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Development of Financial Management Applications at Health Clinics Using Extreme Programming Methods

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Keywords

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Abstract. In the face of complex financial challenges, such as increasing operational costs, decreasing patient numbers, and fluctuating revenues, health clinics must implement intelligent and efficient financial strategies. This research focuses on developing a financial information system to improve efficiency, transparency, and control in the financial management of the clinic. Steps towards the launch, including feature integration, retrospective evaluation, and phased rollout, were implemented to minimize the impact on clinic operations. Evaluating the impact of the system after launch is an important step to ensure the expected benefits are achieved, and continuous improvement through retrospective sessions is critical to continuously improving the development process. The results of this study provide a comprehensive view of the development strategy of a clinic financial management application using the XP approach, which can serve as a foundation for clinics to deal with the complexities and dynamics of managing their financial aspects. This research contributes to understanding best practices in dealing with financial challenges in the healthcare sector.

1. INTRODUCTION

Healthcare clinics are currently faced with a variety of complex financial issues. One of the main challenges is the ever-increasing operational expenses. Costs for medical and non-medical staff salaries, medical equipment maintenance, and clinic infrastructure needs are increasing, reducing clinic profit margins. In addition, the decline in the number of patients coming to the clinic is also a severe challenge. Fierce competition with other clinics and hospitals has forced clinics to reduce the price of their services to retain and attract patients, thus reducing the clinic's overall revenue. Inefficient billing and collection is also an issue, with late payments from patients and insurance companies affecting the clinic's cash flow[1], [2].

Not only that, financing medical equipment and health technology is also a significant obstacle. Clinics must invest substantial funds in updating medical equipment to provide patients with the best standard of service. Meanwhile, income fluctuations associated with seasonal changes or changes in insurance policies also make financial planning difficult. Coupled with the uncertainty of ever-changing healthcare regulations and potential lawsuits that can financially harm clinics, healthcare clinics must face complex challenges in managing their finances. In the face of all these issues, clinics need to develop intelligent and efficient financial strategies to ensure the continuity of their operations while still providing quality healthcare services to patients[3]–[5].

Financial management at a health clinic is a process that includes planning, organizing, controlling, and supervising all financial aspects related to clinic operations. Financial management is essential to maintain the clinic's sustainability, deliver quality healthcare services, and meet financial obligations. Financial planning involves setting the clinic's short-term and long-term financial goals. It includes income, costs, investments, and cash flow projections to ensure sound finances. The clinic should have a clear financial organizational structure, including appointing competent financial staff. This involves organizing and allocating financial resources efficiently[6]–[9]. Financial control is the process used to ensure that financial policies and procedures are correctly implemented. This includes oversight of expenditures, collection of bills, and monitoring against budgets. Good cash flow management is essential. The clinic should closely monitor receipts and expenditures to ensure adequate liquidity[4], [10]–[12].

Clinics may require financing to purchase medical equipment or for development. Proper debt management is essential to avoid excess debt and ensure timely repayment. Clinics may have reserve funds that can be invested to earn higher returns. Investment decisions should be prudent and in line with the established risk policy. Clinics should have an efficient billing system and collect bills from

patients and insurance companies to minimize late payments and unpaid bills. The clinic should comply with rules and regulations pertaining to the healthcare and financial sectors, including patient privacy and financial reporting. Regular financial checks by external parties help ensure the accuracy and reliability of the clinic's financial statements. Clinics should regularly evaluate their financial performance and make necessary changes to achieve their financial goals. Clinics should have plans to deal with emergencies or catastrophic situations that may affect their finances, such as a pandemic or significant loss. Good financial management of health clinics is essential to maintain sustainability and provide quality healthcare to patients. It also helps protect clinics from financial risks in a changing environment[13]–[15].

