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Design of A Smartphone-Based Self-Service Patient Kiosk Application at Bhayangkara Hospital Bengkulu

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ABSTRACT

Background: The manual outpatient registration process at Bhayangkara Level III Hospital Bengkulu leads to long queues and high waiting times, thus necessitating a technological solution. **Objective:** This study aims to design a smartphone-based Self-Service Patient Kiosk (APM) for outpatient polyclinics using Waterfall. **Methods:** This descriptive qualitative research with a software engineering approach applies Waterfall stages: requirements analysis, system design, interface design, and prototyping. Data were collected through observation, interviews, checklists from 11 officers, and system validation using UAT on 7 features, generating 77 responses. **Results:** Results showed 66 responses (85%) needed, and 11 (15%) not needed. The resulting APM prototype includes features for self-patient data input, polyclinic and doctor selection, appointment scheduling, digital queue printing, and real-time queue monitoring. The prototype has a user-friendly interface and integrates with patient registration digitalization. **Conclusion:** In conclusion, the smartphone-based APM effectively accelerates and decentralizes the registration process. **Suggestion:** Future researchers should proceed to coding, SIMRS integration, and direct field testing.

Keywords: Self-Service Patient Kiosk; Smartphone Application; Waterfall Method; Technology Acceptance Model; Outpatient Registration.

INTRODUCTION

The rapid advancement of information technology in the modern era demands massive digital transformation in the healthcare sector, particularly in the optimization of Hospital Information Systems (SIMRS) and the implementation of Electronic Medical Records (EMR). The transition from manual recording systems to administrative digitalization is crucial to ensure the accuracy of clinical data, support national reporting standards efficiently, and continuously improve the quality of services [1]. Integrated data management allows hospitals to present fast and accurate information, which is a crucial indicator in facilitating strategic decision-making by management [2]. Therefore, the modernization of service workflows, especially in the frontline such as outpatient registration, has become a fundamental step that must be prioritized by healthcare institutions to maintain operational standards [3].

Although the urgency of digitalization is widely acknowledged, operational practices in the field indicate that the outpatient registration system at Bhayangkara Level III Hospital Bengkulu is still dominated by conventional processes. This condition directly triggers crucial problems in the form of long physical queues, high waiting times, and workflow inefficiencies for registration staff when verifying patient demographics [4]. These administrative constraints impact the slow distribution of medical records to the intended polyclinics and potentially hinder the synchronization of external reporting due to data that has not been verified in real-time [5]. The accumulation of patients in the counter area also hampers service optimization; thus, technological interventions capable of automatically unraveling the congestion are urgently needed to restore service time standards [6].

A critical examination of the current literature reveals that while various efforts have been made to address outpatient registration inefficiencies through Self-Service Patient Kiosks (APM), these solutions remain constrained by significant limitations. Anggoro and Amin [7] developed a physical hardware-based APM (kiosk) deployed in hospital lobbies; however, this approach requires substantial capital expenditure for hardware procurement and maintenance, while patients are still compelled to be physically present on-site to complete registration. Oktaviansyah [8] designed a web-based APM system; nevertheless, web interfaces often suffer from suboptimal responsiveness on mobile devices and lack the seamless user experience required for patient adoption. Putra et al. [9] created a touchscreen kiosk application, yet this solution remains fixed within hospital premises,

failing to address the fundamental challenge of patient accumulation in waiting areas. Trifena et al. [10] explored interface design improvements but were limited to prototyping without integration with medical record governance or hospital information systems.

Furthermore, the implementation of EMR in Indonesia itself still faces major challenges. According to data from the Indonesian Hospital Association (PERSI), of approximately 3,000 hospitals, only 50% have implemented EMR, and only 16% are functioning optimally [11]. Research by Jatmiko et al. [12] revealed that obstacles to EMR implementation include inadequate infrastructure availability, human resource readiness, funding limitations, and unstable internet networks causing system downtime. An exploratory study by BMC Health Services Research [13] also found that the transition to EMR is complicated by diverse technological, cultural, and infrastructural challenges, with low digital literacy among staff and ongoing reliance on paper records during the transition period.

