

Implementation of Extreme Programming (XP) in the Development of Dental Clinic Information Systems

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Abstract

Along with the development of information technology, dental clinics are required to improve efficiency and quality of service through an integrated information system. This study aims to develop a web-based Dental Clinic Information System using Laravel with the Extreme Programming (XP) method as its development approach. This system is designed to manage electronic medical records, examination schedules, medicine stock, and patient bills efficiently, according to the Regulation of the Minister of Health of Indonesia Number 24 of 2022 concerning electronic medical records. This research method involves four stages in XP: planning, design, coding, and testing. At the design stage, Use Case and Activity Diagram modeling are created to ensure the system meets user needs. The system implementation uses Laravel Filament to build an integrated admin dashboard. Testing is carried out using Black-Box Testing to ensure all features function properly. The results of the study show that the developed system can improve the operational efficiency of dental clinics, reduce manual recording errors, and speed up the administration process. With the XP approach, system development becomes more flexible and adaptive to changes in user needs. It is hoped that this system can be applied in small to medium-scale dental clinics to improve the quality of health services.

1. Introduction

Along with the development of information technology, the health sector continues to face demands to adapt to improve efficiency and quality of service [1]. In the health sector, dental clinics play an important role in providing health services to the community. However, to meet the demands of modern society who want fast, accurate, and integrated services, dental clinics need to make optimal use of information technology [2]. Based on previous research results, the implementation of technology-based information systems has been proven to be able to improve the operational efficiency of clinics, such as patient data management, service schedules, and clinic administration [3]. An integrated information system can also provide additional benefits in the form of reducing human error, simplifying work processes, and improving the overall patient experience [4][5].

However, based on observations made, most dental clinics in Malang, Indonesia, which operate on a small to medium scale, still face operational challenges. These challenges include manual data recording, unintegrated medicine stock management, and inefficient billing management systems. This condition not only hampers the operational performance of the clinic but can also impact the quality of service received by patients [6]. In addition, the existence of the Regulation of the Minister of Health of Indonesia Number 24 of 2022 concerning electronic medical records emphasizes the importance of digital transformation in the health sector [7], including dental clinics. The regulation stipulates that healthcare facilities are required to implement electronic medical records to improve the efficiency, accuracy, and accessibility of patient medical records. Therefore, the implementation of an information system by this regulation is a strategic step to ensure that dental clinics not only meet health service standards but also comply with government regulations.

To overcome these problems and challenges, it is necessary to implement a technology-based management information system that is specifically designed for the operational needs of small to medium-scale dental clinics. One potential solution is the development of a web-based information system using the Agile approach. This approach allows the development of a system that are adaptive, efficient, and tailored to user needs [8]. This approach was chosen in designing the information system in question because Agile emphasizes flexibility and continuous iteration, allowing the development team to respond to changing needs quickly and effectively [9]. In addition, Agile facilitates intensive collaboration between developers and stakeholders, ensuring that each feature developed is truly relevant and provides added value to end users [10]. With this approach, the development of a dental clinic information system can be carried out in stages, so that the risk of failure can be minimized and the results produced are of higher quality.

One of the methods used in the Agile approach is Extreme Programming (XP). Extreme Programming was chosen because of its focus on high-quality software development with rapid iteration cycles and responsiveness to changing needs [11]. XP emphasizes principles such as intensive communication between the development team and stakeholders, rapid feedback giving, and continuous testing to ensure that each system component is functioning properly before moving on to the next stage. In addition, XP emphasizes the delivery of major functions in stages, allowing the system to be used and evaluated earlier by end users [12]. This is very important to ensure that the information system being developed is suited to the specific needs of small to medium-sized dental clinics. With XP, system development becomes more structured but remains flexible, allowing the development team to face technical and operational challenges more effectively.

This study aims to develop a web-based dental clinic information system using Agile and XP approaches as development methods. This system is designed to meet the operational needs of the clinic, such as recording patient data, managing medicine stock, scheduling, and managing bills by the provisions of PMK Number 24 of 2022 [7]. The dental clinic information system was developed using the Laravel open-source framework that implements the Model-View-Controller (MVC) architecture [13]. In this architecture, the Model represents the data structure and provides functions for database management. The View presents an interactive user interface. Meanwhile, the Controller acts as an intermediary between the Model and View to process requests and manage responses [14]. The combination of XP and modular architecture such as MVC ensures that the dental clinic information system can be developed efficiently, easily managed, and able to adapt to future needs. It is hoped that the dental clinic information system produced in this study will be able to support and be used by small to medium-scale dental clinics located in Malang, Indonesia. This information system is expected to help clinics face ever-growing operational challenges, improve internal efficiency, and provide a better user experience.

