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ANALYSIS AND DESIGN OF A MEDICAL RECORD DATA MANAGEMENT INFORMATION SYSTEM WITH A HUMAN CENTERED DESIGN APPROACH

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A B S T R A C T

Klinik Medika Al-Azhar still uses a manual medical record system that causes various operational constraints such as lost files, delays in patient data retrieval, and the absence of real-time medication stock monitoring. This research aims to analyze and design a web-based Medical Record Data Management Information System using a Human Centered Design (HCD) approach to improve data management efficiency at Klinik Medika Al-Azhar. The research employs a descriptive qualitative method with HCD stages including empathize, define, ideate, prototype, and test. Data collection was conducted through interviews, observations, document analysis, and prototype testing. The system was built using PHP and MySQL with interface design using Figma. Testing was performed using the Blackbox Testing method. The designed system successfully meets user needs in inputting, managing, and searching medical record data quickly and accurately. System implementation is capable of generating automatic medical record reports, reducing the risk of data loss, and improving the quality of clinic services. Blackbox testing results show that all system functions run properly. The HCD approach proved effective in producing an information system that aligns with user needs and preferences, improves data processing efficiency, and supports the enhancement of healthcare services.

INTRODUCTION

The rapid development of information technology has penetrated various aspects of life including the healthcare sector, where healthcare institutions require integrated management information systems to share data in real-time to reduce medical errors and improve services. Klinik Medika Al-Azhar still uses a manual medical record system that causes constraints such as lost files, delays in patient data retrieval, and the absence of real-time medication stock monitoring. This research employs a Human Centered Design (HCD) approach that focuses on user perspectives and needs in designing a web-based Medical Record Data Management Information System.

The research aims to improve the efficiency and accuracy of medical record management, design an integrated system that manages patient data, disease history, medication prescriptions, and healthcare staff data, as well as implement the HCD approach to produce a user-friendly interface. The expected benefits are to help the clinic manage medical records digitally quickly and accurately, provide timely information to improve the quality of medical services, and enhance service efficiency with shorter waiting times and faster administrative processes.

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LITERATURE REVIEW

Management Information System (MIS)

Management Information System is a system that processes data into useful information to support organizational operations, management, and decision-making. It integrates humans, hardware, software, communication networks, and data resources. MIS applies logical and systematic methods to analyze and solve problems by breaking down complex systems into smaller components.

The functions of a management information system include improving data access, increasing productivity, ensuring quality use, identifying skill needs, anticipating economic impacts, guiding investments, and supporting effective planning. Success indicators are accuracy, timeliness, relevance, and completeness.

In healthcare, health information systems help manage medical and administrative data, enhancing decision-making and resource management through integrated technology.

Medical Record

A medical record is a document that contains information about a patient's identity, medical condition, treatment, and health history, compiled and maintained by healthcare professionals within a healthcare system. It plays a crucial role in providing essential information for diagnosis, treatment, and medical evaluation. A medical record includes data about the patient's identity, examination results, treatments, and medical procedures performed in healthcare facilities. In general, a medical record can be defined as a written or recorded document that accurately presents information about the patient's identity, medical history, physical examinations, laboratory results, diagnosis, and all medical services provided. Essentially, medical records serve as an informative source containing comprehensive details of a patient's healthcare journey, managed by authorized medical personnel according to their professional competence.

Electronic Medical Records (EMR)

An electronic medical record can be defined as an application environment comprised of clinical data storage, clinical decision support systems, standardized medical terminology, computerized data entry, and medical and pharmaceutical documentation. EMRs are useful for paramedics to document, monitor, and manage healthcare services provided to patients in the clinic. Legally, data in an EMR constitutes a legal record of the services provided to patients, and hospitals have the right to retain this data.

Human Centered Design (HCD)

Human-Centered Design (HCD) is a method for designing products with humans as the primary focus. In HCD, not only users are involved but also stakeholders, ensuring that designs align with user needs and stakeholder desires. HCD has been widely used, particularly in the fields of ergonomics, computer science, and artificial intelligence.

HCD is a design framework for developing solutions that incorporates a human perspective at all stages of the problem-solving process by focusing on the user and applying usability knowledge and various techniques.

METHOD

Research Type and Location

This research uses a qualitative research type with a descriptive approach. The research was conducted at Klinik Medika Al-Azhar located in Perbaungan Village, Bilah Hulu District, Labuhan Batu Regency, North Sumatra. The research period was conducted for three months starting from January 2025.