Developing a financial management system in health clinics is crucial to improving efficiency, transparency, and control in managing clinic finances. Developing a sound financial management system will help clinics overcome the financial problems they face and keep their finances healthy. It will also provide a solid foundation for prudent financial decision-making in support of quality healthcare for patients. In developing health clinic financial management information systems, several current methods and technologies can be used to ensure efficiency, transparency, and better financial management. Some previous research related to software development in health clinics, Utilization of cloud computing services allows secure storage and access of financial data from various locations. It also allows for better team collaboration and flexibility in managing financial information. Integrating financial information systems with electronic medical records (EMR) allows the management of financial and medical information in one system. This can improve efficiency, provide visibility, and enable more comprehensive data analysis. Advanced data analysis, such as predictive analysis, can help clinics understand financial trends and make more accurate projections. This enables more informed decision-making. It uses an interactive reporting system that allows users to generate reports quickly according to their needs. This makes it easier for management to monitor the clinic's financial performance. Given the confidentiality and sensitivity of patient and financial data, clinics need to invest in sophisticated information security systems, including data encryption, cyber threat monitoring, and protection against unauthorized access[7], [16].

Blockchain technology can be used to record financial transactions securely and document them. This can increase transparency and reduce the risk of fraud or errors[17]–[19]. Mobile apps can be used by clinic staff to access financial information from anywhere, check financial reports, and perform crucial financial management actions. AI can be used in financial data analysis to identify patterns and trends that may be difficult for humans to spot. Automation can also be used for routine processes, such as billing and collection. Clinics can utilize big data technology to glean insights from large amounts of financial and clinical data. This can help in better decision-making. IoT can monitor physical resources within the clinic, such as medical equipment and drug usage. This can help control operational costs. Development methodologies such as Agile or Scrum can be used to develop clinic financial information systems. This allows for rapid iteration and flexible response to changing needs[20].

The Extreme Programming (XP) method is one of the software development approaches with several advantages and benefits that can be a good choice in developing health clinic financial management information systems. XP allows developers to quickly respond to changing needs, which often occur in the dynamic environment of health clinics. It enables the development of more adaptable systems to changes in business rules or regulations. XP encourages the active involvement of stakeholders, including medical staff and clinic management. This helps ensure that the developed system meets the clinic's and its users' needs. In XP, development is done in short iterations, usually one to two weeks. This makes it possible to test and get feedback early on so problems can be identified and fixed faster. The practice of continuous testing is at the core of XP. It ensures that every system component is thoroughly tested throughout development to identify problems and errors immediately[21], [22].

XP encourages better coding practices, including refactoring and continuous code maintenance. This can result in systems with higher code quality and easier to manage. With practices such as "Planning Games" and "Daily Standup Meetings," XP helps maintain project transparency so development teams and stakeholders can identify issues or bottlenecks quickly[22]–[25]. User

involvement and the ability to change system features and functionality during development can increase user satisfaction. This is particularly important in healthcare clinics that focus on quality care. XP enables the identification and handling of risks more efficiently. With short iterations, necessary changes can be implemented before risks develop into serious problems. XP enables the delivery of functional software in a relatively short period. This can be very beneficial in dealing with the fast-changing financial challenges and opportunities in healthcare.

While XP has several advantages, it is worth remembering that this method is only sometimes suitable for all projects. The success of XP depends on the active involvement of the development team, a willingness to adapt to change, and good communication between team members and stakeholders. In the context of health clinics, if XP processes and practices are well implemented, it can result in a financial management information system that better suits the clinic's needs and supports efficient financial management.

2. METHOD

The research consisted of six main stages, as shown in Figure 1. In the planning stage, developing a financial management application at the clinic involved identifying stakeholders, including clinic management and medical staff, and determining the needs and objectives of the financial information system. The features to be developed are selected and prioritized, and an initial development plan, including schedule and budget, is established. At the coding stage, the development team started the implementation of the features by applying XP practices, such as pair coding, to ensure code quality and good collaboration. After implementation, an intensive testing phase includes functional, integration, and automated tests. The integration process ensures the implemented changes or features interact well within the system. After each iteration, a retrospective is conducted to evaluate the success and improvements needed in the development process. After several iterations, the system is ready for rollout to end users, with particular attention to minimizing the impact on clinic operations.

