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RESEARCH PAPER

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Design of a Clinical CRM Model Integrated with EMR to Support NCD Education

Avid Wijaya[1], Prima Soultoni Akbar[1], Eiska Rohmania Zein[1], Fery Fadly[2], Rizka Ajeng Trikusumah[2]

[1] Department of Medical Record and Health Information, Poltekkes Kemenkes Malang, Malang, Indonesia
[2] Department of Medical Record and Health Information, Poltekkes Kemenkes Tasikmalaya, Tasikmalaya, Indonesia

Abstract

Non-Communicable Diseases (NCDs) have become a major global health issue requiring serious attention, a challenge for the global health system, because of factors such as urbanization, lifestyle changes, and population aging have caused increased cases of diseases such as diabetes, cancer, and cardiovascular disorders worldwide. Clinics play a crucial role in providing health education to the community to increase awareness of NCD prevention. Health service optimization can be achieved through the integration of Customer Relationship Management (CRM) and Electronic Medical Record (EMR) systems, which enable improved patient-provider relationships and more effective access to medical records. This study aims to develop an integrated CRM EMR application model for clinics as a tool for NCD education. The study employed a user-centered design approach with a descriptive research methodology. The research stages consisted of research, requirements, design, and evaluation, conducted through literature reviews, field data collection, and interviews with clinic staff to identify system requirements and user experiences. The design phase produced a database model, relational tables, and a user interface prototype that represent the integration of CRM and EMR systems. The findings indicate that the proposed model has the potential to improve the efficiency of patient data management, facilitate health education, and strengthen interactions between patients and healthcare providers. The main contribution of this research is the provision of technical outputs in the form of a database design and user interface prototype, which can serve as the foundation for further development and implementation of an integrated CRM EMR system in clinics. By embedding the CRM–EMR model within broader e-health strategies and community-based health promotion programs, this research lays the groundwork for a sustainable digital ecosystem that supports preventive healthcare and advances Indonesia's digital health transformation.

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Author Email

avidwijaya@poltekkes-malang.ac.id
primasoultoniakbar@gmail.com
eiskazein@poltekkes-malang.ac.id
ferfadl27@gmail.com
rizkaajengt@gmail.com

I. Introduction

Non-communicable diseases have become a major challenge for the global health system because factors such as urbanization, lifestyle changes, and population aging have caused increased cases of diseases such as diabetes, cancer, and cardiovascular disorders worldwide. To overcome this problem, a holistic approach that includes prevention, early detection, and long -term management [1] [2] [3] [4]. The World Health Organization (WHO) has set global targets to reduce the mortality of non-transmitted diseases prematurely, with the aim of reducing 25% premature deaths due to non-communicable diseases in 2025 [5]. In addition, increased incidence of non-communicable diseases, especially cardiovascular disease, has occurred in various countries, including in developing countries [6] [7] [8].

In Indonesia, the burden is particularly pronounced. In 2018, NCDs were estimated to account for 73% of all deaths, with cardiovascular diseases responsible for around 35%, cancers 12%, chronic respiratory diseases 6%, and diabetes mellitus about 6% [9]. Moreover, Indonesia faces considerable geographical and socio-demographic disparities in NCD burden: a 2019 study observed that exposure to risk factors such as high systolic blood pressure, elevated fasting plasma glucose, tobacco use, and unhealthy diet has driven increasing health losses (YLLs and DALYs) in several provinces [10].

Utilization of technology to integrate the application of Customer Relationship Management (CRM) with Electronic Medical Records (EMR) in the clinic can play an important role in educating individuals about NCD. This system can help early detection of PTM risk factors in the community, facilitate prevention measures, and encourage a healthy lifestyle [11]. Educating the public about PTM prevention is essential, especially in the context of the COVID-19 pandemic, which has

Corresponding author: Avid Wijaya, avidwijaya@poltekkes-malang.ac.id, Department of Medical Record and Health Information, Poltekkes Kemenkes Malang, Malang, Indonesia.
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heightened global health concerns [12]. The development of technology-based information systems can increase public knowledge about NCD prevention, foster awareness, and encourage the disease prevention [11].

