Development of an Electronic Medical Record System for Health Therapy Services using the Rapid Application Development Methodology

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***Abstract*— Rumah Kebugaran Difabel (RKD) Pinilih Sejahtera is a healthcare institution that provides therapy services for persons with disabilities, such as physiotherapy and kinesiotherapy. Currently, medical records are manually recorded on paper, causing frequent data loss, unstructured information, and difficulty in monitoring patient progress. Each patient has unique characteristics, which requires an individualized long-term therapy approach supported by complete and structured data. To address this issue, this study aims to develop a web-based Electronic Medical Record (EMR) system to support the specific needs of therapy services for persons with disabilities. The system was developed using the Rapid Application Development (RAD) method, involving data collection through interviews, observations, and document analysis, followed by requirements planning, three iterations of design workshop with users, and implementation that included training and system testing. Functional testing used the black box testing method, applying 266 test scenarios across three user roles: admin, management, and therapist. All scenarios were successfully passed, confirming the system met its functional specifications. Usability testing involved seven users and assessed task completion time, success rate, error rate, and efficiency. The results showed that users completed tasks faster than expected, with time on task rate of 0.65 (admin), 0.69 (management), and 0.59 (therapists). Effectiveness was high, with 100% success rate for admin and therapists, and 94.44% for management. Error rates were minimal, and efficiency levels reached 100% for admin and therapists, and 93.58% for management. In conclusion, the EMR system proved to be well-functioning, effective, efficient, and easy to use.**

Keywords*— *Electronic Medical Record, Disabilities, Rapid Application Development, Black Box Testing, Usability Testing

I. INTRODUCTION

The advancement of information technology has significantly transformed various sectors, including healthcare. In particular, the implementation of Electronic Medical Record (EMR) systems supports the digital management of patient data, improving efficiency and service continuity. For individuals with disabilities, EMR is essential for long-term care, enabling accurate medical history tracking, and personalized treatment planning.

RKD Pinilih is a health institution dedicated to supporting people with disabilities by providing health therapy services such as physiotherapy and kinesiotherapy. However, the current manual recording system has led to several issues, including potential data loss, lack of data consistency, and difficulty in tracking patient progress. These limitations adversely impact the effectiveness of monitoring patient progress and the efficiency of healthcare operations.

Healthcare providers are required to implement EMR systems as part of their service procedure [1]. In addition, healthcare institutions are mandated to ensure accessible, high-quality, and personalized services for individuals with disabilities [2] EMR systems are defined as digital platforms that supports the systematic organization of patient data for clinical and administrative purposes. In this context, the development of an EMR system is not only a strategic necessity but also a legal obligation.

To overcome these problems, a web-based EMR system was developed using the RAD method. RAD enables rapid system development through iterative design stages and actively involves users in providing feedback. The system was designed for admins, managers, and therapists as users. The main purpose of this system is to facilitate the management of patient data, document the history of treatment results, and the preparation of patient reports and service operations. The implementation of this EMR system is expected to improve quality of service at RKD Pinilih.

II. LITERATURE REVIEW

A. Rapid Application Development

The Rapid Application Development (RAD) method is effective in various studies for EMR system development while staying user-focused. Amin et al. used RAD to build a web-based EMR at Wijaya Kusuma Hospital, Lumajang, which passed black box testing and User Acceptance Testing but needed stronger data security due to static authentication [3]. Similarly, Jayanti et al. implemented RAD in a Medical Rehabilitation Clinic, achieved a 100% success rate in black box testing, though further work was needed on rehabilitation modules and administrative integration[4] Both studies highlight RAD's strengths in time efficiency and feature flexibility. As an object-oriented approach, RAD supports fast development and adapts well to changing requirements. RAD consists of three main phases [5].

1) Requirements Planning

In this phase, system requirements are identified through data collection analysis. Functional and non-functional requirements are prioritized based on user needs. The output is a system requirements specification document.

2) Design Workshop

This stage focuses on designing the user interface (UI/UX), database structure, and system architecture. Prototypes are developed and refined iteratively based on user feedback until they meet expectations.

3) Implementation

The final system is deployed in the operational environment. Users receive training, and final testing is conducted to ensure functionality and usability before full implementation.

B. Black Box Testing

Black box testing is a testing method that focuses on software functionality without requiring knowledge of the internal code structure [6]. This test ensures that the system works according to the specified specifications. The black box testing method has various advantages, such as focusing on user experience, the ability to detect errors at an early stage, and is effective for validating system requirements.

