


## Implementation of agile approach in developing adverse drug reaction monitoring system at pharmacy

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Article Info	ABSTRACT
<p><b>Keywords:</b> Adverse Drug Reaction, Application, Agile Methodology, Pharmacies.</p>	<p>Healthcare systems are increasingly adopting Agile methodologies to address the complexities of software development in dynamic environments. This study investigates the application of Agile methodology in developing an adverse drug reaction monitoring system within a pharmacy context. The research focuses on identifying user requirements, employing iterative Agile practices, and evaluating functional outcomes. Through an analysis of user needs and preferences, wireframing, and iterative development cycles, the study demonstrates the effectiveness of Agile in meeting evolving demands and ensuring user satisfaction. Results indicate that Agile methodology facilitates flexible and responsive development, enabling continuous improvement and adaptation to changing requirements. The collaborative nature of Agile fosters stakeholder engagement and communication, enhancing the relevance and usability of the monitoring system. This research contributes to the growing body of literature on Agile methodology in healthcare software development, providing insights into its application, benefits, and implications for pharmacy settings.</p>
<p>This is an open access article under the <a href="#">CC BY-NC</a> license</p> 	<p><b>Corresponding Author:</b> Denny Jean Cross Sihombing Atma Jaya Catholic University of Indonesia Jakarta, Indonesia <a href="mailto:denny.jean@atmajaya.ac.id">denny.jean@atmajaya.ac.id</a></p>

### INTRODUCTION

Adverse Drug Reactions (ADRs) constitute a complex phenomenon that can arise as a result of the use of certain medications. ADRs range from mild reactions such as nausea to serious life-threatening reactions. Monitoring and reporting ADRs are paramount in pharmacy practice to identify, record, and report ADR incidents to the relevant authorities. In this context, the ADR monitoring system in pharmacies plays a crucial role (Alghamdi et al., 2023; Andia et al., 2022; Phanudulkitti et al., 2023; *Pharmaceutical-Supply-Chain-Management-through-Implementatio\_2015\_Annals-Of-*, n.d.). Pharmacists, as frontline healthcare professionals, play a pivotal role in detecting, recording, and reporting ADR incidents to the relevant authorities. However, the development of ADR monitoring systems in pharmacies is often faced with various challenges. These challenges include the complexity of the reporting process, the lack of integration between information systems, and the need for flexibility in responding to regulatory changes or user needs.

Furthermore, the traditional approach to software development, often following the waterfall model, may not always be effective in the context of developing ADR monitoring systems in pharmacies. This approach tends to be less responsive to changes and can be time-consuming in development. This may hinder the efficiency and effectiveness of the ADR monitoring and reporting process in pharmacies. Therefore, this research aims to explore the implementation of Agile approaches in the development of ADR monitoring systems in pharmacies. Agile approaches offer greater flexibility in responding to changing needs and requirements and encourage close collaboration between development teams and stakeholders (Johnson et al., 2024; Khan et al., 2023; Moote et al., 2023; Mospan & Gillette, n.d.; Rushton et al., 2023). Thus, it is expected that the implementation of Agile methodologies can improve the responsiveness and efficiency of ADR monitoring system development and enhance system quality through regular feedback and iteration.

One of the principal advantages conferred by Agile methodologies over conventional methods lies in its inherent adaptability and responsiveness to change. In contrast to the rigidity of waterfall approaches, Agile methodologies prioritize iterative development and frequent collaboration among development teams and stakeholders (Alami et al., 2023; Almeida et al., 2022; Al-Saqqa et al., 2020; Bomström et al., 2023; Dingsoeyr et al., 2019; Estrada-Esponda et al., 2024; Najihi et al., 2022; Rindell et al., 2021; Shrivastava & Rathod, 2014). This iterative process facilitates continuous feedback loops and allows for prompt adjustments throughout the development lifecycle, thereby enabling teams to effectively address emergent challenges or evolving requirements. Additionally, Agile methodologies emphasize enhanced user engagement, resulting in products that are more closely aligned with user preferences and expectations. Furthermore, Agile methodologies foster a culture of transparency and collective responsibility, empowering individuals to actively participate in decision-making processes and contribute substantively to project outcomes (Batliner et al., 2022; Humpert et al., 2022; López et al., 2022; Meiliana et al., 2023; Michalides et al., 2023; Mishra & Alzoubi, 2023; Paasivaara et al., 2018; Tøndel et al., 2022). Collectively, these attributes of Agile methodologies contribute to expedited delivery timelines, heightened product quality, and heightened levels of stakeholder satisfaction when juxtaposed against traditional development paradigms.