Based on this literature review, the novelty of this research lies in the architectural design of a fully smartphone-based APM application that implements a multi-layered data verification flow to prevent administrative service pending for patients at a type C hospital level. Unlike previous findings that heavily rely on providing high-cost static kiosk machines or web systems that are less responsive on mobile devices, this research innovates by developing a portable application that allows registration, medical data completeness validation, doctor selection, and digital queue number printing directly from the patient's own device remotely. This approach uses the Waterfall method to structurally design the interface, producing a user-friendly prototype for cross-generations, and specifically facilitating easy integration with the hospital's database without generating any physical queues at all [14].

The objective of this research is to design and develop a prototype of a smartphone-based Self-Service Patient Kiosk (APM) application using the Waterfall method to optimize outpatient polyclinic registration services at Bhayangkara Level III Hospital Bengkulu. The design of this application aims to produce a comprehensive, efficient, and applicable digital solution to eliminate patient accumulation in waiting areas, reduce the administrative burden on medical record staff, and improve data accuracy within the hospital management information system ecosystem [15].

METHODS

This study employed a descriptive qualitative approach integrated with the Software Development Life Cycle (SDLC) Waterfall model [16]. The Waterfall approach was selected because it emphasizes a sequential and systematic software engineering cycle, encompassing requirements analysis, system design, interface prototyping, and testing phases [17]. While the study is primarily qualitative, it incorporates a mixed-method strategy—qualitative-dominant with quantitative descriptive support—to provide a more comprehensive understanding of system requirements [18]. The quantitative element, consisting of frequency and percentage calculations, serves solely as a descriptive tool to present the urgency of feature requirements based on informant perceptions, not as inferential statistical analysis, thereby complementing the qualitative data obtained from observations and in-depth interviews [19]. Similarly, the Technology Acceptance Model (TAM) was employed strictly as a conceptual framework to guide the analysis of perceived usefulness and perceived ease of use from the informants' perspective, rather than as a statistical measurement tool [20].

The research was conducted comprehensively at the Outpatient Polyclinic Registration Unit of Bhayangkara Level III Hospital Bengkulu over three months, from April to June 2026, to obtain a comprehensive overview of standard operating procedures and medical record governance [15]. The population comprised all outpatient registration administrative staff at the hospital. Based on data saturation theory, sampling was performed using a total sampling technique, whereby the entire population of 11 staff members was designated as the sample and key informants [21]. The variables of this study encompassed three main components: system requirements analysis, operational flowchart design, and application user interface (UI/UX) layout design. The interface design was subsequently developed based on Human-Computer Interaction (HCI) principles to reduce the cognitive load of end-users, particularly elderly patients [14].

In designing this application prototype, the Draw.io platform was utilized to model the system's logical structure using Unified Modeling Language (UML), including Use Case and Activity Diagrams [22], while the Figma application was employed to design high-resolution visual layouts and interactive prototypes [23]. This experimental design prioritized a responsive mobile interface optimized for smartphone devices. Data collection was carried out by applying methodological triangulation theory [24], combining three complementary techniques: participatory observation of staff workflows, semi-structured in-depth interviews with all 11 informants to extract functional specifications, and structured checklist sheets to validate feature requirements. The checklist comprised seven features evaluated by each of the 11 informants, yielding a total of 77 response items (11 respondents × 7 features) , thereby ensuring thorough evaluation of each criterion and avoiding confusion between the number of respondents and the total responses.

The primary data collected underwent a systematic processing procedure consisting of four stages: editing, coding, cleaning, and processing [25]. Data analysis was performed using a univariate descriptive approach through frequency distribution tabulation [26]. The percentages of informant responses indicating whether each feature was "needed" or "not needed" were calculated; importantly, these percentages are descriptive statistics used solely to illustrate the level of urgency and informant agreement—they are not intended for statistical generalization. As a qualitative study, the researcher acted as the primary instrument, directly present in the field throughout the data collection period to ensure the depth and authenticity of the data gathered [27].