Black box testing is a testing method by providing input and evaluating the resulting output. This test aims to ensure that the system can be used by users without problems. Black box testing can be conducted without understanding the technical details of the system, making it suitable for independent testers to ensure unbiased and objective results [7]. The goal is to confirm the system works as intended and is user-friendly.

C. Usability Testing

Usability testing involves observing end-users as they complete tasks to evaluate whether a system is usable or needs improvement. Usability testing aims to assess four main aspects: task success, time on task, errors, and efficiency [8]. Task success as the user's ability to complete a task, time on task as the time taken to complete it, errors as the number of mistakes, and efficiency reflects how well users manage their time in completing tasks [9]. Task success measured using a success rate, assigning scores as follows: 1 for success, 0.5 for partial success (with help), and 0 for failure (exceeds time or incorrect) [10]. The time threshold is twice the developer's time and users are given up to 5 minutes before moving to the next task [9]. A minimum success rate of 78% indicates a very effective system [11]. It is calculated using Formula 1:

$$Success\ rate = \frac{success + (partial\ success\ x\ 0.5)}{total\ task\ x\ total\ respondent}\ x\ 100\% \quad (1)$$

Time on task is measured by comparing users' average task times with the benchmark time. The acceptable time on task rate is up to 1.5 [12]. It is calculated using Formula 2:

$$Time\ on\ task\ rate = \frac{\sum time\ on\ task\ mean}{\sum benchmark\ time} \quad (2)$$

Error rate is calculated from the number of mistakes such as misclicks, incorrect inputs, improper sequences, or unresponsive features. An average error rate below 0.7 is considered good [11]. It is calculated using Formula 3:

$$Error\ rate = \frac{total\ error}{total\ task\ x\ total\ respondent} \quad (3)$$

Efficiency measures the proportion of time used on successful task completion. A score above 80% indicates a highly efficient system [13]. Efficiency is calculated using Formula 4:

$$Efficiency = \frac{\sum success\ task\ time}{\sum total\ task\ time}\ x\ 100\% \quad (4)$$

III. METHODOLOGY

This study used a RAD methodology to ensure both user-centered and rapid system development. RAD supported fast prototyping and iterative refinement based on user feedback. The stages are as in Fig.1.

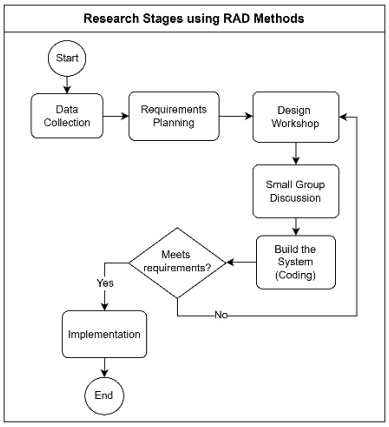

Fig. 1. Research stages using the RAD methods

A. Data Collection

The first phase of the study aimed to build an in-depth understanding of user needs and challenges in the healthcare environment at RKD Pinilih. To gather this information, data collection was conducted through interviews with RKD stakeholders on August 15, 2024, direct observations of the manual recording workflow on August 24, 2024, and document studies, including RKD manual forms and relevant journal articles. Through interviews, observations, and document reviews, the researcher gained initial insights into user workflows, documentation practices, and operational challenges at RKD. This step ensured that system development would be aligned with real-world conditions and user expectations.

Data obtained during the data collection stage were analyzed to formulate the main problem statement that the system development aimed to solve. The analysis revealed several key issues such as the continued use of manual patient medical records, with minimal digital infrastructure to support digitization. Therapy outcomes were often communicated verbally without written documentation, making it difficult to monitor patients over time. Data from partner institutions were not consistently stored at RKD, resulting in fragmented patient information. Furthermore, limited human resources and frequent personnel turnover led to inconsistent and non-standardized documentation. The large number of patients with diverse disabilities required a structured historical recording system to support long-term medical care.

B. Requirements Planning

Based on the problem statement, the next step was to identify and plan the system's requirements, both functional and non-functional.

1) Functional requirements

The EMR system must support user authentication for different roles (management, admin, therapist) with access levels. It should enable CRUD operations for master data (patients, staff, users, disability), allow treatment programs recording (scheduling and results), store detailed patient medical record, and present reports on patient demographics and program statistics for management evaluation.