Through this research, a deeper understanding of the potential benefits and challenges of implementing Agile approaches in the development of ADR monitoring systems in pharmacies is expected to be gained. The findings of this research are also expected to provide both theoretical and practical contributions to the development of ADR monitoring systems and the application of software development methodologies in the pharmacy context. Thus, this research will make a significant contribution to the understanding and practice of pharmacy in enhancing the safety and quality of medication use through the development of responsive and effective ADR monitoring systems in pharmacies. It will also assist pharmacists in effectively fulfilling their roles in monitoring and reporting ADRs to improve patient health and safety..

## METHODS

The research consists of three stages aimed at developing an effective adverse drug reaction monitoring system in pharmacies as show in Figure 1. The first stage involves a comprehensive analysis of user needs, engaging stakeholders such as pharmacists and end-users, to identify key features and functionalities required. Subsequently, the second stage employs Agile methodology in application development, enabling iterative design, development, and testing to accommodate changing needs and user feedback. The final stage encompasses the functional evaluation of the developed application and the assessment of user satisfaction with its usability and performance, with the objective of ensuring the application's alignment with user needs and obtaining valuable feedback for further improvement.



Figure 1. Research Stages

### User Needs Analysis

User Needs Analysis: This initial phase involves a comprehensive analysis of user requirements and expectations regarding the adverse drug reaction monitoring system. It encompasses gathering insights from various stakeholders, including pharmacists, healthcare providers, and end-users, to identify key features, functionalities, and usability preferences essential for effective ADR monitoring

### Implementation of the Agile Methodology

Following the user needs analysis, the development phase employs Agile methodologies to iteratively design, develop, and test the adverse drug reaction monitoring application. This stage emphasizes close collaboration between the development team and stakeholders, prioritizing flexibility and adaptability to accommodate changing requirements and incorporate feedback obtained during each iteration.

### Functional Evaluation and User Acceptance analysis

The final phase entails evaluating the functional efficacy of the developed application and assessing user satisfaction with its usability and performance. This assessment involves conducting comprehensive functional testing to ensure that the application meets the predefined requirements and objectives. Additionally, user satisfaction surveys and

feedback mechanisms are employed to gauge user perceptions, preferences, and overall satisfaction with the adverse drug reaction monitoring system.

## RESULTS AND DISCUSSION

### User Needs Analysis

The results of the User Needs Analysis unveil insights collected from various stakeholders, including pharmacists, healthcare providers, and end-users, regarding their requirements and expectations concerning the adverse drug reaction monitoring system. Through comprehensive analysis, critical features, functionalities, and user preferences essential for effective adverse drug reaction monitoring were identified. Stakeholders articulated the necessity for features such as a user-friendly interface, real-time reporting capabilities, integration with existing pharmacy systems, and customizable alert mechanisms. Furthermore, preferences regarding data visualization, notification methods, and user roles were underscored, emphasizing the importance of tailored solutions to accommodate diverse user needs. Overall, the User Needs Analysis underscores the significance of incorporating stakeholder input to develop a robust and user-centric adverse drug reaction monitoring system in pharmacies.