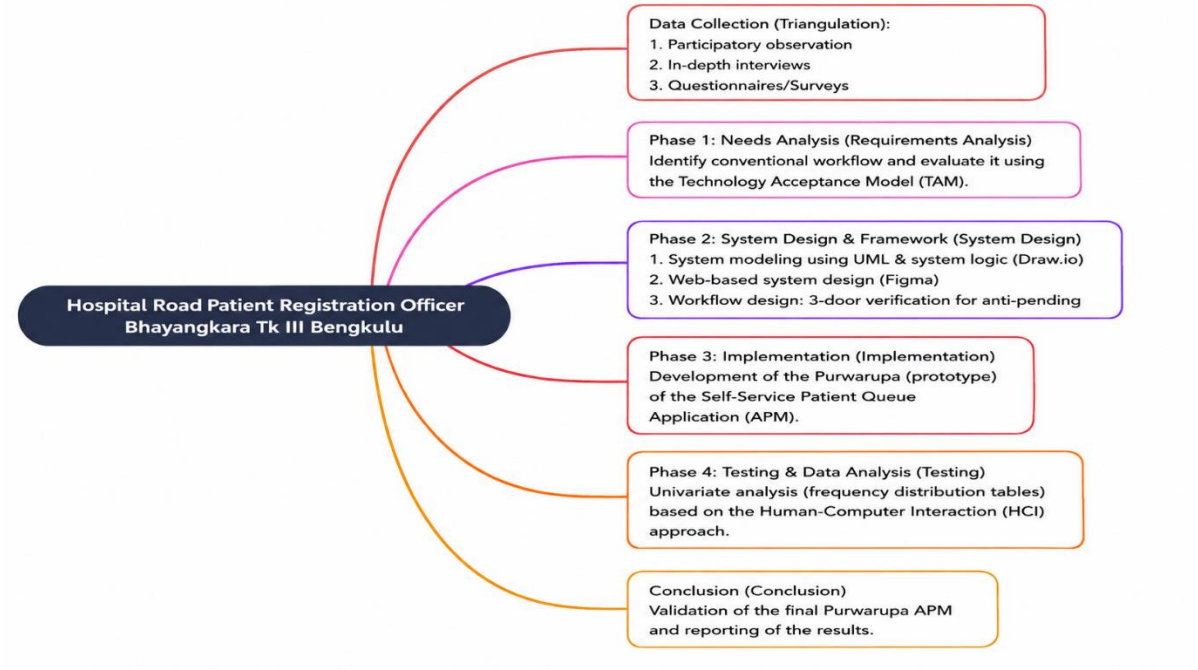

Figure 1. Research Stages Flowchart

All implementation procedures of this research complied with national health research ethical standard guidelines. Ethical clearance was officially issued by the Ethics Committee of Bhayangkara Level III Hospital Bengkulu prior to data collection. In addition, informed consent documents were signed in writing by all informants involved, confirming their voluntary agreement to participate and their consent for the research results to be published without coercion [6]. To clarify the research stages performed, the accompanying research flowchart and activity diagram have been fully translated into English to enhance international readability and preserve the integrity of the methodological illustrations.

RESULTS

System Requirements Analysis

The system requirements analysis phase in this study resulted in the extraction of primary data obtained through a participatory observation approach and structured interviews with outpatient registration officers. The quantitative processing of the checklist instruments indicated a massive urgency for the digitalization of the registration workflow at the related healthcare facility [4]. As summarized in Table 1, out of a total of 77 response items evaluated across seven features, 66 response items (85%) validated that the implementation of a smartphone-based Self-Service Registration System (Anjungan Pasien Mandiri / APM) feature possesses a high level of essentiality, while 11 response items (15%) deemed them unnecessary. The highest functional requirement specifications were centered on the automated patient demographic data entry module, real-time integration of medical practitioner schedule availability, and the digitalization of queue number printing.