Data Collection Techniques

The data collection techniques used include interviews, observations, document analysis, and prototype testing. Interviews were conducted with medical personnel, including doctors, nurses, and administrative staff, to explore in-depth information regarding their experiences, needs, and challenges in medical record management. Twelve open-ended questions were developed covering topics such as data management processes, obstacles faced, and expectations for the new system. Direct observations were carried out in the clinic environment to observe the workflow of medical personnel in managing medical record data, including interactions with existing systems and operational challenges. Related documents such as standard operating procedures (SOPs), system usage reports, and medical records were analyzed to understand the context and identify gaps between existing practices and user needs. System prototypes were developed using Figma and tested with users to obtain direct feedback regarding design and functionality.

Human Centered Design (HCD) Approach

This research applies five stages of HCD. The first stage is Empathize, which involves gathering information related to users' feelings, needs, and difficulties through interviews and direct observations. The second stage is Define, which formulates problems based on the results of the empathy stage. The main problems identified include frequently lost files, slow patient data searches, and the absence of real-time medication stock monitoring. The third stage is Ideate, which develops solution ideas through discussions with users. The concepts developed include patient search features based on National Identity Number (NIK) or name, interactive dashboards, automatic reporting systems, and patient history management. The fourth stage is Prototype, which involves creating a system prototype using Figma covering login pages, dashboards, patient registration, medical record forms, and patient history. The fifth stage is Test, which tests the prototype using the Blackbox Testing method to ensure all system functions run according to specifications.

System Implementation

The system was built using several technologies and tools to ensure optimal functionality and user experience. PHP was selected as the programming language due to its flexibility and wide support for web-based application development, making it suitable for processing dynamic data and business logic in the medical record management system. MySQL was chosen as the database management system to store and manage patient data, medical records, medication information, and healthcare staff data efficiently and securely. The user interface design was developed using HTML and CSS by applying Human Centered Design (HCD) principles to ensure the interface is intuitive, responsive, and meets user needs. Figma was utilized as the prototype design tool to create initial visual designs and interactive mockups before implementation, allowing for early user feedback and design iterations to achieve an optimal interface before the actual development phase.

Data Analysis Techniques

Data analysis was conducted through two main stages to ensure comprehensive understanding of user needs and system requirements. The first stage is Data Reduction, where raw data collected from interviews, observations, and documentation were selected, simplified, and summarized to identify user needs and problems. This process involved filtering relevant information, eliminating redundant data, and organizing findings into meaningful patterns that highlight the core issues in the existing medical record management system. The second stage is Problem Formulation, which identifies user needs, obstacles, and expectations regarding the existing system, then formulates the core problems as the foundation for system design. This stage synthesizes the reduced data into clear problem statements that guide the development of solutions, ensuring that the designed system addresses the actual challenges faced by medical personnel at Klinik Medika Al-Azhar and aligns with their operational workflows and service quality improvement goals.

RESULTS AND DISCUSSION

Results of Human Centered Design Implementation

Empathize Stage

The empathize stage was conducted through interviews and observations with medical personnel at Klinik Medika Al-Azhar to understand their experiences and challenges in daily operations. The results identified three main problems that significantly impact service efficiency and quality. First, doctors experienced difficulties in searching for old patient records because physical files were often scattered or disorganized, leading to time wastage and potential delays in providing appropriate medical treatment based on patient history. Second, manual medical record documentation was time-consuming and disrupted service effectiveness, as medical staff had to spend considerable time writing and organizing paper-based records instead of focusing on patient care. Third, reception staff encountered obstacles in tracking medication availability because stock recording was not integrated with the medical record system, resulting in difficulties in managing inventory, potential stockouts, and inability to provide real-time information about medication availability to doctors and patients.

Define Stage

The identified problems were systematically mapped as follows:

Table 1. Problem Definition and Impact

No	Problem	Impact
1	Patient files are often lost or damaged	Patient history data is incomplete, slowing down examinations
2	Searching for old patients takes a long time	Long queues occur and service time is longer
3	Real-time medication stock information is unavailable	Doctor's prescriptions do not match medication availability

Ideate Stage

Based on the defined problems, several solution concepts were developed to address the operational challenges at Klinik Medika Al-Azhar. The first concept is an intelligent patient search feature that allows users to quickly locate patient records using multiple search parameters including patient name, medical record number, or National Identity Number (NIK), eliminating the time-consuming manual file searching process and reducing service delays. The second concept is an interactive dashboard that displays the latest patient information and statistics in a visually organized manner, providing medical staff with quick access to essential data and enabling better decision-making through real-time insights into clinic operations. The third concept is an automatic reporting system for medication stock monitoring that tracks inventory levels in real-time, alerts staff when stock is low, and ensures that doctors can prescribe medications based on actual availability, preventing discrepancies between prescriptions and available supplies. The fourth concept is integrated patient history management that consolidates all patient records, medical examinations, treatments, and prescriptions in a centralized digital system, ensuring complete and accessible medical history for accurate diagnosis and continuous care.