2. Research Method

In the case study of developing a small to medium-scale dental clinic information system, the development method used was XP. As described in Taftazani's research (2024), the XP method has proven effective for developing web-based systems, especially in processes that require flexibility to change user needs [15]. Extreme Programming (XP) emphasizes values such as intensive communication, rapid feedback, and the courage to face and accommodate change [13]. The stages of the XP method can be seen in Figure 1.

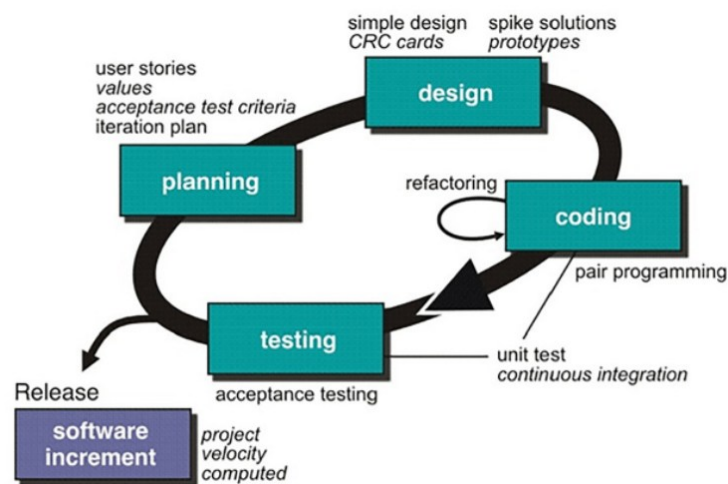


Figure 1. XP stages [15]

The XP method consists of four main stages that take place iteratively, namely planning, design, coding, and testing [16]. In the planning stage, the initial needs of the user are collected, which in XP are known as user stories. This process is important to ensure that developers understand the business context, system output requirements, and key features of the dental clinic information system to be built. This stage aims to analyze system requirements so that they can be designed according to user stories [17].

Next, in the design stage, the dental clinic system to be built is modeled. At this stage, UML modeling will be produced in the form of case diagrams and activity diagrams. Designing in XP still prioritizes the Keep it Simple principle [18] and ensures the feasibility of the designed system [19].

The next stage is coding, which focuses on the coding process to implement the system. The design that has been created is transformed into a system using the Laravel framework. In this architecture, the Model acts as a data manager, including structures and functions related to the database. The View is tasked with presenting an interactive and easy-to-use user interface. Meanwhile, the Controller functions as a liaison between the Model and View, managing the flow of requests from users and the responses given by the system [14].

The final stage is testing, which aims to validate the results of software development. At this stage, acceptance testing is carried out to ensure that the software produced is by the established acceptance criteria. Testing is carried out using the black box testing method, which focuses on testing system functions without looking at the internal structure of the code.

3. Results and Discussion

3.1 Planning

At the planning stage, researchers conducted interviews and discussions with users (doctors, nurses, pharmacists, IT admins, and financial admins) to find out the user story. The result of this user story is the identification of the functional needs of the dental clinic system. The Dental Clinic Information System is designed to meet the main operational needs through various functional features. In Table 1 several main features include managing user access through login and registration, registering new patients, setting examination schedules, and recording medical records in a structured manner. In addition, the dental clinic information system also supports real-time medicine stock management and an efficient patient billing system to ensure that clinic services run smoothly and are integrated. At this planning stage, researchers also confirmed with users to determine the suitability between the functional needs that have been defined in Table 1 with the Regulation of the Minister of Health of Indonesia Number 24 of 2022.

No	Functional requirement
1	This system provides Login and Registration features
2	This system provides a Patient Registration feature
3	This system provides a feature for managing Examination Schedules
4	This system provides a feature for managing Patient Medical Records
5	This system provides a feature for managing Medicine Stock Data
6	This system provides a feature for managing Patient Bills

3.2 Design

In the design stage, the research team designed UML modeling in the form of use case diagrams and activity diagrams to describe the structure and flow of the system to be developed. The results of this modeling are the main guide in system development, ensuring that the implementation meets user needs and can accommodate all processes that have been designed. The details are presented in the following sub-chapters.

3.2.1 Use case diagram

Researchers designed the use case diagram design in Figure 2. This diagram illustrates the interaction between the five main actors of doctors, nurses, pharmacists, IT admins, and financial admins with the dental clinic information system. Each actor has a specific role and access rights, such as managing patient medical record data, medicine stock, and patient bills according to their respective tasks.

3.2.2 Activity Diagram

Based on the user story about functional requirements, researchers designed an activity diagram to model the workflow in the system to be built. This section presents an activity diagram for the doctor's actor managing patient medical records as shown in Figure 3. Figure 4 presents an activity diagram for the financial admin actor managing patient bills.