Previous studies have explored CRM integration in healthcare to enhance patient-centred care, particularly through Social CRM frameworks that empower patients and promote online health education (Anshari & Almunawar, 2012) [13]. Moreover, systematic evidence shows that while CRM systems in healthcare yield improved patient communication, satisfaction, and engagement, the number of comprehensive empirical studies remains limited [14]. Despite these developments, few studies have specifically examined the integration of CRM with EMR systems for NCD education and prevention in primary healthcare settings in developing countries. This research aims to fill that gap by designing a CRM EMR framework tailored to community-based clinics in Indonesia.

The primary objective of integrating CRM applications with EMR systems in clinics is to provide education on NCDs, with the aim of reducing their incidence and impact. By leveraging technology for educational purposes, individuals can be empowered to make informed decisions about their well-being, thereby reducing the prevalence of NCDs. This integration not only strengthens patient engagement but also streamlines healthcare interventions tailored to each patient's unique needs and risk factors, ultimately driving improved health outcomes and reducing healthcare expenditures over time. [15], [16].

Leveraging EMR systems provides crucial functionalities that can enhance continuity and coordination of care, especially in managing chronic conditions like diabetes and hypertension. By tracking vital patient metrics, these systems facilitate timely access to critical healthcare data, which is instrumental for responsive treatment and effective disease management [17]. Additionally, integrating CRM applications allows health professionals to create personalized educational content tailored to individual patients' needs, addressing specific risk factors associated with NCDs. Such efforts have previously demonstrated improvements in patient engagement and self-management behaviors, thereby positively influencing health outcomes [18].

The development of an adapted information system for non-communicable diseases is very necessary in modern health services [19]. Implementing technologies such as CRM can strengthen patient relationships and improve health services [20]. In addition, using an interactive user interface design can improve user experience in the application, which leads to increased involvement and use [21]. Moreover, integrating these technologies into a unified digital ecosystem enables real-time monitoring, personalized clinical decision support, and more efficient coordination between healthcare providers. This holistic approach ultimately enhances service responsiveness and supports proactive management of non-communicable diseases in diverse healthcare settings.

Primary healthcare facilities in Indonesia still face challenges in managing the follow-up of patients with chronic diseases due to the separation of administrative systems and clinical data. The lack of interoperability between information systems is a major obstacle in monitoring and educating patients regarding non-communicable diseases (NCDs). Research shows that the implementation of electronic medical records (EMR) systems in various healthcare facilities is still uneven, especially in primary care clinics, which is influenced by limited infrastructure readiness, human resources, and policy support [22], [23]. This condition hinders early detection efforts and continuity of patient care. Therefore, the development of an integrated technology-based model that combines Customer Relationship Management (CRM) and EMR is crucial for improving service coordination, patient management, and public health education on NCDs at the primary care level [24].

The importance of overcoming PTM comes from the status of the disease as a major cause of global death, with most of the deaths concentrated in developing countries [25]. Therefore, initiatives that utilize technology for the education and prevention of PTM plays an important role in mitigating the burden of this disease, which is increasing, and improving the results of public health. Remember this, Sustainable Investment in Innovative Technology Solutions and Targeted Educational Campaigns is very important to overcome the challenges caused by NCD effectively and encourage healthier people throughout the world.

II. Materials and Method

This study adopts a qualitative descriptive approach within the User-Centered Design (UCD) framework, emphasizing users as the primary focus throughout the system development process. The research builds upon the analytical findings from the first-year phase and continues with the modeling of CRM EMR integration as a foundation for further system implementation. Data were collected through semi-structured interviews, field observations, and document analysis of relevant literature and previous project results. To ensure data fidelity and objectivity, all interview sessions were audio recorded and transcribed verbatim, and source triangulation was conducted across interviews, observations, and documents. The research stages is shown in Fig.1

The research stage involves collecting initial data to understand the context, user needs, and the problems to be solved. It incorporates data gathered during the previous year's study, which provided the initial analysis. Scientific references from published journals are used to support understanding and inform subsequent processes. The requirements stage focuses on identifying and defining design needs and requirements. It includes specifying the required features and functions, as well as the criteria that the final product must meet. These requirements form the basis for subsequent design development. Once the requirements have been identified, the design stage begins. This involves developing design concepts, wireframes, and prototypes.