2) Non-functional requirements

The system requires modern computers (Mac/Windows), a browser like Chrome, and at least 8 GB RAM. Software tools used include Windows 11, Visual Studio Code, Google Chrome, Figma, and XAMPP to support system development.

C. Design Workshop

Once the requirements were established, the system design progressed through three iterations of design workshops. In this phase, database design were also carried out, including the use case diagram, flowchart, and Crow's Foot diagram to structure data relationships and system processes. Fig 2. shows the Crow's Foot Diagram of only PK-FK as the database design.

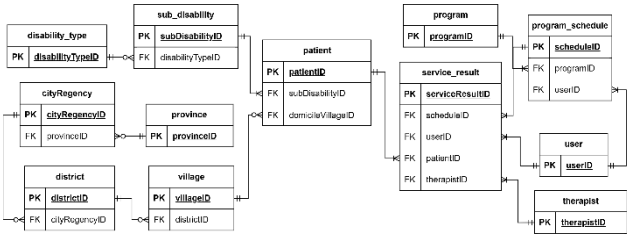

Fig. 2. Crow's Foot Diagram for EMR System (PK-FK)

The first iteration was conducted on November 1, 2024. During the first iteration, a Figma-based prototype was presented to prospective users. Their feedback focused on interface clarity, such as button placement, workflow, and navigation, and suggested enhancements like adding master data for disability types, expanding data attributes, and implementing the SOAP standard (Subjective, Objective, Assessment, Plan) for documenting service program results and medical records. Users also requested more interactive report graphs to enable deeper analysis.

In the second iteration on March 21, 2025, a functional coded system was presented, incorporating revisions based on initial feedback. Improvements included updating the system logo, adding more detailed data attributes, and enhancing the clarity of interactive report graphics. A print feature for the graphs was also added to support reporting needs.

The third iteration is the final improvement stage of the system, carried out based on user feedback from the previous iteration. Improvements include adding a filter based on sub-district (*kelurahan*) in the medical records menu to make it easier to search and record patient data by area of residence, especially in the Sedayu region. In addition, a pie chart visualization was added to show the distribution of patients by sub-district. These iterative cycles of design and refinement ensured that the system evolved in alignment with real-world user expectations and workflows.

D. Implementation

The final stage involved system training, testing, and deployment. On May 1, 2025, training sessions were held for RKD personnel to familiarize them with the system and ensure effective usage. After that, two types of testing followed were conducted. Black box testing was performed to ensure all functions met the specifications and usability testing to assess time on task, task success, error, and efficiency for admin, management, and therapist. Task scenarios designed to reflect the common activities performed by each role are presented in Table I, Table II, and Table III below.

TABLE I. TASK SCENARIO USABILITY TESTING ADMIN

Code	Task Description
TA01	Insert a new patient record into the system.
TA02	Edit information of an existing medical, paramedical, or non-medical personnel.
TA03	Delete a user record from the system.
TA04	Insert a new disability type or subtype to the system.
TA05	Insert a new schedule for kinesiotherapy service.
TA06	Record the result of a physiotherapy service.
TA07	Edit a previously recorded physiotherapy result.
TA08	Print the list of patients using a specific filter.
TA09	Print the detailed medical history of a specific patient.
TA10	Print a report categorized by patient disability subtypes.

TABLE II. TASK SCENARIO USABILITY TESTING MANAGEMENT

Code	Task Description
TM01	View data of a registered patient in the system.
TM02	View information related to a physiotherapy schedule and result.
TM03	View information related to a kinesiotherapy schedule and result.
TM04	Print the list of patients using a specific filter.
TM05	Print the detailed therapy history of a specific patient.
TM06	Print a graphical report based on the total number of service programs filtered by month or year.

TABLE III. TASK SCENARIO USABILITY TESTING THERAPIST

Code	Task Description
TT01	Insert a new physiotherapy service schedule.
TT02	Edit a previously recorded physiotherapy schedule.
TT03	Delete a kinesiotherapy schedule from the system.
TT04	Insert a result of a kinesiotherapy session.
TT05	Edit a previously recorded kinesiotherapy result.

IV. RESULTS AND DISCUSSION

A. System Implementation

The system is built using PHP, Javascript, HTML, and CSS, and MySQL for the database. Fig. 3 shows the input form for results of medical services. This pop up is used to record the outcomes of services, with physiotherapy as an example. The input form adopts the SOAP standard. Subjective contains the patient's complaints, Objective includes findings from medical or non-medical personnel, Assessment outlines the diagnosis, and Plan details the next steps and treatment recommendations. This structured documentation format ensures that patient progress is recorded consistently.