The Activity Diagram in Figure 3 illustrates the doctor's process in managing patient medical records. Starting by selecting the "Medical Records" menu, the system will then display the patient's data. The doctor can choose to add or edit medical records. If adding, the doctor fills out the form and the system saves the new data. If it is editing, the doctor fills out the editing form and the system updates the existing data. There is no delete feature because the patient's medical records are important data that must remain stored in the system.

The Activity Diagram in Figure 4 illustrates the process of managing patient invoices by the Financial Admin. It starts with the Financial Admin selecting the invoice menu and the system displays the existing data. The Financial Admin can add, edit, or print invoices. If adding, the Financial Admin fills out the form and the system saves the new

data. If editing, the Financial Admin fills out the editing form and the system updates the data. If printing, the system prints the invoice that has been processed. The process is complete after the data has been successfully added, edited, or printed.

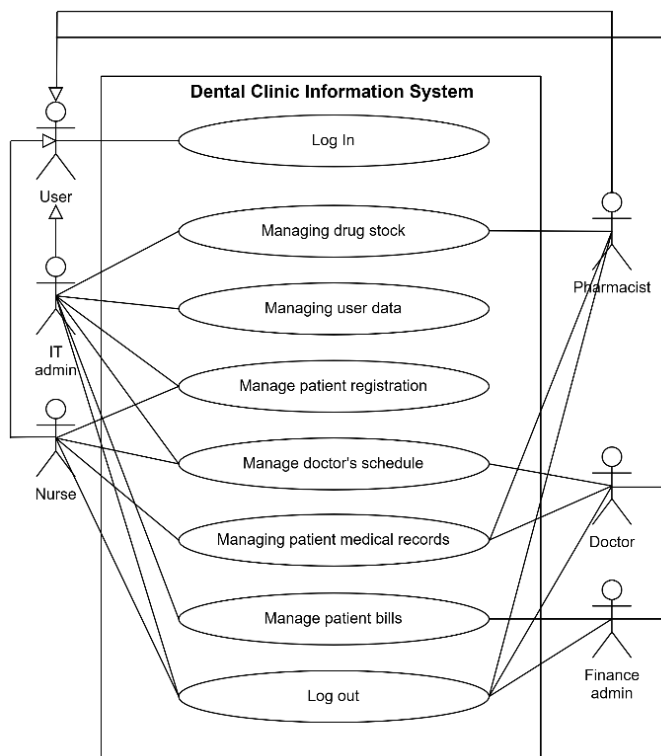


Figure 2. Use case diagram

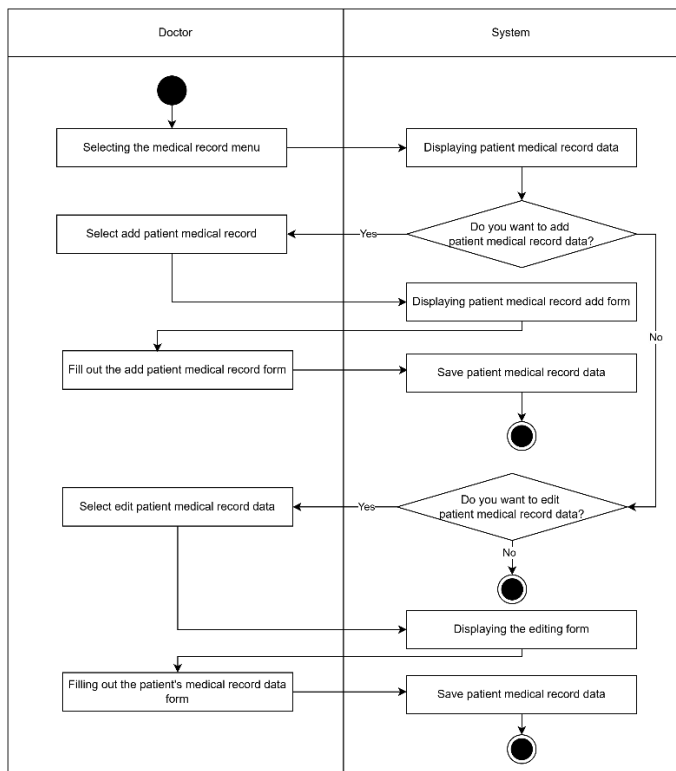


Figure 3. Activity diagram for managing medical records

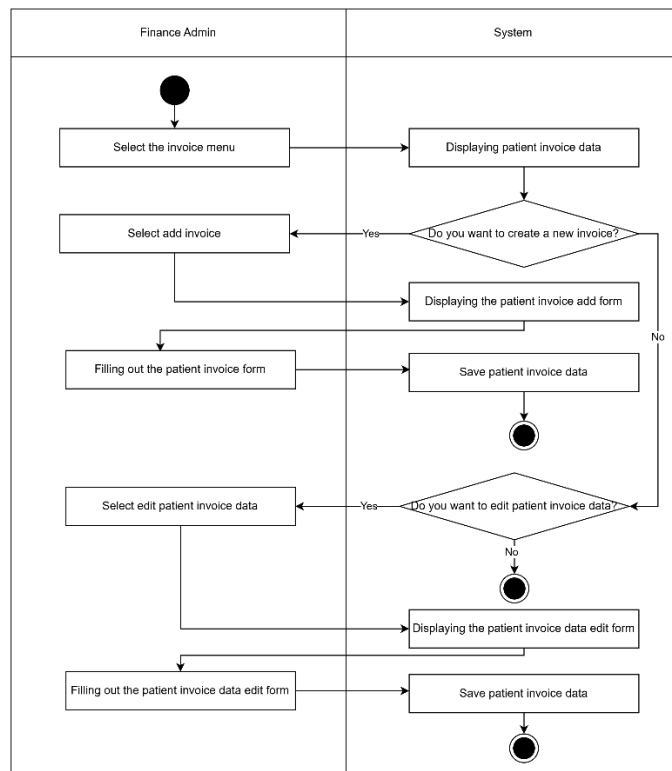
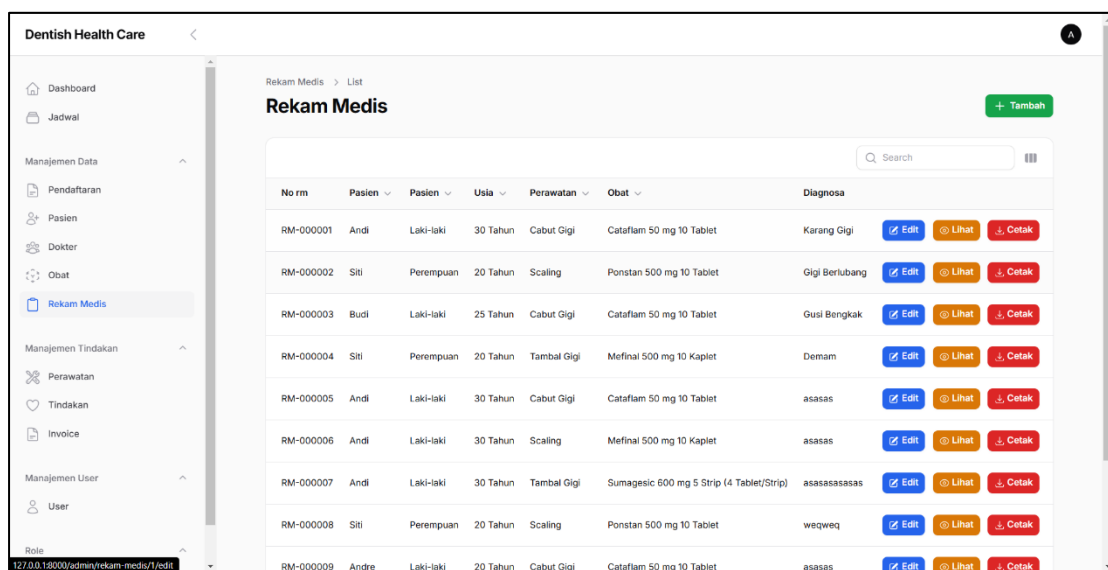


