development method used is the Agile method, focusing on extreme programming (XP) to enable flexibility and responsiveness to changing user needs. The evaluation was conducted through a series of functionality and user acceptance tests. The evaluation results show that this application successfully meets user expectations, with a satisfaction rate of 78%. This research contributes to developing an effective solution for improving the pharmacy industry's operational efficiency and service quality. With the Agile approach, this application can be a handy tool for pharmacies.
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INTRODUCTION

The pharmacy industry is an integral part of the health system that plays a role in providing appropriate and safe access to medicines and pharmaceutical services essential for the community's well-being (Alghamdi et al., 2023; Chen et al., 2023; Hohmeier et al., 2023; Moote et al., 2023). Pharmacies are not only places to obtain medicines but also serve as health information centers that provide consultation and education to patients on the correct use of medicines and the importance of health maintenance. In the health system context, pharmacies also play a role in ensuring the efficient and safe distribution of pharmaceutical products, bridging between doctors and patients in the context of disease management and treatment. However, the pharmacy industry is not immune to several challenges, including increased competition, changing regulations, and demands to improve operational efficiency while maintaining high-quality standards.

Along with technology development, the pharmacy industry has undergone a significant transformation. Information systems and digital technology have changed how pharmacies operate, from stock management to customer interaction (Aljaber et al., 2023; Baumgartner et al., n.d.; Khan et al., 2023). Digitally integrated pharmacy management systems enable more accurate stock monitoring, faster order fulfillment, and more efficient reporting. In addition, technological developments have also brought innovations in

pharmacy services, such as online drug consultations and the use of mobile applications for personal health management. However, technological advancements also come with new challenges, including patient data protection and complex system integration. Therefore, developing adaptive and innovative quality management system applications is becoming increasingly important in supporting efficient pharmacy operations responsive to industry developments and customer needs.

In the context of pharmacies, quality management systems play a crucial role in ensuring the successful operation and delivery of safe, high-quality pharmacy services. A quality management system in pharmacy encompasses a set of procedures and practices designed to ensure that all aspects of pharmacy operations, from drug storage to dispensation to patients, comply with established quality standards. A clear definition and in-depth understanding of the quality management system are essential to maintain the integrity and reliability of the pharmaceutical services provided by the pharmacy.

The standards and regulations governing the pharmacy industry are strict and vary worldwide. Organizations and agencies such as the Food and Drug Administration (FDA) in the United States and the World Food and Drug Administration (WHO) are essential in setting quality and safety standards for medicines. The role of a quality management system in a pharmacy is to ensure that all processes and practices carried out within the pharmacy adhere to these standards and regulations. As such, the quality management system contributes to the quality of services provided to patients and ensures that the pharmacy operates by applicable legal and ethical requirements. Therefore, developing Agile-based quality management system applications is becoming increasingly important to help pharmacies deal with the complexities and dynamics of achieving compliance with applicable standards and regulations (Abeyaratne & Galbraith, n.d.-a, n.d.-b; Park et al., n.d.).

Agile methodologies in software development have become a popular and effective approach in dealing with complexity and dynamics in the development process. Agile methodologies emphasize close team collaboration, flexibility to change, and rapid iterative delivery of valuable functionality. The basic principles of Agile methodologies include prioritizing people and interactions over processes and tools, regular delivery of working software, and responsiveness to changing customer needs.

The main advantage of Agile methodology in software development is its ability to adapt to changing needs and market conditions quickly. By breaking the project into smaller iterations (sprints), the development team can get faster feedback from users and adapt the project plan as needs evolve. In addition, the iterative approach in Agile methodologies allows teams to focus on developing the most valuable features first, increasing user satisfaction and overall project success.

Agile methodology is not only limited to software development but has also been successfully applied in various industries, including information technology (Al-Saqqa et al., 2020; Dingsøyr et al., 2012; Santos et al., n.d.; Serrador & Pinto, 2015). In the IT industry, Agile approaches help companies to respond quickly to changing customer needs, improve product quality, and reduce project risks. By applying Agile principles, information

technology companies can improve operational efficiency, increase customer satisfaction, and gain a competitive advantage in a rapidly changing market. Therefore, developing an Agile-based quality management system application for optimizing pharmacy processes will benefit from the advantages of this methodology in software development (Alami et al., 2022, 2023; Almeida et al., 2022; Estrada-Esponda et al., 2024).