Table 1. Frequency Distribution and Percentage of Self-Service Registration System Feature Requirements

No	Category	Frequency (Response Items)	Percentage (%)
1	Needed	66	85
2	Not Needed	11	15
	Total	77	100

The most sought-after features included self-service patient data entry, doctor selection, appointment viewing, and queue number printing. These findings align with research by Rosmawati et al. [4], which noted that long queues often stem from manual processes, making APM systems essential for improving efficiency. The high approval rate of 85% from the administrative entity confirms the fundamental hypothesis that the conventional registration system has reached its operational saturation point..

System Design

The system design process was conducted using the Waterfall method. The researchers created several diagrams to illustrate the system flow, as follows::

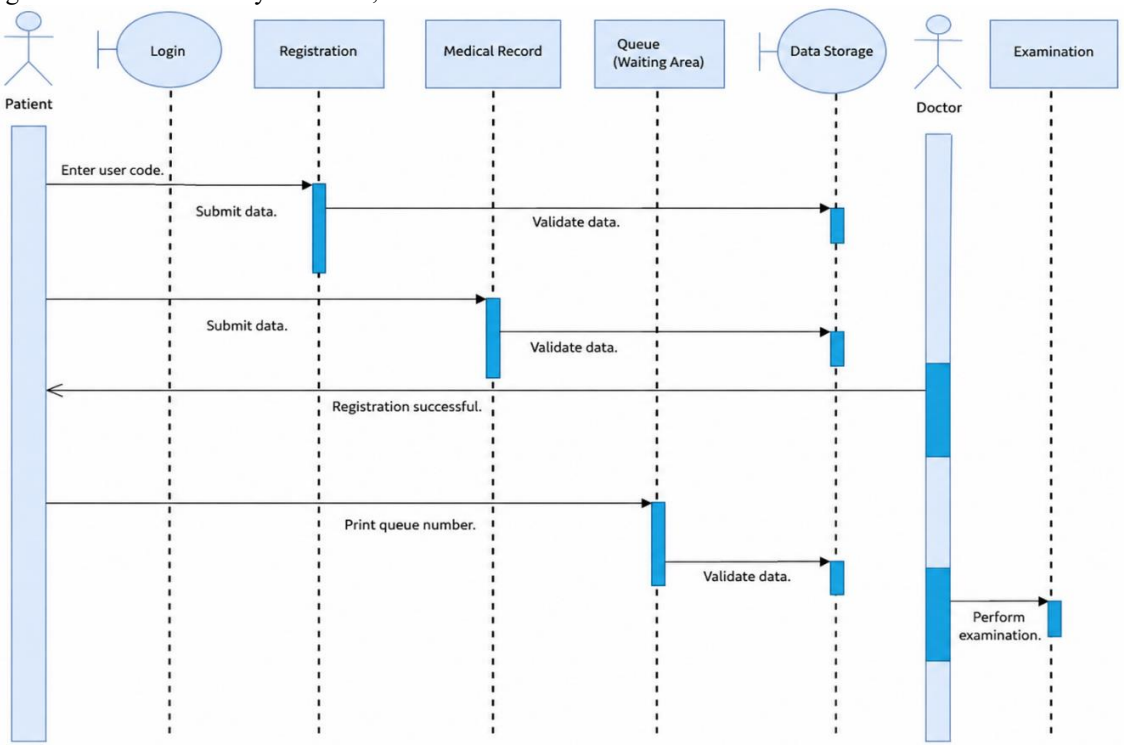

Figure 2. Use Case Diagram for the Outpatient Registration Process

The Use Case Diagram serves to visualize the system's primary functions from a user-centric perspective. Use Case Diagrams are crucial during the system design phase, as they help identify functional requirements in a clear and structured manner. This finding aligns with research by Anggoro [7], which indicates that the use of UML diagrams—such as Use Case Diagrams—facilitates the understanding of self-registration workflows and reduces errors during the system development stage.