Figure 4. Activity diagram for managing patient invoices

3.3 Coding

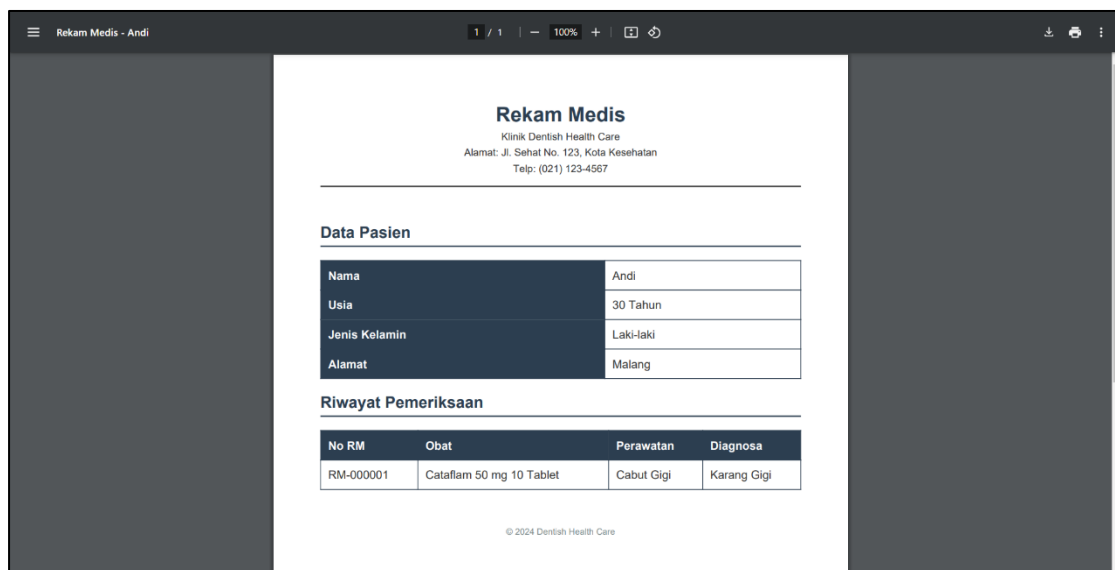
In the coding section, the researchers translate the previously created case diagram and activity diagram into the developed system. In this study, Laravel is used as the main framework in the development of the Dental Clinic Information System because it offers various features that support the development of web-based applications efficiently. For data management, this study uses Laravel Filament to build an admin dashboard, which functions to manage patient medical records and medicine stock in a more structured and efficient manner. The system is developed modularly, so it is more flexible and can be easily adjusted to the needs of the clinic. Laravel itself uses an MVC architecture that helps separate business logic, display, and data management so that the system is more organized and easier to manage.

In the medical record menu, the system displays a table that lists patient information, including medical record number, patient name, type of treatment given, medication used, and diagnosis. To facilitate data management, there are Edit, View, and Print buttons on each entry, allowing doctors to update information, view medical record details, and print patient data if necessary. The medical record menu display can be seen in Figure 5, while the patient's medical record display in print format is shown in Figure 6.



No rm	Pasien	Pasien	Usia	Perawatan	Obat	Diagnosa	
RM-000001	Andi	Laki-laki	30 Tahun	Cabut Gigi	Cataflam 50 mg 10 Tablet	Karang Gigi	Edit Lihat Cetak
RM-000002	Siti	Perempuan	20 Tahun	Scaling	Ponstan 500 mg 10 Tablet	Gigi Berlubang	Edit Lihat Cetak
RM-000003	Budi	Laki-laki	25 Tahun	Cabut Gigi	Cataflam 50 mg 10 Tablet	Gusi Bengkak	Edit Lihat Cetak
RM-000004	Siti	Perempuan	20 Tahun	Tambal Gigi	Mefinal 500 mg 10 Kaplet	Demam	Edit Lihat Cetak
RM-000005	Andi	Laki-laki	30 Tahun	Cabut Gigi	Cataflam 50 mg 10 Tablet	asasas	Edit Lihat Cetak
RM-000006	Andi	Laki-laki	30 Tahun	Scaling	Mefinal 500 mg 10 Kaplet	asasas	Edit Lihat Cetak
RM-000007	Andi	Laki-laki	30 Tahun	Tambal Gigi	Sumagesic 600 mg 5 Strip (4 Tablet/Strip)	asasasasas	Edit Lihat Cetak
RM-000008	Siti	Perempuan	20 Tahun	Scaling	Ponstan 500 mg 10 Tablet	wewewq	Edit Lihat Cetak
RM-000009	Andre	Laki-laki	20 Tahun	Cabut Gigi	Cataflam 50 mg 10 Tablet	asasas	Edit Lihat Cetak

Figure 5. Medical record menu display



Rekam Medis
Klinik Dentish Health Care
Alamat: Jl. Sehat No. 123, Kota Kesehatan
Telp: (021) 123-4567