In developing a quality management system application for pharmacies, several issues and challenges must be identified and addressed. One of the main challenges is meeting pharmacy users' complex and varied needs. Each pharmacy may have different needs depending on its size, the type of services it provides, and the regulations applicable in its operating region. Therefore, the design of the quality management system application should accommodate these diverse needs by ensuring relevant functionality and appropriate adaptations. Slowness in the development process and lack of flexibility in responding to changes are other problems often encountered in developing quality management system applications for pharmacies. An overly lengthy development process can hinder the application's ability to immediately respond to needs or regulatory changes that may occur in the pharmaceutical industry. Therefore, adopting an Agile approach that allows iterative development and flexibility in changing needs or priorities is essential (Baxter et al., 2023; Humpert et al., 2022; Kantola et al., 2022; López et al., 2022; Mishra & Alzoubi, 2023; Paasivaara et al., 2018; Tøndel et al., 2022).

The quality of the end product and user satisfaction should be the primary focus in developing pharmacy quality management system applications. Such applications should be designed and developed to high-quality standards to ensure their safe and effective use in sensitive pharmacy environments. Intuitive and easy-to-use applications are also essential to increase user satisfaction and widespread adoption of applications in pharmacies. By prioritizing product quality and user satisfaction as the main focus, developing quality management system applications for pharmacies can add significant value to the pharmaceutical industry.

This research aims to develop an Agile-based quality management system application that can assist pharmacies in improving operational efficiency, ensuring compliance with applicable standards and regulations, and improving the quality of services provided to customers. By adopting an Agile approach, this research aims to create a solution responsive to changing needs and regulations so that it can respond more flexibly to the dynamics in the pharmaceutical industry. In addition, it also aims to increase user engagement through intuitive interface design and valuable features, thereby increasing the adoption of the app by pharmacies and ensuring effective and efficient use of the app in daily practice.

The main contribution of this research is the development of an innovative and adaptive quality management system application, which can assist pharmacies in improving service quality, compliance with quality standards, and operational efficiency. By providing a solution responsive to regulatory changes and industry trends, this application is expected to help pharmacies face complex and dynamic challenges in the pharmaceutical industry. In addition, the development of this application is also expected to contribute to

improving user experience and their involvement in the quality management process in pharmacies, thereby strengthening the position of pharmacies in providing high-quality healthcare services to the community. Thus, this research is expected to add significant value to the pharmaceutical and healthcare industry.

METHODS

In order to develop an Agile-based quality management system application for pharmacies, the research was divided into three main stages. The first stage involved an in-depth analysis of user needs, focusing on stakeholder identification, data collection through interviews and surveys, and needs analysis to determine the critical features required. The second stage involved developing the application using Agile (Extreme Programming) methodology, emphasizing sprint planning, implementation of key features, and continuous testing and integration. The final stage is functionality evaluation and user acceptance, where the application is evaluated through a series of functional and acceptance tests to ensure its readiness, responsiveness, and effectiveness. This entire process as shown in Figure 1, is designed to ensure that the developed application meets the needs and quality standards set and can generate user satisfaction and improve operational efficiency in the pharmacy environment.



Figure 1. Research Stages

User Requirement Analysis

In the user needs analysis stage, the main focus is to thoroughly understand the perspectives and needs of potential users of the quality management system application in the pharmacy. The steps in this stage include identifying key stakeholders, collecting action information through in-depth interviews, and survey carefully analyzing the lysis of the identified needs. Based on the results of this analysis, key features will be determined and prioritized for integration into the application.

Application Development

Furthermore, in the application development stage using the Agile (Extreme Programming) methodology, sprint planning and division of tasks become the main focus.

Once the key features are defined, the development team will plan and schedule sprints to implement the features. During implementation, continuous testing and integration are done to ensure the quality and functionality of the application. Periodic updates and customizations based on user feedback are also integral to this development process.

User Acceptance Evaluation

Finally, functionality evaluation and user acceptance are essential stages in evaluating the readiness and effectiveness of the application. The reliability and responsiveness of the application will be evaluated through a series of functional and acceptance tests. The results of this evaluation are then used to analyze user satisfaction and overall application effectiveness. These steps will ensure that the developed quality management system application meets the users' needs and achieves the set quality objectives and standards.