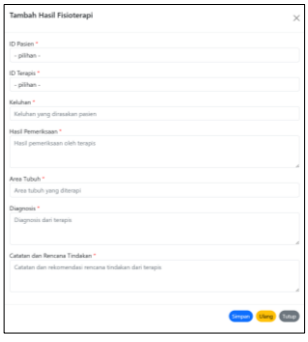

Fig. 3. Input form for results of medical services

Fig. 4 shows medical record page. This page displays a list of all registered patients, which can be filtered using several criteria such as age group, blood type, gender, type of disability, and village (*kelurahan*). The system provides

export features to generate reports in PDF or Excel format, facilitating data sharing and reporting. Fig. 5 shows medical record details page. This page shows the patient's medical history in detail, including the results of various service programs or medical treatments they have received. It provides a complete overview of the patient's clinical journey.

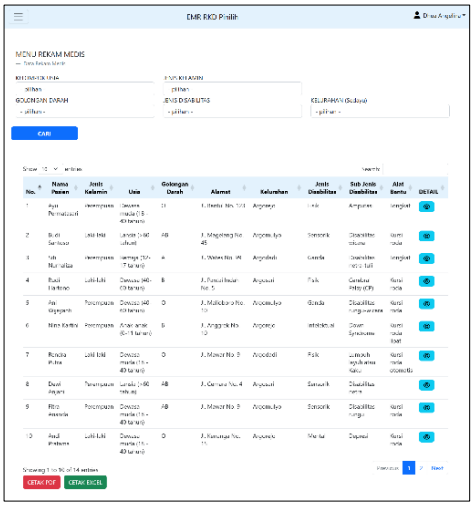

Fig. 4. Medical record page

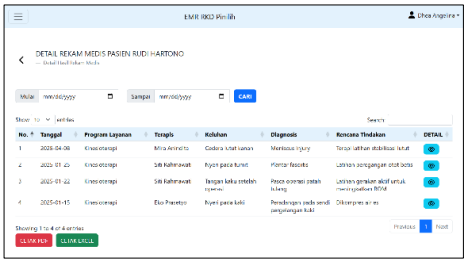

Fig. 5. Medical record details page

B. Black Box Testing Result

Black box testing was conducted on April 30, 2025, by an Informatics Engineering student from Duta Wacana Christian University (DWCU) as an independent tester. Without prior knowledge of the internal structure of the system, the tester objectively evaluated 14 groups of scenarios for Admin, Management, and Therapists. All 266 scenarios were passed successfully, indicating that the system is functioning properly. The black box testing results are shown in Table IV.

TABLE IV. BLACK BOX TESTING RESULT

Test Scenario	Total Scenario			Status
	Admin	*Management*	*Therapist*	
Login & Logout	5	5	5	Success
Forgot Password	6	6	6	Success
Home & Profile Settings	5	5	5	Success
Patient Master Data	8	2	-	Success
Healthcare Personnel Master Data	8	2	-	Success
User Master Data	8	2	-	Success
Disability Master Data	8	2	-	Success
Physiotherapy	16	4	16	Success
Kinesiotherapy	16	4	16	Success
Medical Record	18	18	16	Success
Medical Record Details	8	8	6	Success
Reports	16	16	-	Success
Total Scenario	**122**	**74**	**70**	

C. Usability Testing Result

Usability testing was conducted on May 1, 2025, involving end users from RKD Pinilih as part of the system's final evaluation. A total of 7 respondents participated, representing three user roles with 2 admins, 3 management staff, and 2 therapists. Respondent profiles are presented in Table V.

TABLE V.RESPONDENT PROFILES

Name	Role	Age	Job
Esty Try	Admin	42	Entrepeneur
Hestu Nugraheni	Admin	44	Entrepeneur
Tri Suhartini	Management	46	Entrepeneur
Noor Asrida	Management	60	Retiree
F. Ayu Laras	Management	25	Student
Dayu	Therapist	57	Housewife
Yuliyanti	Therapist	48	Housewife

1) Admin Respondents

Two respondents, Mrs. Esty Try and Mrs. Hestu Nugraheni, participated in usability testing for the admin role.

a) Time on Task

Table VI shows task on time result for admin respondents. The average task completion time was 68.4 seconds, while the benchmark average across all tasks was 106 seconds. A time on task rate of 0.65 indicates that tasks were completed more quickly than the benchmark standard.