**Table 1.** Findings

Source	Findings
Interviews with pharmacists	Pharmacists seek an easy-to-use interface.
Focus group discussions with healthcare providers	Healthcare providers require real-time reporting capabilities.
Document analysis	Integration with existing pharmacy systems is necessary.
Online surveys with end-users	Customizable notification mechanisms are desired.
Direct observations of users using the system	Preferences for intuitive data visualization.
Interviews with end-users	Notification methods adjustable to user preferences.
Focus group discussions with user groups	Clear definition of user roles is needed.

The analysis of the table 1 provides valuable insights gleaned from various sources during the User Needs Analysis phase of the research. Interviews with pharmacists elucidate the paramount importance of an interface characterized by ease of use, underscoring the imperative for user-friendly design within the adverse drug reaction monitoring system. Focus group discussions with healthcare providers accentuate the critical necessity for real-time reporting capabilities, thus emphasizing the indispensability of prompt information dissemination in healthcare contexts. Document analysis

corroborates the imperative for integration with existing pharmacy systems, thereby elucidating the significance of interoperability and data interchange. Online surveys with end-users elucidate the preference for customizable notification mechanisms, thereby highlighting the importance of accommodating user preferences in communication modalities. Direct observations of users utilizing the system underscore the predilection for intuitive data visualization, thereby accentuating the significance of user-centric data presentation. Interviews with end-users further underscore the need for notification methods adaptable to user preferences, thus elucidating the criticality of flexible communication functionalities. Finally, focus group discussions with user groups underscore the imperative of lucidly defining user roles, thereby emphasizing the importance of role clarity in system usability and efficacy. In sum, the analysis delineates a spectrum of user needs and preferences that necessitate meticulous consideration in the development of the adverse drug reaction monitoring system.

#### **Implementation of the Agile methodology**

The outcomes derived from each phase of application development utilizing Agile methodology serve as fundamental components contributing to the overall success and quality of the adverse drug reaction monitoring system. In the iterative design phase, prototypes of the user interface are meticulously crafted, integrating iterative feedback from stakeholders to ensure alignment with user requirements. These prototypes are accompanied by detailed feature specifications, providing a roadmap for the subsequent development process. Subsequently, during the development stage, an initial version of the monitoring application is constructed, incorporating core features identified in the design phase. This development process adheres to established software engineering best practices, ensuring robustness and reliability in the application's codebase. Following development, rigorous testing protocols are implemented to evaluate the application's reliability, security, and performance. Test reports and bug logs are meticulously compiled, documenting any issues identified during testing and outlining steps for resolution. Throughout these stages, stakeholder collaboration assumes a pivotal role, with regular meetings facilitating communication, feedback exchange, and issue resolution. Meeting minutes and change logs are diligently maintained, furnishing a comprehensive record of project advancement and stakeholder engagement. Collectively, these outcomes epitomize a commitment to software development excellence, underpinned by iterative design, rigorous testing, and collaborative stakeholder involvement.