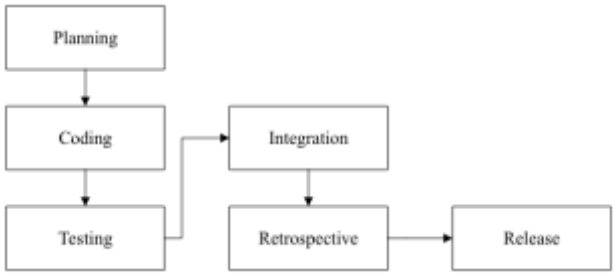

Figure 1 Research Stages

Planning

Identify stakeholders, including clinic management and medical staff. Identify the needs and objectives of the financial management information system. Select and prioritize the features to be developed. Determine the initial development plan, including schedule and budget.

Coding

The development team starts implementing the planned features in that iteration. XP practices, such as pair programming, can be applied to ensure code quality and collaboration.

Testing

Once the features have been implemented, they are tested intensively to ensure quality and reliability. Tests can include functional testing, integration, and automated testing.

Integration

Any changes or features implemented in the iteration are integrated into the system. Ensure that all system components interact correctly.

Retrospective

After each iteration, the development team evaluates to understand what has worked and what needs improvement. The goal of the assessment is to improve the development process continuously.

Release

After a few iterations, the system can be ready for launch to end users. Ensure the rollout is done with minimal maintenance and the lowest possible impact on clinic operations.

3. RESULTS AND DISCUSSION

Planning

The outcome of this stage identifies the stakeholders involved in developing the clinic's financial management information system. These include clinic management, medical staff, and the IT department or software developers. Next, the needs and objectives of the system were identified with a focus on addressing the complex financial issues faced by the clinic. The features required to achieve these objectives were selected and prioritized based on their urgency and impact on financial management efficiency.

After that, a preliminary development plan stage, schedule, and budget were carefully organized. The plan includes concrete steps to be taken in the development of the system, a schedule for each stage, and an estimated budget covering development costs, human resources, and required infrastructure. Thus, this planning stage provides a solid foundation for developing a responsive and efficient clinic financial management information system. Careful feature selection and planning will form the basis for subsequent development steps, including implementing Extreme Programming (XP) methodology to ensure overall project success.

Table 1 Results of the Planning Stage

Stages	Results
Stakeholder Identification	Stakeholders involved include clinic management and medical staff. Stakeholders include those involved in the clinic's financial management and the system's end users.
Identification of System Needs and Objectives	The needs and objectives of the financial management information system were identified by understanding the financial challenges faced by the clinic. The focus was on the clinic's problems related to operational expenses, declining patient numbers, billing, and collection of bills.
Feature Selection and Prioritization	Features required to address financial issues are carefully selected. Priority is given based on urgency and impact on the efficiency and effectiveness of financial management.
Initial Development Plan, Schedule, and Budget	The initial development plan includes details of the concrete steps that will be taken to develop the system. The schedule is organized, taking into account immediate needs and possible deadlines. A budget is drawn up to cover the cost of development, human resources, and necessary infrastructure.

Coding

In the Coding stage, the development team begins the implementation of the features that have been planned in the previous iteration. The main focus at this stage is to translate the identified design and requirements into working code. Various XP practices, especially pair programming, can be applied to ensure code quality and effective collaboration between team members. Two team members work together on a single computer by applying pair coding practices. One member acts as the "pilot," responsible for writing the code, while the other acts as the "navigator," who focuses on checking the written code and providing immediate feedback. This improves the code's quality through multiple viewpoints and strengthens collaboration and a shared understanding of the project.