Data Pasien

Nama	Andi
Usia	30 Tahun
Jenis Kelamin	Laki-laki
Alamat	Malang

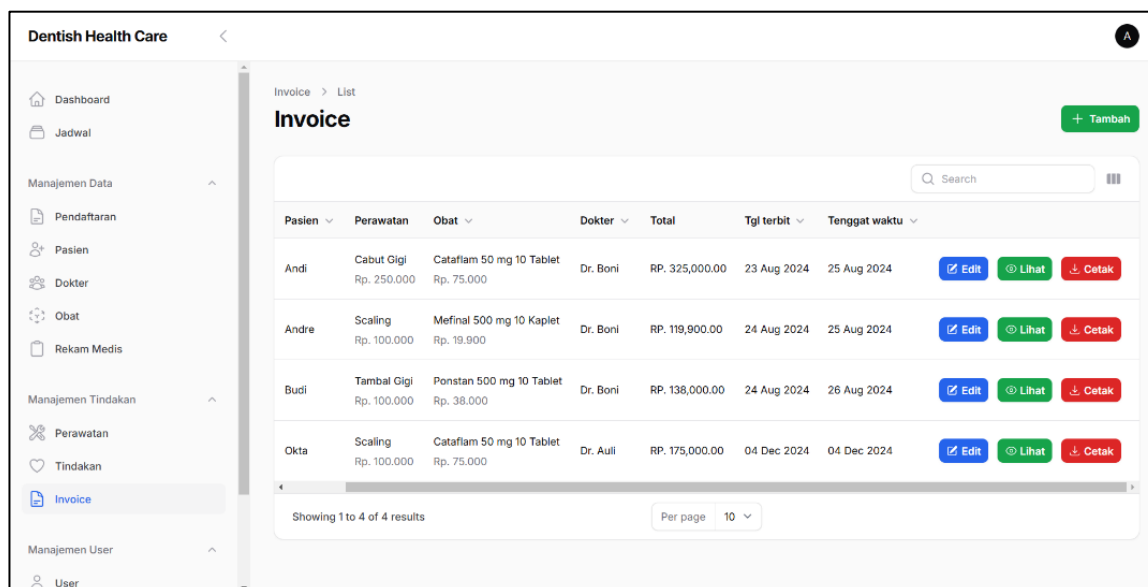
Riwayat Pemeriksaan

No RM	Obat	Perawatan	Diagnosa
RM-000001	Cataflam 50 mg 10 Tablet	Cabut Gigi	Karang Gigi

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Figure 6. View of medical records after printing

On the patient billing page, the system displays a list of invoices for several patients, which includes information such as patient name, type of care received, medication given, total cost, date of issue, and payment deadline. To facilitate the management, there are Edit, View, and Print buttons on each invoice, so that the admin can update data, review billing details, and print documents if needed. The appearance of the patient billing page can be seen in Figure 7. Meanwhile, for the patient's invoice details, see Figure 8.



Pasien	Perawatan	Obat	Dokter	Total	Tgl terbit	Tenggat waktu	
Andi	Cabut Gigi Rp. 250.000	Cataflam 50 mg 10 Tablet Rp. 75.000	Dr. Boni	RP. 325,000.00	23 Aug 2024	25 Aug 2024	Edit Lihat Cetak
Andre	Scaling Rp. 100.000	Mefinal 500 mg 10 Kaplet Rp. 19.900	Dr. Boni	RP. 119,900.00	24 Aug 2024	25 Aug 2024	Edit Lihat Cetak
Budi	Tambal Gigi Rp. 100.000	Ponstan 500 mg 10 Tablet Rp. 38.000	Dr. Boni	RP. 138,000.00	24 Aug 2024	26 Aug 2024	Edit Lihat Cetak
Okta	Scaling Rp. 100.000	Cataflam 50 mg 10 Tablet Rp. 75.000	Dr. Auli	RP. 175,000.00	04 Dec 2024	04 Dec 2024	Edit Lihat Cetak

Figure 7. Invoice menu display



Keterangan	Harga
Scaling	Rp. 100.000
Mefinal 500 mg 10 Kaplet	Rp. 19.900
Total:	Rp 119,900

Figure 8. View of patient invoice details

After all the system modules are developed, the next step is to integrate all the components so that they can function as one. Laravel Filament will be used to build an integrated dashboard, which allows admins to manage all data on one more efficient platform. Before the system is implemented, internal testing will be conducted to ensure that each module works well and is to the clinic's needs.

3.4 Testing

The testing of the "Dentist Health Care" information system aims to ensure that the system functions according to user needs and meets the specifications that have been set. The focus of testing includes system function validation, data validation, and user navigation. Testing is carried out using the Blackbox Testing method, which involves three

main aspects: ensuring system input and output are as expected, ensuring each input has proper validation, and ensuring navigation between features runs smoothly. The scope of testing includes several main features in the dental clinic information system, namely: 1) Doctor's schedule; 2) New patient registration; 3) medicine stock data management; 4) Patient medical record management; and 5) Patient invoice management. Each feature is tested to ensure that the system can operate properly and according to the desired functionality. The test results can be seen in Table 2 below.