RESULTS AND DISCUSSION

User Requirement

The user requirements analysis stage is essential in developing quality management system applications for pharmacies. Stakeholder identification, requirements information gathering, and requirements analysis and documentation are critical steps in this stage. Stakeholder identification helps understand who will use the application and their roles and responsibilities. Next, requirements information gathering was done through interviews, surveys, and literature review to deeply understand the users' processes, challenges, and needs regarding the quality management system. The results of the information gathering were then analyzed to determine the critical features required and prioritized based on their criticality and importance to users and pharmacy operations. Thus, the user needs analysis stage provides a solid foundation for developing applications that meet user needs and expectations appropriately.

Table 1. Data Collection Results

Data Source	Findings
Stakeholder Identification	Identify the roles and responsibilities of stakeholders, such as pharmacists, clerks, pharmacy management, and possibly others involved in using the quality management system application.
Needs Information Collection	Conduct interviews with relevant parties in the pharmacy to deeply understand their processes, challenges, and needs regarding the quality management system. Conduct a past user satisfaction survey to gather relevant feedback on their experience with the previous application or system. Conduct a literature review on quality management system applications for pharmacies to learn about best practices and trends in developing such

	applications.
Needs Analysis and Documentation	Determine the critical features required based on the results of information gathering from interviews, surveys, and literature reviews. Prioritize requirements based on their criticality and importance to users and pharmacy operations to determine how these features should be developed.

The user requirements analysis stage is essential in developing quality management system applications for pharmacies. Stakeholder identification, requirements information gathering, and requirements analysis and documentation are critical steps in this stage. Stakeholder identification helps understand who will use the application and their roles and responsibilities. Next, requirements information gathering was done through interviews, surveys, and literature review to deeply understand the users' processes, challenges, and needs regarding the quality management system. The results of the information gathering were then analyzed to determine the critical features required and prioritized based on their criticality and importance to users and pharmacy operations. Thus, the user needs analysis stage provides a solid foundation for developing applications that meet user needs and expectations appropriately.

Application Development

The application development stage using the Agile (Extreme Programming) methodology involves activities designed to ensure application development is efficient and responsive to change. Sprint Planning and Task Sharing is the first step in this stage, where the development team plans short development iterations (sprints) and divides tasks according to the expertise and responsibilities of each team member. Next, in Key Features Implementation, key features prioritized from the user requirements analysis stage will be developed and implemented into the application. The development team does This process collaboratively to ensure the development goes according to the plan and targets set.

The next stage is Continuous Testing and Integration, where testing is done continuously throughout the development process to ensure the quality and functionality of the application. Continuous integration is also done to ensure interoperability between the components of the developed application. Periodic updates and adjustments based on user feedback are essential steps in ensuring that the application always matches the needs and expectations of the users. Feedback from users is used to make periodic improvements and adjustments to the application. Finally, the Application of Extreme Programming (XP) Principles in Development emphasizes collaboration, communication, and continuous feedback between development team members. XP principles, such as pair programming and testing first, are applied to ensure code quality and consistency during application development. Thus, using Agile (Extreme Programming), the application development stage provides a structured and adaptive framework to ensure successful application development that meets user needs.

Table 2. Application Features

Features	Function
Product Quality Monitoring	This feature allows pharmacies to monitor product quality in their inventory closely. This includes drug expiry date tracking to avoid selling expired products and product track records to trace the origin and storage of products in detail.
Regulatory Compliance Reporting	This feature allows pharmacies to automatically generate reports to ensure compliance with applicable regulations and quality standards. With this feature, pharmacies can generate the necessary reports more efficiently and on time, ensuring that they comply with all requirements imposed by regulatory bodies.
Performance Monitoring and Data Analytics	This feature allows pharmacies to monitor their performance and analyze drug sales data to identify trends and consumption patterns. With this information, pharmacies can make better decisions related to product inventory, marketing strategies, and improved services to customers.
Security and Access Rights	This feature includes setting limited access rights to prevent unauthorized access to sensitive information and audit logs to track user activity and changes within the system. With this feature, pharmacies can ensure that their customer and operational information is maximally protected from security threats and other potential risks.