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The design focuses on creating solutions that address the previously identified user needs and may include visual, interaction, and functional aspects of the product. The final stage is the evaluation of the developed design. This step ensures that the design meets user needs and performs as expected. Evaluation may involve user testing of prototypes. The results of this evaluation are used to refine and adjust the design before the final product is implemented or launched.

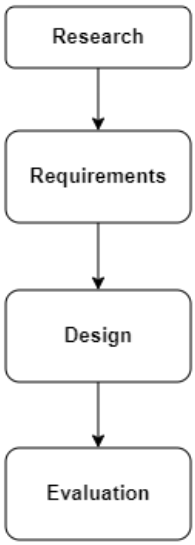

Fig. 1 User-Centered Design fLOWCHART

Each phase involved user participation through observation, interviews, participatory workshops, and usability testing using SUS. Tools such as Figma, MySQL Workbench, and requirement traceability matrices supported each design and evaluation iteration. The study was conducted in two primary healthcare clinics in Malang City, which were purposively selected for their active involvement in non-communicable disease (NCD) management programs and their readiness to adopt digital health innovations. Each clinic included four key informants representing both administrative and clinical roles, such as registration officers, nurses, and general practitioners. The selection of participants employed purposive sampling, with clearly defined inclusion and exclusion criteria to ensure the relevance and diversity of perspectives. Data were obtained through semi-structured interviews, analysis of published literature, and secondary findings from the first-year phase of the research. The inclusion criteria include administrative staff or healthcare/medical personnel working at primary clinics in Malang City who are willing to participate in the study. The exclusion criteria include administrative staff or healthcare personnel who are unable to attend or who are absent during data collection due to reasons such as illness or other constraints.

III. Results

This research is focused on the design of the Integration of Customer Relationship Management (CRM) with the Electronic Medical Record (EMR) on clinical services. The activity begins with an in-depth analysis of the system needs and mapping of service business processes, including patient registration, queue management, health checks, medical record recording, and follow-up services. The results of the analysis indicate that a database model is needed that integrates patient administrative data (CRM) with clinical data (EMR) in a structured, consistent, and accessible manner, enabling real-time access for health workers and clinical management.This database design follows the relational schema illustrated in the following chart.

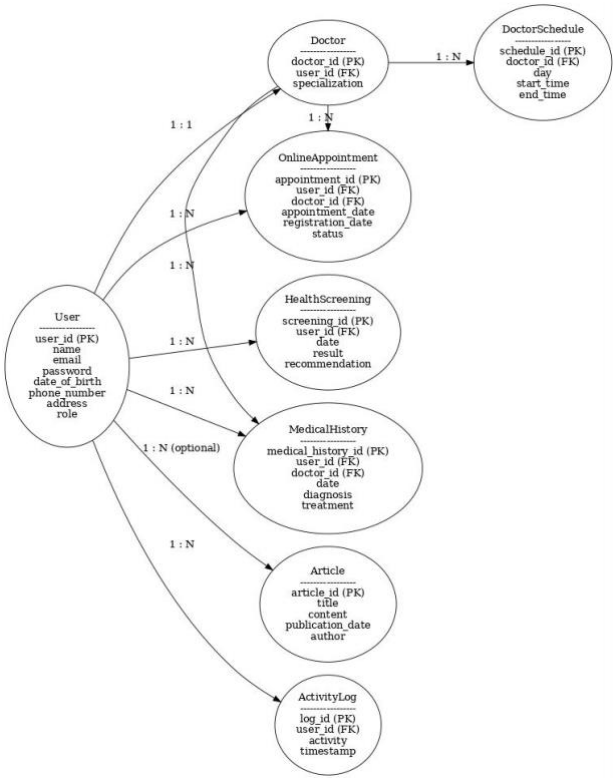

Fig. 2 Relationship Data

This diagram illustrates how user data, doctors, practice schedules, registration, health screenings, medical histories, health articles, and activity logs are interconnected in the system. The main table is a user who stores information on each user, both patients, doctors, and admins. Each user has attributes such as name, email, user ID, password, cell phone number, address, and role. If a user acts as a doctor, they have one corresponding record in the doctor table, which stores specialization information. A doctor can have many practice schedules stored in the schedule table, which contains information on days and practice hours. Patients can register online through a queanonline table that records the objectives, registration date, and queue status. Patients can also do independent health screening; the results are stored in the Healthy Health table, complete with the date, results, and recommendations. The entire history of patient treatment is recorded in the history of the treatment that connects patients with the doctor who handles them, and contains the date of visit, diagnosis, and therapy given.