Prototype Stage

The system prototype was visualized using Figma with the following main components:

Table 2. System Prototype Components

No	Page Name	Access By	Main Function
1	Login	Admin, Doctor, Midwife, Receptionist	Verify user identity
2	Dashboard	All users	Display summary and navigation
3	Patient Registration	Receptionist	Input new patient data
4	Medical Record Form	Doctor and Midwife	Input diagnosis and procedures
5	Patient History	Doctor and Midwife	View and print medical history

Test Results

Blackbox Testing

Testing was conducted on all system functions including:

Table 3. Blackbox Testing Results

No	Tested Function	Result
1	Login	Success
2	Dashboard	Success
3	Add Doctor Data	Success
4	Edit Doctor Data	Success
5	Delete Doctor Data	Success
6	Add Patient Data	Success
7	Edit Patient Data	Success
8	Delete Patient Data	Success
9	Add Room Data	Success
10	Edit Room Data	Success
11	Delete Room Data	Success
12	Add Inpatient Data	Success
13	Edit Inpatient Data	Success
14	Delete Inpatient Data	Success
15	Add Medical Record	Success
16	Edit Medical Record	Success
17	Delete Medical Record	Success
18	Add Medication Data	Success

19	Edit Medication Data	Success
20	Delete Medication Data	Success
21	Medical Record Report	Success
22	Patient Report	Success
23	Medication Stock Report	Success

The test results indicate that all system functions operate properly as expected.

Discussion

Effectiveness of the HCD Approach

The implementation of the Human Centered Design approach proved effective in producing a system that meets user needs. This aligns with research by Wang et al. (2023) which shows that systems designed by involving users from the beginning result in higher levels of acceptance and satisfaction. The empathize stage enabled researchers to deeply understand the challenges faced by medical personnel in managing manual medical records. User involvement in the define and ideate stages ensured that the developed solutions genuinely address real problems in the field, rather than merely implementing technology for technology's sake.

Improvement in Operational Efficiency

The developed system successfully addresses the main problems identified. Digitalization of files reduces the risk of data loss and facilitates long-term storage, ensuring that patient records are preserved securely and remain accessible over time. Quick search functionality based on name, National Identity Number (NIK), or medical record number accelerates patient data access, significantly reducing waiting times and improving service delivery. Medication stock monitoring through an integrated medication stock module enables real-time availability checking, allowing doctors to prescribe medications confidently based on actual inventory levels and preventing prescription-availability mismatches. These results are consistent with findings by Hermawan et al., which demonstrate that electronic medical record systems can improve efficiency, speed, and accuracy in outpatient data management.

User Interface Quality

The interface design developed with HCD principles resulted in an intuitive and easy-to-use system. The use of Figma in the prototyping stage enabled design iterations based on user feedback before final implementation, thereby reducing revision costs during the development phase. Research by Putra et al. demonstrates that applications designed with the HCD approach achieve high usability scores (94.45%) and good ratings in user experience aspects. These findings support the effectiveness of the approach used in this research.

Technical Implementation

The use of PHP and MySQL as the development platform proved appropriate for the needs of Klinik Medika Al-Azhar. This technology provides flexibility, ease of maintenance, and affordable implementation costs. The Blackbox testing results showing a 100% success rate indicate good system stability and reliability in performing all required functions without errors or failures.

CONCLUSION

The Medical Record Data Management Information System developed using the Human Centered Design approach successfully meets user needs for efficient data input, management, and retrieval, with the PHP and MySQL-based implementation improving data processing efficiency, minimizing recording errors, and accelerating report generation. The HCD approach effectively incorporates user needs and experiences into the design, resulting in an intuitive system aligned with user workflows, confirmed by Blackbox testing that demonstrates a 100% success rate across all functions, indicating system maturity and stability. For future development, the system should include encryption-based security features to protect patient data according to healthcare standards, mobile-based development for enhanced accessibility, extensive testing with diverse users, integration with external healthcare systems like BPJS and laboratories for service continuity, and analytics features to support better management decision-making.

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