Table 2. Black box testing

No	Test scenario	Test data	Expected results	Test results
Doctor's schedule				
1	Displaying the schedule on the calendar	-	The schedule appears on the calendar	Succeed
2	Add a new schedule	Date: 20/12/2024	The schedule was successfully added and displayed	Succeed
3	Adding schedules with overlapping times	Doctor: dr Budi	An error message appears "Schedule already in use"	Succeed
4	Delete schedule	Schedule: 15/12/2024, 10:00	The schedule successfully deleted	Succeed
New patient registration				
1	Adding a new patient	Name: Budi, Age: 30	Patient successfully registered	Succeed
2	Adding patients with incomplete data	Name: -, Address: -	An error message appears "Data is incomplete"	Succeed
3	Updating patient data	Name: Budi, Age: 30 become Name: Budi Hartanto, Age: 30	Patient data successfully updated	Succeed
4	Print the registration form	-	Automatically downloaded form	Succeed
5	Print patient cards	-	Patient cards are downloaded automatically	Succeed
6	Displaying registration data	-	All registration data is displayed	Succeed
Drug stock management				
1	Adding new drug data	Drug Name: Paracetamol, Stock: 50	Drug data successfully added	Succeed
2	Updating Drug Data	Drug Name: Paracetamol, Stock: 50 becomes Drug Name: Paracetamol, Stock: 10	Drug data successfully updated	Succeed
3	Adding drug data with incomplete data	Drug Name: -, Stock: -	An error message appears "Data is incomplete"	Succeed
4	Displays a list of drug stocks	-	All drug stocks are displayed according to the data	Succeed
Medical records management				
1	Adding patient medical records	Name: Budi, Diagnosis: Flu	Medical record data is stored	Succeed
2	Updating patient medical records	Name: Budi, Diagnosis: Flu becomes	Medical record data successfully updated	Succeed

		Name: Budi Hartanto, Diagnosis: Flu		
3	Adding medical record data with incomplete data	Name: -, Diagnosis: -	An error message appears "Data is incomplete"	Succeed
4	View patient medical record details	-	Displays patient medical record details	Succeed
5	Print patient medical records	-	Patient medical records are automatically downloaded	Succeed
6	Displays a list of patient medical records	-	All medical records appear according to data	Succeed
Invoice				
1	Displaying invoice list	-	All invoices appear according to data	Succeed
2	Updating Invoice Data	Patient Name: Andi, Treatment: Tooth Extraction becomes Patient Name: Andi Putra, Treatment: Tooth Extraction Payment Date: null	Invoice data successfully updated	Succeed
3	Payment Status	Become Payment Date: 12/26/2024	Payment status changes to "PAID"	Succeed
3	Adding invoice data with incomplete data	Patient Name: -, Treatment: -	An error message appears "Data is incomplete"	Succeed
4	View invoice details	-	Display invoice details	Succeed
5	Print invoice	-	Invoices are automatically downloaded	Succeed

4. Conclusion

This study successfully developed a web-based Dental Clinic Information System using Laravel with the Extreme Programming (XP) method. This system allows the management of electronic medical records, examination schedules, medicine stock, and patient bills in an integrated manner, by the regulations of the Minister of Health Regulation Number 24 of 2022 concerning electronic medical records. The implementation results show that this system can reduce manual recording, increase operational efficiency, and facilitate access to patient data for medical personnel. The use of Laravel Filament in the admin dashboard has been proven to accelerate the data management process and improve user experience. In addition, the XP method allows the system to be developed iteratively and responsively to user needs so that the system is more flexible to be applied in various small to medium-scale dental clinics.

System testing was conducted using the Black-Box Testing method, which includes testing of key features such as medical record management, examination schedules, drug stock, and patient billing. The test results showed that all features functioned as expected, with proper validation of system input and output. The testing also ensured that navigation between features runs smoothly, and the system can handle possible scenarios in dental clinic operations. As a next step, this research can be further developed with the integration of artificial intelligence (AI) features for patient health data analysis and synchronization with the health insurance system to support medical claim automation. In addition, testing can be expanded using the usability testing method to evaluate user experience and improve the system interface to be more intuitive and easier to use.

References

- [1] C. A. Okolo, S. Ijeh, J. O. Arowoogun, A. O. Adeniyi, and O. Omotayo, "Reviewing the impact of health information technology on healthcare management efficiency," *International Medical Science Research Journal*, vol. 4, no. 4, pp. 420-440, 2024, doi: <https://doi.org/10.51594/imsrj.v4i4.1000>.
- [2] N. Lelyana, "Strategic analysis in the application of digital technology in dental practice," *Journal of Social Interactions and Humanities*, vol. 2, no. 3, pp. 253-274, 2023, doi: <https://doi.org/10.55927/jsih.v2i3.6441>.
- [3] M. Malik, A. F. Kazi, and A. Hussain, "Adoption of health technologies for effective health information system: Need of the hour for Pakistan," *PLOS ONE*, vol. 16, no. 10, pp. e0258081, 2021, doi: <https://doi.org/10.1371/journal.pone.0258081>.