Corresponding author: Avid Wijaya, avidwijaya@poltekkes-malang.ac.id, Department of Medical Record and Health Information, Poltekkes Kemenkes Malang, Malang, Indonesia.
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In addition, the system provides an article table to store health articles accessible to users, with attributes for title, content, publication date, and author. For audit and security purposes, each logout is recorded in the logactivity table, which stores the time and type of activity. Relationships between tables are designed in an integrated manner so as to allow patient data tracking, doctor's schedule, and service history to be easily accessed, while maintaining data consistency and supporting future features such as payment integration or

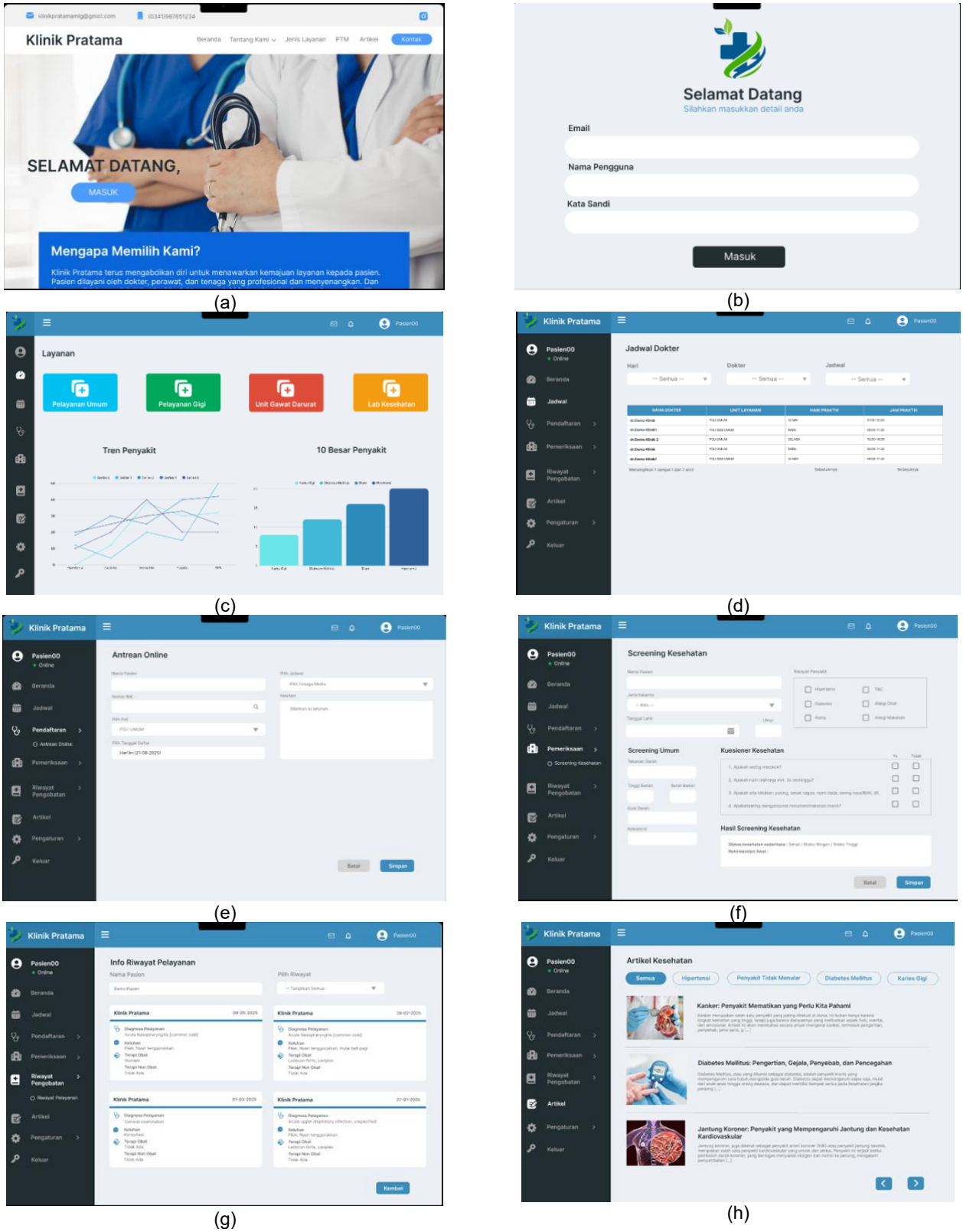

Fig. 3. System Display (a) Home Display, (b) Login Menu, (c) Main Home, (d) Schedule Menu, (e) Online Registration Menu, (f) Check Menu, (g) Treatment History Menu, (h) Article Menu