During this stage, the team may encounter implementation challenges or questions that may arise. Therefore, open and effective communication between team members is crucial. Joint problem-solving and adaptation to changing needs may also occur during Coding. In this stage, the development team focused on implementing the pre-planned interactive reporting module. Team members collaboratively wrote and tested code through pair coding, ensuring that each

implementation step matched the clinic's needs and iteration goals. This coding phase resulted in significant progress in delivering features that would enhance the clinic management's ability to monitor financial performance efficiently.

Testing

In the Integration stage, any changes or features implemented in iterations are integrated into the system as a whole. At this stage, the main focus is to ensure that all system components interact properly and function synergistically. The integration process involves merging the various pieces of code developed by the development team into a unified whole. The Integration stage involves thorough testing to ensure that the interactions between features work well without significant conflicts or bugs. In the context of XP, the practice of continuous testing will continue to ensure that each component of the system is thoroughly tested throughout the development process. Testing may include functional, integration, and automated testing to ensure system reliability. Before integration, the development team independently tests each implemented feature or change. Integration ensures that communication between features does not cause conflicts or incompatibilities. It should be emphasized that integration includes technical aspects and pays attention to the compatibility of features with business and stakeholder needs.

In this stage, the interactive reporting module features implemented by the development team are integrated into the clinic's overall financial management system. After integration, the system underwent a series of tests to ensure that the features interacted with other components without causing problems. The result was the successful integration of the reporting module into the more extensive system, and the clinic was able to see significant improvements in its ability to monitor financial performance effectively.

Retrospective

The Retrospective stage is a critical step in the development methodology, where after each iteration, the development team conducts a thorough evaluation to understand what has worked and what needs to be improved. This retrospective session's main objective is to continuously improving the development process and team performance. After the development iteration of the interactive reporting module, the team conducted a retrospective session. The evaluation showed that pair coding effectively improved code quality and team collaboration. However, the retrospective findings revealed that communication between teams could be improved, especially in response to sudden changes in requirements. As a follow-up, the team decided to increase daily meetings to facilitate more open communication and adjust the development plan based on possible changes in needs. These retrospective conclusions became the foundation for continuous improvement and quality enhancement during the next iteration.

Release

The Release stage is the final phase in the development cycle, where after several iterations, the system is considered ready for rollout to the end users, in this case, the clinic operations. The main focus at this stage is to ensure the rollout is done with minimal maintenance and the lowest possible impact on clinic operations. After several iterations of the clinic's financial management system development, the team decided that the system had reached a sufficient level of maturity for launch. The rollout was phased in with minimal maintenance on clinic operations by conducting thorough final tests. User support was provided throughout the rollout period, and the IT team continued to monitor system performance. The post-launch evaluation showed that the system improved efficiency in the clinic's financial management without significantly impacting day-to-day operations. Complete documentation of the rollout and evaluation results became a valuable reference for further improvement and development.

4. CONCLUSION

Developing a financial management application for health clinics using the Extreme Programming (XP) Method is a highly relevant step that can provide practical solutions to clinics' complex financial challenges. These challenges include increasing operational costs, decreasing patient numbers, fluctuating revenues, and changing policies and regulations in the healthcare sector.

Sound financial management in health clinics is crucial to maintain operational sustainability, provide quality services, and meet financial obligations. The development of a financial information system, as the focus of the research, is considered a strategic step to improve efficiency, transparency, and control in clinical financial management. Stages such as Planning, Iteration Planning, Coding, Integration, Retrospective, and Release form the foundation of XP implementation, with each stage playing an essential role in achieving successful financial information system development. In the move towards launch, feature integration, retrospective evaluation, and phased rollout were implemented to minimize the impact on clinic operations. Evaluating the impact of the system after launch is a crucial step to ensure that the expected benefits are achieved, and continuous improvement processes through retrospective sessions are essential to continuously improving the development process. As such, this research provides a comprehensive view of the development strategy of a clinical financial management application using the XP approach, which can serve as a foundation for clinics to deal with the complexities and dynamics of managing financial aspects.

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