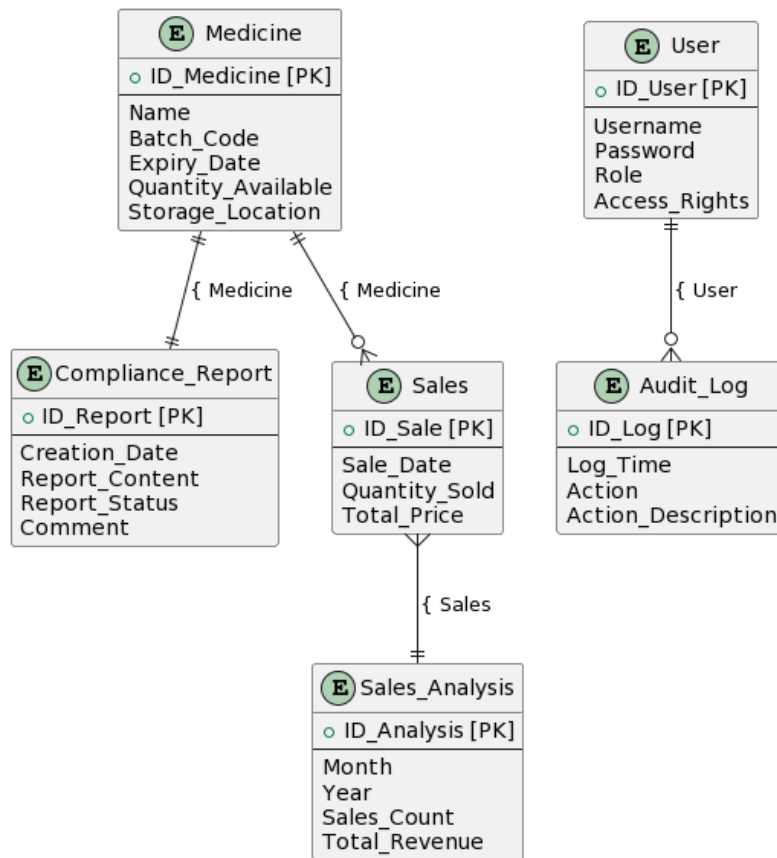


Figure 2. ER Diagram

The Entity-Relationship (ER) diagram, Figure 2, illustrates the relationships between entities in a pharmacy management system. These entities include drugs, compliance reports, sales, sales analysis, users, and audit records. The drugs entity records information about the drugs available at the pharmacy, while the compliance report stores regulatory compliance reports. Sales records drug sales transactions, while sales analysis allows monitoring of drug sales performance over time. User entities represent the system's users, and audit logs record the activities performed by users. The diagram provides a clear picture of the relationships between the entities, enabling a better understanding of how data is organized and connected in the pharmacy management system.

User Acceptance Evaluation

The functionality evaluation and user acceptance stages have been successfully implemented with structured steps. Functional testing of the application was conducted through several stages, including unit testing to check the functionality of each part of the application according to the set specifications, integration testing to ensure interoperability between the application components, and system testing to evaluate the overall application performance. In addition, user acceptance testing was conducted by inviting 20 users to participate in a beta test in a production environment to identify problems and additional needs and collect feedback through surveys or interviews to evaluate their readiness and satisfaction with the application. The results of the evaluation were then

analyzed to evaluate the app's performance and responsiveness, as well as to compare the initial goals and the final achievement of the app to evaluate the project's success and identify areas of future improvement. Thus, this evaluation stage helps to ensure that the developed application meets the users' needs and achieves the expected standards. The survey and interview results show a user satisfaction level of 78%, indicating that most users are satisfied with the quality and functionality of the application that has been developed. Such high user satisfaction indicates that the application successfully meets or exceeds user expectations in daily use. With a high level of user satisfaction, the application has successfully met user needs and expectations and provided significant added value to users.

CONCLUSION

Developing an Agile-based quality management system application for pharmacy process optimization is a relevant and practical step in improving operational efficiency and meeting user needs in the pharmacy industry. Through the Agile approach, the application development process can be more responsive to changes and more focused on user needs. The functionality evaluation and user acceptance results showed that the application successfully met the expected standards, with the user satisfaction level reaching 78%. This indicates that the application has significantly added value to users and helped improve operational efficiency and pharmacy service quality. Thus, the development of an Agile-based quality management system application has great potential to be an effective solution in addressing the challenges and improving the performance of the pharmacy industry in the future.

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