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automatic notification. The display has been developed as shown in Figure 3.

The developed system comprises several primary displays and menus designed to support user interaction and accessibility. The Home Display presents essential information such as clinical profiles, vision and mission statements, available services, information on non-communicable disease, health articles, and contact details. To access the CRM-Patient module, users can click the “Enter” button provided on the home page. Upon pressing Enter, users are directed to the Login Menu, where they are required to enter their email address, username, and password to proceed. After successful authentication, the system navigates to the Main Home interface, which provides access to clinical service information, displays current disease trends, and lists the top ten diseases in the region. The Schedule Menu allows users to view doctors’ schedules, which can be filtered according to specific days, doctors’ names, or consultation hours. In the Online Registration Menu, users can register for polyclinic visits through an online form, complete the required fields, and confirm their registration by clicking the “Save” button.

The Health Screening Menu enables users to complete a digital questionnaire related to health status and view personalized screening results after submission. Meanwhile, the Treatment History Menu provides access to patients’ previous medical visits. By consenting to the integration of Electronic Medical Record (EMR) data, users can efficiently review and sort their treatment history. Lastly, the Article Menu allows users to browse and read various health-related articles, each accompanied by a feature to open detailed explanations for selected topics.

IV. Discussion

As a result of the design stage, a database relational design has been produced that represents the relationships among entities as a whole. The database design includes main entities such as users, doctors, schedules, losses, antreanonlines, health screens, treatment, articles, and logicactivity. Relationships between entities are designed to support integration with the EMR, for example, by connecting User_ID and Dokter_id in the treatment table so that each treatment record can be traced to the patient's clinical data in the EMR. This model allows synchronization of service data and minimizes information redundancy, thereby increasing the efficiency of clinical data management. By implementing the latest information technology, clinical data management can be conducted more systematically and organized, providing health workers with faster, more accurate access to information [26].

This result forms the basis for the next stage: the implementation of the integrated system prototype, the development of APIs/Middleware for data exchange, and trials in the clinical environment. This is in line with the need to apply evidence-based practices in clinical decision making, where accurate and latest information is very important to provide the best quality of treatment to patients [27].

In addition, research at this stage produces a CRM-Patient system interface design that functions as a guide to user interaction with applications. Interface design is informed by the results of user needs analysis (User Requirement Analysis), observations of the clinical service process, and interviews with health workers and patients. This design aims to facilitate users' access to clinical information, registration, viewing the doctor's schedule, monitoring treatment history, and conducting health screenings independently. Effective interface design will improve user experience and minimize errors in the registration process and health services, thereby increasing overall patient satisfaction [28]. The importance of user -friendly interface design in an online registration system not only affects ease of access, but also affects patient satisfaction with health services [29], [30].

The interface is designed with the principle of user-friendly and responsive design, so that it can be accessed via computer devices or smartphones [30], [31]. The ability to adapt encourages more optimal user interactions while maintaining the function and aesthetics of the interface, regardless of the media used to access it [32], [33]. Interfaces that adapt seamlessly to various devices maintain both functionality and aesthetic appeal, ensuring that users can navigate the system effortlessly, regardless of the media they utilize [34]. The menu structure is arranged hierarchically to facilitate navigation, starting from the initial display that contains clinical profiles, vision and mission, type of service, non-communicable disease education, health articles, and clinical contact [35], [36]. Next, users can enter the system through a secure login menu, then be directed to the main homepage that displays service information, disease trends, and a list of the top 10 diseases in the clinical area.