$$Time\ on\ task\ rate = \frac{68.4}{106} = 0.65$$

b) Task Success

Table VII shows that both admin respondents completed all tasks successfully, resulting in a 100% success rate and indicating high system effectiveness.

$$Success\ rate = \frac{20+0}{10\ x\ 2} x\ 100\% = 100\%$$

c) Errors

No errors occurred during task execution by either respondent. An error rate of 0 indicates the system is highly understandable and easy to operate for admin users.

d) Efficiency

The total time spent complete all tasks was 1,368 seconds, with all tasks completed successfully. The 100% score indicates that the system supports a highly efficient workflow.

$$Efficiency = \frac{1368}{1368}\ x\ 100\% = 100\%$$

TABLE VI. TIME ON TASK BY ADMIN

Task	R1	R2	Time on Task (second)	Developer Time (second)	Benchmark Time (second)
TA01	295	265	280	230	460
TA02	45	40	42,5	30	60
TA03	15	15	15	12	24
TA04	30	30	30	15	30
TA05	60	55	57,5	53	106
TA06	115	125	120	100	200
TA07	65	55	60	35	70
TA08	28	35	31,5	25	50
TA09	20	15	17,5	15	30
TA10	30	30	30	15	30
Average			**68,4**	**53**	**106**

TABLE VII. TASK SUCCESS BY ADMIN

Task	R1	R2	Success Score	Partial Score	Effectiveness (%)
TA01	1	1	2	0	100%
TA02	1	1	2	0	100%
TA03	1	1	2	0	100%
TA04	1	1	2	0	100%
TA05	1	1	2	0	100%
TA06	1	1	2	0	100%
TA07	1	1	2	0	100%
TA08	1	1	2	0	100%
TA09	1	1	2	0	100%
TA10	1	1	2	0	100%
Total			**20**	**0**	**100%**

2) Management Respondents

Three respondents, Mrs. Maria Tri Suhartini, Mrs. Noor Asrida, and Ms. F. Ayu Laras, participated in the usability testing for the management role.

a) Time on Task

The average task completion time was 26.05 seconds, while the benchmark average was 38 seconds. The longest task was TM05 (printing patient medical record details), with an average of 33.33 seconds. A time on task rate of 0.69 indicates that users complete tasks faster than the benchmark, which means that the system is easy to use.

$$Time\ on\ task\ rate = \frac{26.05}{38} = 0.69$$

TABLE VIII. TIME ON TASK BY MANAGEMENT

Task	R1	R2	R3	Time on Task (second)	Developer Time (second)	Benchmark Time (second)
TM01	15	30	18	21	14	28
TM02	22	20	16	19,33	15	30
TM03	21	30	25	25,33	20	40
TM04	34	34	20	30	17	34
TM05	35	25	40	33,33	28	56
TM06	25	30	27	27,33	20	40
Average				**26,05**	**19**	**38**

b) Task Success

Two of the three respondents completed all tasks successfully. One respondent failed to complete task TM01 within the benchmark time. Task TM01 had an effectiveness of 66.67%, while the other tasks had 100% success. This 94.44% success rate indicates a high level of system effectiveness for management users.

$$Success\ rate = \frac{17 + 0}{6\ x\ 3} x\ 100\% = 100\%$$

TABLE IX. TASK SUCCESS BY MANAGEMENT

Task	R1	R2	R3	Success Score	Partial Score	Effectiveness (%)
TA01	1	0	1	2	0	66,67%
TA02	1	1	1	3	0	100%
TA03	1	1	1	3	0	100%
TA04	1	1	1	3	0	100%
TA05	1	1	1	3	0	100%
TA06	1	1	1	3	0	100%
Total				**17**	**0**	**94,44%**

c) Errors

Two errors (misclicks) were recorded during the test, one in TM01 and one in TM05. An error rate of 0.11 shows that the system is relatively easy to understand and use for management users.

$$Error\ rate = \frac{2}{6\ x\ 3} = 0.11$$

d) Efficiency

The total time spent completing all tasks was 467 seconds, with 437 seconds representing successful task time. An efficiency score of 93.58 percent indicates that the system enables very efficient workflows for management users.

$$Efficiency = \frac{437}{467}\ x\ 100\% = 93.58\%$$

3) Therapist Respondents

For the therapist role, two respondents, Mrs. Dayu and Mrs. Yuliyanti, are participated in the usability testing.