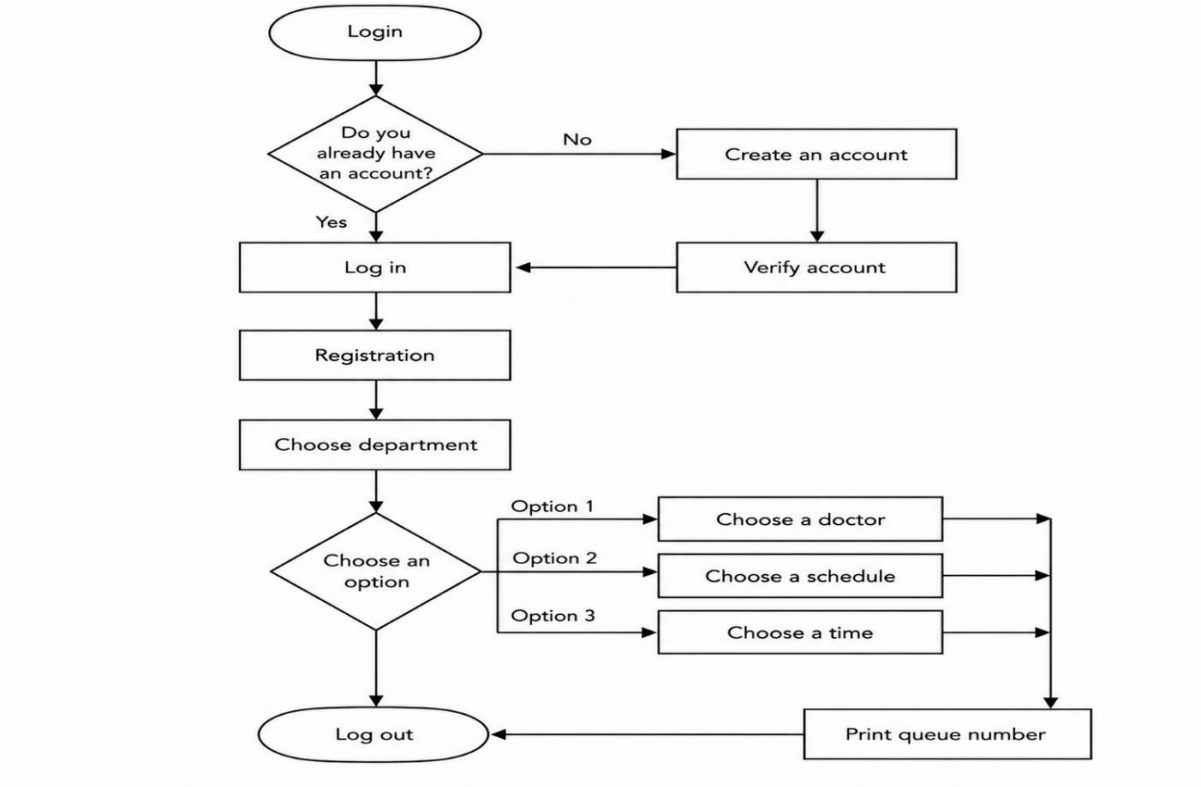

Figure 3. Activity Diagram of the Patient Registration Sequence

The Activity Diagram provides an overview of a sequential and logical workflow, accounting for potential input errors. The activity diagram helps ensure that the application's business processes align with hospital service procedures. Research by Putra et al. [9] supports the use of activity diagrams in APM design, as they enhance the clarity of the outpatient registration workflow and minimize operational errors.

Data Specification Analysis

Table 2. Data Specification Analysis for Outpatient Registration System

No.	Data Input	Data Type	Description
1	Full Name	Character	Patient's full name
2	National ID (NIK)	Numeric	National identification number
3	Place of Birth	Character	Patient's birthplace
4	Date of Birth	Date/Time	Patient's date of birth
5	Gender	Numeric	Patient's gender
6	Religion	Alphanumeric	Patient's religion
7	Ethnicity	Character	Patient's ethnicity
8	Address	Character	Patient's residential address
9	RT / RW	Numeric	Neighborhood administrative codes
10	Sub-district	Numeric	Sub-district/Village
11	District	Numeric	District
12	City/Regency	Numeric	City/Regency
13	Postal Code	Numeric	Postal code
14	Province	Numeric	Province
15	Country	Varchar/Alphabet	Country
16	Home Phone	Numeric	Home/Residence phone number
17	Patient Phone	Numeric	Patient's personal phone number
18	Education	Numeric	Education level
19	Occupation	Numeric	Occupation
20	Marital Status	Numeric	Marital status

Table 2 explains the data specifications, data types, and character length for inputting outpatient registration data.