- [4] D. F. Sittig, A. Wright, E. Coiera, F. Magrabi, R. Ratwani, D. W. Bates, and H. Singh, "Current challenges in health information technology-related patient safety," *Health Informatics Journal*, vol. 26, no. 1, pp. 181-189, 2020, doi: <https://doi.org/10.1177/1460458218814893>.
- [5] H. Xie, G. Prybutok, X. Peng, and V. Prybutok, "Determinants of trust in health information technology: An empirical investigation in the context of an online clinic appointment system," *International Journal of Human-Computer Interaction*, vol. 36, no. 12, pp. 1095-1109, 2020, doi: <https://doi.org/10.1080/10447318.2020.1712061>.
- [6] D. P. Salsabila, R. S. Pradini, dan A. N. Khudori, "Perancangan User Interface dan User Experience Aplikasi Klinik Gigi Menggunakan Metode Design Thinking," *Jurnal Saintekom: Sains, Teknologi, Komputer dan Manajemen*, vol. 14, no. 1, pp. 61-71, Mar. 2024, doi: <https://doi.org/10.33020/saintekom.v14i1.601>.
- [7] Kementerian Kesehatan Republik Indonesia, "Peraturan Menteri Kesehatan Nomor 24 Tahun 2022 tentang Rekam Medis Elektronik," 2022.
- [8] C. G. Cobb, *the project manager's guide to mastering Agile: Principles and practices for an adaptive approach*. John Wiley & Sons, 2023.
- [9] V. Venkatesh, J. Y. Thong, F. K. Chan, H. Hoehle, and K. Spohrer, "How agile software development methods reduce work exhaustion: Insights on role perceptions and organizational skills," *Information Systems Journal*, vol. 30, no. 4, pp. 733-761, 2020, doi: <https://doi.org/10.1111/isj.12282>.
- [10] S. G. Tetteh, "Empirical study of agile software development methodologies: A comparative analysis," *Asian Journal of Research in Computer Science*, vol. 17, no. 5, pp. 30-42, 2024, doi: <https://doi.org/10.1145/2693208.2693233>.
- [11] A. Akhtar, B. Bakhtawar, and S. Akhtar, "Extreme programming vs scrum: A comparison of agile models," *International Journal of Technology, Innovation and Management (IJTIM)*, vol. 2, no. 2, pp. 80-96, 2022, doi: <https://doi.org/10.54489/ijtim.v2i2.77>.
- [12] A. Shrivastava, I. Jaggi, N. Katoch, D. Gupta, and S. Gupta, "A systematic review on extreme programming," *Journal of Physics: Conference Series*, vol. 1969, no. 1, p. 012046, 2021, doi: <https://doi.org/10.1088/1742-6596/1969/1/012046>.
- [13] M. I. Fadilah, T. F. Kusumasari, and S. Suakanto, "Implementation of MVC architecture on RESTful API for monitoring COVID-19 patient condition parameters using Laravel framework with waterfall method," in *International Conference on Enterprise and Industrial Systems (ICOEINS 2023)*, 2023, pp. 258-270, doi: https://doi.org/10.2991/978-94-6463-340-5_23.
- [14] D. Jain, *Ultimate Laravel for Modern Web Development: Build Robust and Interactive Enterprise-Grade Web Apps using Laravel's MVC, Authentication, APIs, and Cloud Deployment (English Edition)*. Orange Education Pvt Ltd, 2024.
- [15] M. A. F. Taftazani, E. Darwiyanto, and R. Nurtantyana, "The development of network power system website using extreme programming method: A case study PT Smartfren Surabaya Branch," *Indonesian Journal on Computing (Indo-JC)*, vol. 9, no. 2, pp. 154-167, 2024, doi: <https://doi.org/10.34818/INDOJC.2024.9.2.972>.
- [16] N. E. CayturoSilva et al., "Optimizing attendance management in educational institutions through mobile technologies: A machine learning and cloud computing approach," *International Journal of Interactive Mobile Technologies*, vol. 18, no. 12, 2024, doi: <https://doi.org/10.3991/ijim.v18i12.46917>.
- [17] A. A. Laksono, E. R. Putri, and M. Syahlanisyiam, "Rancang bangun sistem informasi klinik gigi berbasis web menggunakan metode extreme programming," *BINER: Jurnal Ilmu Komputer, Teknik dan Multimedia*, vol. 1, no. 2, pp. 219-237, 2023.
- [18] Z. Hussain, M. Lechner, H. Milchrahm, S. Shahzad, W. Slany, and M. Umgeher, "Optimizing extreme programming," in *2008 International Conference on Computer and Communication Engineering*, 2008, pp. 1052-1056, doi: <https://doi.org/10.1109/ICCE.2008.4580769>.
- [19] F. Anwer, S. Aftab, and I. Ali, "Proposal of tailored extreme programming model for small projects," *International Journal of Computer Applications*, vol. 171, no. 7, pp. 23-28, 2017, doi: <https://doi.org/10.5120/ijca2017915112>.