Research on human-computer interaction (HCI) highlights significant changes in how humans relate to technology, which not only affect interface design but also shape users' responses to digital information [37]. By giving special attention to physical interaction elements such as movement, touch, and response, haptic designers can design digital experiences that feel more intuitive and immersive. This approach allows users to interact with the system more naturally, as if processing, they are directly related to objects in the real world, thereby increasing involvement, reducing cognitive barriers, and strengthening emotional connections between users and the technology used.

The interface design also includes the main functional menu, such as the doctor's schedule (with sorting features based on the doctor's day or name), online queue (online registration), health screening (digital questionnaire with automatic results), treatment history (with the integration of patient EMR data), and health articles that can be accessed interactively. The results of this interface design are presented in the form of mockups and navigation flow diagrams, which have been validated internally by the research team and college partners to ensure suitability

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with clinical service flow. The importance of responsive design in mobile applications underscores that effective validation can enhance the effectiveness of the learning process with mobile technology, thereby enabling its adaptation for clinical use [38]. The interface validation process includes an evaluation of the ease of navigation and user interaction [39].

Nevertheless, implementation of integrated clinical-administrative systems frequently encounters significant obstacles. A scoping review by Tsai et al. revealed that while Electronic Health Record (EHR) systems offer substantial benefits, various barriers continue to impede their full adoption, including technical infrastructure deficits (e.g., unreliable connectivity), data-interoperability gaps, and privacy/security concerns [40]. Likewise, Hossain et al. (2025) emphasised that in Indonesia, entrenched paper-based workflows, limited IT skills, and organisational culture inhibited meaningful EMR deployment [41]. These findings suggest that for a CRM–EMR integration initiative to succeed, implementation plans must incorporate strategies for infrastructure investment, staff training and support, data governance, and change management; otherwise; the risk of user resistance, reduced efficiencies; or even system abandonment remains high.

The implementation of an integrated Customer Relationship Management (CRM) and Electronic Medical Record (EMR) system is projected to produce measurable benefits for both patient education and clinical operations. Integrating CRM functions such as personalized communication, appointment reminders, and educational notifications with EMR-based data management has been proven to improve patient engagement and health literacy, especially among individuals with chronic diseases [42]. Furthermore, previous studies have shown that digital health record implementation and workflow automation can increase operational efficiency, reducing administrative workload and documentation errors by 30-40% [43]. Over time, continuous follow-up and personalized health education enabled by such integrated systems can encourage lifestyle modification and adherence to preventive care programs, thereby reducing non-communicable disease (NCD) risks at the primary healthcare level. Collectively, these impacts emphasize the dual role of CRM–EMR integration in strengthening patient empowerment while enhancing workflow efficiency in resource-limited clinical settings.

Despite these limitations, this study establishes a vital groundwork for the sustainable integration of Customer Relationship Management (CRM) and Electronic Medical Record (EMR) systems in primary healthcare environments. The qualitative, user-centered design (UCD) approach applied throughout the research produced a contextually adaptive model that accurately reflects operational realities and end-user expectations in community-based clinics. The iterative design and evaluation cycles have not only confirmed the model's feasibility in improving patient education, workflow efficiency, and data management within a unified digital framework but also highlighted its long-term sustainability potential. Ensuring sustainability requires a modular system architecture, ongoing staff training, and alignment with national digital health policies, such as *SATUSEHAT*. Consequently, the developed model serves as both a proof of concept and a strategic framework for scalable implementation, institutional adoption, and ongoing policy integration in Indonesia's primary healthcare system.

V. Conclusion

This study highlights the importance of integrating CRM and EMR systems in clinics to enhance patient education on Non-Communicable Diseases (NCDs) and improve healthcare service delivery. Through the application of a user-centered design approach, a comprehensive database model, relational tables, and user interface prototypes were developed to address user needs and support clinical workflows. The integration model has the potential to improve patient engagement, streamline administrative processes, and enable more targeted health interventions. Future work will focus on evaluating the usability of the proposed system through user testing, refining the interface design based on feedback, and developing a functional prototype for clinical implementation. This research contributes to the foundation for scalable digital health solutions that can reduce the burden of NCDs and support evidence-based decision-making in primary healthcare settings. In addition, ensuring the long term sustainability and policy alignment of this integration is crucial. The system should be progressively connected to national health information infrastructures such as Indonesia's *SATUSEHAT* platform to ensure interoperability, data standardization, and continuity of care. Investment in staff digital literacy, data governance frameworks, and periodic system evaluation will be essential to maintain reliability and public trust. By embedding the CRM–EMR model within broader e-health strategies and community-based health promotion programs, this research lays the groundwork for a sustainable digital ecosystem that supports preventive healthcare and advances Indonesia's digital health transformation.