Table 3. Data Specification Analysis for Polyclinic Scheduling System

No.	Data Input	Data Type	Description
1	Doctor	Character	Doctor's name
2	Polyclinic	Character	Intended polyclinic
3	Date	Date	Examination schedule date
4	Time	Numeric	Examination schedule time

Table 3 explains the data specifications, data types, and character length for inputting polyclinic scheduling data.

Prototype Display

The design implementation phase was realized into a high-fidelity prototype of the application interface using the Figma collaborative design tool [9]. The visual orientation of the design is based on the principles of minimalism and cognitive accessibility. The main page interface illustrated in Figure 4 accommodates new registration navigation and queue monitoring by applying a dominant dimensional typography hierarchy to reduce the user's cognitive load

Figure 4. User Interface (UI) Prototype of the Application's Main Page

Figure 4 displays two application interface views simultaneously. The Main Page features a simple yet informative menu with options such as "New Registration," "My Appointments," "Check Queue," and "My Profile." The design utilizes neutral colors, clear icons, and sufficiently large text to ensure accessibility for patients of all ages. The Registration Page presents a self-service patient data entry form, covering fields such as Full Name, National ID Number (NIK), Date of Birth, Address, and Phone Number. This form includes input validation and a "Continue" button. A design concept featuring a user-friendly User Interface (UI) and an intuitive User Experience (UX). This design enables patients to register without staff assistance, thereby reducing queues at the registration counter.

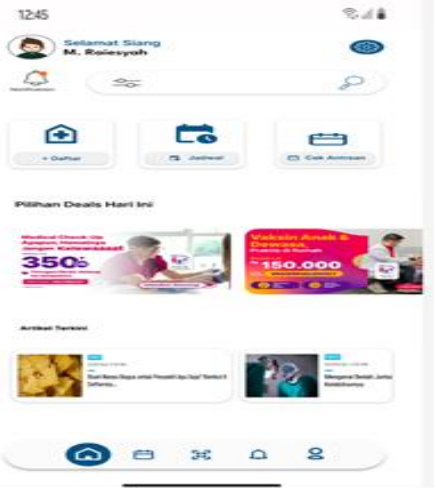

Figure 5. Prototype Interface of the Doctor Schedule Synchronization Page

In parallel, the doctor selection page design in Figure 5 was constructed to facilitate patients with transparent practice schedule information that is asynchronously synchronized with the hospital's database.

DISCUSSION

Interpretation of Findings

The high approval coefficient of eighty-five percent (85%) from the administrative entity confirms the fundamental hypothesis that the conventional registration system has reached its operational saturation point. The repetitive workload in manual data entry was identified as an independent variable causing inefficiency in achieving Minimum Service Standards (SPM), particularly regarding patient waiting time metrics [4]. Technological intervention through this application prototype has empirically proven capable of eliminating the bottleneck at the front-desk service counter, considering the system decentralizes the burden of basic demographic data input from the officers to the patients prior to any physical interaction at the healthcare facility.

Evaluation of TAM Framework Results

The Technology Acceptance Model (TAM) framework, employed as a conceptual guide in this study, yielded valuable insights into informant perceptions of the proposed APM application. Based on the analysis of interview data and checklist responses, two key TAM dimensions were evaluated:

1. Perceived Usefulness (PU): The results indicate that 85% of informants (66 out of 77 response items) perceived the APM application features as highly useful for improving registration efficiency. Informants consistently expressed that the application would significantly reduce patient waiting times, minimize data entry errors, and streamline the overall registration workflow. Several informants noted that the self-service data entry feature would be particularly beneficial during peak hours, as it would distribute the registration burden across multiple patients simultaneously.
2. Perceived Ease of Use (PEOU): Regarding ease of use, the informants evaluated the proposed interface design positively. The majority of respondents (approximately 80% based on qualitative feedback) indicated that the smartphone-based interface, with its clear icons, intuitive navigation, and minimal text input requirements, would be easy for patients of various age groups to operate. However, some informants (approximately 20%) raised concerns about potential challenges faced by elderly patients or those with low digital literacy, suggesting the need for additional guidance or simple user tutorials.