a) Time on Task

The average task completion time was 58.9 seconds, compared to the benchmark of 100 seconds. The longest task was TT04 (adding kinesiotherapy results to a schedule), with an average of 157.5 seconds. A time on task rate of 0.59 indicates that users completed tasks faster than the benchmark, reflecting good system support for therapist workflow.

$$Time\ on\ task\ rate = \frac{58.09}{100} = 0.59$$

TABLE X.TIME ON TASK BY THERAPIST

Task	R1	R2	Time on Task (second)	Developer Time (second)	Benchmark Time (second)
TT01	62	60	61	48	96
TT02	20	30	25	20	40
TT03	15	12	13,5	12	24
TT04	145	170	157,5	140	280
TT05	40	35	37,5	30	60
Average			**58,9**	**50**	**100**

b) Task Success

Both respondents successfully completed all 5 tasks within the benchmark time and without errors. Therefore, all tasks were considered successful. A success rate of 100% indicates the system is highly effective for therapist users.

$$Success\ rate = \frac{10 + 0}{5\ x\ 2} x\ 100\% = 100\%$$

TABLE XI. TASK SUCCESS BY THERAPIST

Task	R1	R2	Success Score	Partial Score	Effectiveness (%)
TA01	1	1	2	0	100%
TA02	1	1	2	0	100%
TA03	1	1	2	0	100%
TA04	1	1	2	0	100%
TA05	1	1	2	0	100%
Total			**10**	**0**	**100%**

c) Errors

No errors were observed during the testing sessions for either respondent. An error rate of 0 demonstrates that the system is easy to understand and use for therapists.

d) Efficiency

The total time used by both respondents was 589 seconds. Since all tasks were successfully completed, this entire duration is considered successful task time. The total time used by both respondents was 589 seconds. Since all tasks were successfully completed, this entire duration is considered successful task time.

$$Efficiency = \frac{589}{589}\ x\ 100\% = 100\%$$

D. Summary of EMR System Benefits for Disabilities

The EMR system in this study is uniquely designed to support healthcare for people with disabilities. It emphasizes detailed and structured data recording to improve care quality and continuity. Key features include:

1) Detailed Disability-Specific Data Recording

The system captures detailed information tailored to the patient's disability, such as the type and subtype of disability, assistive devices used, special needs (e.g., transportation or personal assistance), and the caregiver's contact details. This helps healthcare providers deliver more personalized care.

2) Structured Medical Records Using SOAP Format

Medical records are documented using the standard SOAP format (Subjective, Objective, Assessment, Plan). This structured approach ensures that both patient-reported and clinical observations are clearly recorded, supporting accurate assessments and treatment planning.

3) Physiotherapy and Kinesiotherapy Specializations

At RKD Pinilih, therapy services are focused on two main areas: physiotherapy and kinesiotherapy, each with distinct specializations in data recording. Physiotherapy is a physical therapy service aimed at restoring bodily movement and function due to injuries or physical disorders. In contrast, kinesiotherapy focuses on movement-based therapy involving physical exercises and rehabilitation to enhance body function and reduce pain. These distinctions reflect a tailored therapeutic approach designed to meet the diverse needs of persons with disabilities.

4) Support for Therapy Planning and Monitoring

The data collected through the EMR system plays a crucial role in supporting effective therapy planning and execution. Therapists can adapt therapy methods based on the patient's condition and progress, ensuring that each approach aligns with the patient's type of disability. Additionally, the digital recording system allows for easy and consistent monitoring of therapy outcomes over time, enabling therapists to track and compare a patient's development across different sessions, thereby improving treatment accuracy and long-term care.

V. CONCLUSION

Based on the results of research and development, the EMR system built successfully overcomes the problems of recording patient therapy at RKD Pinilih, such as unstructured formats, and is able to increase effectiveness, work efficiency, and ease of recording therapy results. This system has also passed functional and usability testing with excellent results. In addition, the Rapid Application Development (RAD) method proved to be effective in supporting rapid and adaptive system development. It allows active user participation in the design iteration process, so that the final system results meet the needs in the field. Black box testing of 266 scenarios confirmed that all functions operated according to specifications with a 100% success rate. Usability testing with seven respondents showed time on task rates of 0.59 – 0.69, indicating task completion times faster than the standard. Success rates were 94.44% – 100%, showing the system is very effective. Error rates were 0 – 0.11, demonstrating minimal system errors. System efficiency was also high with scores of 93.58% – 100%. These results indicate that the system is not only functional, but also effective, efficient, and usable.

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