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Corresponding author: Avid Wijaya, avidwijaya@poltekkes-malang.ac.id, Department of Medical Record and Health Information, Poltekkes Kemenkes Malang, Malang, Indonesia.
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Corresponding author: Avid Wijaya, avidwijaya@poltekkes-malang.ac.id, Department of Medical Record and Health Information, Poltekkes Kemenkes Malang, Malang, Indonesia.
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Author Biography

Avid Wijaya was born in 1992 in Wamena, Papua, Indonesia. He is a lecturer at the Department of Medical Records and Health Information, Poltekkes Kemenkes Malang. He earned his Bachelor's degree in Health Information Management from Politeknik Negeri Jember in 2015 and a Master's degree in Public Health (Health Informatics) from Universitas Indonesia in 2018. His professional interests include health information systems, electronic medical records, and digital health innovation. With experience as a

Corresponding author: Avid Wijaya, avidwijaya@poltekkes-malang.ac.id, Department of Medical Record and Health Information, Poltekkes Kemenkes Malang, Malang, Indonesia.
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programmer and researcher, he actively contributes to academic publications and community projects promoting the integration of technology and health in Indonesia. He continues to strengthen digital health education and research collaboration to support Indonesia's evolving health information ecosystem.

Prima Soultoni Akbar is an academic and researcher specializing in medical records and health information. As a lecturer at the Health Polytechnic of the Ministry of Health Malang (Poltekkes Kemenkes Malang), he is actively involved in various research projects and has published several scientific papers in the health sector. His dedication to research was strengthened by his experience during his Master of Public Health at UNS (Sebelas Maret University), where he worked as an editorial staff member managing 5 international journals. Through his active research, Prima Soultoni Akbar is committed to improving healthcare service quality in Indonesia, particularly in areas directly related to the utilization of medical records and health information.

Eiska Rohmania Zein, born in Nganjuk, East Java, on October 13, 1994, is a lecturer in the Diploma 3 Medical Records and Health Information Program at Poltekkes Kemenkes Malang. She earned her D4 in Medical Records from Jember State Polytechnic (2017) and a Master's in Public Health from the University of Jember (2020). She teaches Medical Terminology, Coding Systems, Medical Record Concepts, and Research Methodology. Actively engaged in academic writing, she contributes to journals, textbooks, and book chapters on health information and medical records. She is strongly committed to advancing teaching quality and fostering innovation in medical records and health information practices.

Fery Fadly is an academic and researcher in Medical Records and Health Informatics. He has been teaching for five years and is actively involved in education and research. He earned a Diploma in Nursing from Telanai Bhakti Nursing Academy, a Bachelor's degree in Health Sciences from STIKes Harapan Ibu Jambi, and a Master of Public Health in Health Informatics from the University of Indonesia. His interests include medical records, health information systems, and data analysis. He also serves as a journal editor and reviewer, contributing to the quality of scientific publications and promoting evidence-based practices in health informatics. He remains committed to advancing the field through continuous professional development and collaborative scholarly work.

Rizka Ajeng Trikusumah is an Educational Laboratory Assistant at Poltekkes Kemenkes Tasikmalaya, specializing in health information management and academic digitalization. She earned her Diploma from Poltekkes Tasikmalaya and is pursuing a Bachelor's in Health Information Management at STIKes Mitra Husada Karanganyar. She previously worked at Kanker Dharmais Hospital and Pelni Jakarta Hospital, gaining experience in coding, reporting, and HIS implementation. Since 2022, she has managed academic and laboratory activities and mentors students. Rizka is also a member of the editorial team of JREMikes Journal and a PORMIKI member, with a focus on digital transformation and laboratory management innovation. She continues to expand her expertise through active engagement in research, professional networks, and technology-driven initiatives.

Corresponding author: Avid Wijaya, avidwijaya@poltekkes-malang.ac.id, Department of Medical Record and Health Information, Poltekkes Kemenkes Malang, Malang, Indonesia.
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