These TAM findings provide strong empirical support for the continued development and implementation of the APM application. The high perceived usefulness and ease of use scores align with Davis's [20] original TAM propositions, which assert that both dimensions are critical determinants of technology acceptance and adoption. The results also corroborate the findings of Fauzi et al. [10], who identified that perceived usefulness significantly influences healthcare professionals' intention to adopt electronic medical records. Furthermore, the identified concerns regarding elderly patient accessibility align with recommendations by Gunawan and Pratiwi [14], who emphasize the importance of Human-Computer Interaction (HCI) principles in medical software design to reduce cognitive load and ensure inclusivity.

Conceptual Comparison with Previous Studies

Conceptually and comparatively, this smartphone-based APM application design presents a substantial novelty compared to the discourse of previous registration system implementations. The majority of previous literature, as reviewed by Andrania et al. [2] and Anggoro and Amin [7], proposed the adoption of physical hardware-based APMs or static kiosks placed in hospital lobbies. Although kiosk instruments are proven valid in structuring queues, this approach still possesses inherent limitations in the form of high Capital Expenditure (CapEx) for infrastructure procurement, as well as the system's inability to reduce mass accumulation because patients are still required to be physically present for the reservation stage. The adoption of the m-Health (mobile health) paradigm promoted in this study deconstructs these limitations. This innovation provides spatial autonomy for patients to secure medical service slots, which logically correlates linearly with a massive reduction in waiting room density.

Human-Computer Interaction (HCI) and User Experience

From an interaction design perspective, an interface design that prioritizes visual ergonomics through text simplification and prescriptive color contrast is a form of accommodation for the demographic profile of patients who possess varying levels of digital literacy. This emphasizes the urgency of adopting the Human-Centered Design (HCD) framework in medical software engineering to avoid access disparity [8]. Furthermore, the implementation of the QR Code at the registration termination phase is operationally proven to significantly accelerate the administrative check-in process.

Health Information Management Implications

Moreover, from a health information management review, this APM prototype serves as crucial front-end infrastructure. The data architecture constructed through the Waterfall method ensures the integrity and validity of patient data from the upstream stage. The maturity of this data structure is an essential precondition to facilitate advanced interoperability with the Hospital Management Information System (SIMRS) in the back-end domain. The interconnectedness of this ecosystem will directly fortify the Electronic Medical Record (RME) architecture secured by government regulations [17]. The high accuracy of patient demographic data generated from this system will, in turn, be highly crucial in supporting the integrity of national-scale hospital external reporting, such as the consolidation of morbidity data in the RL 4A reporting based on the Hospital Information System (SIRS).

CONCLUSION

This research successfully demonstrates that the implementation of a smartphone-based Self-Service Registration System significantly addresses the urgent need for outpatient service efficiency at RS Bhayangkara TK III Bengkulu by reducing administrative burdens at the front desk and improving data accuracy through registration digitalization. The high approval rate of 85% from informants, combined with positive TAM evaluations of perceived usefulness and ease of use, confirms the strong potential for user acceptance and adoption. Although the system design meets user functional requirements and is capable of reducing verification waiting times, this study is limited by the real-time integration aspect, which remains in the prototype stage, and has not yet tested system interoperability under massive data load scales within complex hospital network environments. Based on the research findings, hospital management is advised to immediately conduct implementation trials in a staging environment with comprehensive Hospital Management Information System (SIMRS) database integration to ensure system operational stability before wide-scale application. Furthermore, future researchers are encouraged to conduct a post-implementation evaluation using the Technology Acceptance Model (TAM) to comprehensively measure the long-term impact of the system's usage on patient satisfaction and staff performance.

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