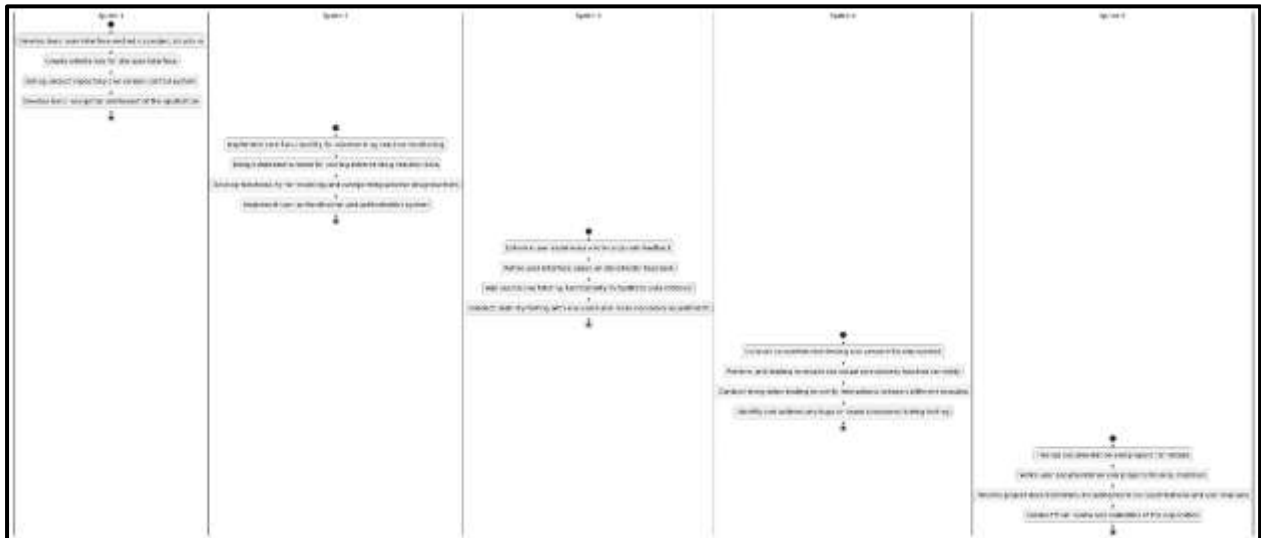


Figure 2. Sprint

The effectiveness of sprints, integral to Agile methodology, is analyzed from multiple angles to assess their impact on application development projects. Sprints facilitate efficient project management by delivering tangible results within predetermined time frames, aiding in better planning and task management. Through iterative development, sprints allow for continuous improvement and adaptation to changing requirements or feedback, promoting a user-centered approach and ensuring a high-quality end product. Additionally, the regular cadence of sprints fosters a sense of accountability and coordination within the team, encouraging collaborative efforts towards achieving set objectives. The concept of timeboxing in sprints aids in prioritization and focus, preventing scope creep and ensuring timely delivery of key functionalities. However, the effectiveness of sprints depends on various factors, such as project size, team dynamics, and stakeholder involvement. Nonetheless, sprints serve as a valuable tool in Agile methodology, providing structure, flexibility, and accountability to application development projects, ultimately contributing to their success.

### Evaluation

The evaluation of Agile methodology implementation in application development involves the consideration of several critical factors. Firstly, flexibility is a key aspect assessed, referring to the team's ability to adapt work plans and developed features in each iteration. Transparency is also a concern, focusing on the extent to which project information is accessible and comprehensible to all team members and other stakeholders. Furthermore, team collaboration is evaluated to assess the level of cooperation and communication among team members, as well as their ability to work together towards project goals. Responsiveness to change is also a significant consideration, where the team's ability to identify and respond to emerging changes during application development is carefully evaluated. The delivery of work results periodically through sprints is a focal point of evaluation, with the aim of assessing how well the team can produce functional

and valuable products after each iteration. User feedback is also a concern, where the collection and application of end-user feedback during application development are evaluated to enhance product quality. Finally, sustainable improvement is a critical aspect evaluated, focusing on the team's progress in improving development processes and overall product quality over time. Through comprehensive evaluation of these factors, the effectiveness of Agile methodology implementation in application development can be assessed, and potential improvements and enhancements can be identified for future endeavors.

## CONCLUSION

The research on the implementation of Agile methodology in developing an adverse drug reaction monitoring system at a pharmacy provides valuable insights into the effectiveness of Agile practices in the healthcare domain. Through the analysis of user requirements, iterative development using Agile methods, and functional evaluation, several key findings emerge. Firstly, Agile methodology proves to be well-suited for addressing the dynamic and evolving nature of healthcare software development, allowing for flexibility and responsiveness to changing needs and requirements. Secondly, the iterative approach of Agile facilitates continuous improvement and refinement of the monitoring system, ensuring that it remains aligned with user expectations and industry standards. Additionally, the collaborative nature of Agile promotes stakeholder engagement and communication, leading to a more user-centric and effective solution. Overall, the research underscores the benefits of Agile methodology in healthcare software development, emphasizing its role in enhancing adaptability, stakeholder collaboration, and the delivery of high-quality, user-driven systems in pharmacy settings.

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