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Design Science Approach to Web-Based Monitoring and Analytics for Toddler Posyandu Activities: The Baperkam Sunyaragi Case

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Abstract

Background: Manual recording of toddler weighing data at *Baperkam* Sunyaragi has resulted in recurrent input errors, delayed growth assessment, and limited analytical capacity, increasing the risk of late detection of nutritional problems such as stunting and wasting. Internal records in 2023 showed that approximately 18% of weighing reports contained inconsistencies in weight or age entries, and growth analysis was delayed by up to two weeks due to manual tabulation.
Objective: This study aims to design and implement a web-based monitoring and analytics system to improve the accuracy, timeliness, and accessibility of toddler growth data for health workers and parents.
Methods: The method used in this research is the waterfall software development approach, which includes the stages of needs analysis, system design, implementation, testing, and evaluation. The developed application facilitates information access for health workers and parents of toddlers.
Results: Black-box testing of 38 functional test cases showed a 100% feature validity rate across user roles. The system reduced data recording time by 67.6% (from 8.5 to 2.75 minutes per session) and eliminated input errors (0% versus 12.3% in manual recording). It improved efficiency and accuracy, and enabled integrated nutritional status analysis.
Conclusion: The developed system improves data reliability and supports earlier identification of at-risk toddlers. However, the study is limited to single-site implementation and short-term evaluation, requiring broader deployment and longitudinal assessment to measure its long-term impact on nutritional monitoring outcomes.

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INTRODUCTION

Monitoring the growth of toddlers is an important aspect in efforts to improve public health, especially in preventing and overcoming malnutrition and stunting problems (Nenobais et al., 2025; Prihanggara & Handini, 2025). Regular weighing of toddlers is one of the main steps in this monitoring, where the collected data can be used to analyze the growth and nutritional status of children (Annisa et al., 2023; Zsakai et al., 2023). However, at *Baperkam* Sunyaragi, the recording of weighing data for toddlers is still carried out using a register book. This causes various obstacles, such as the risk of data loss, recording errors, delays in the recapitulation process, and difficulties in accessing and analyzing information quickly and accurately (Jangam & Muntala, 2023; Senbekov et al., 2020). According to the World Health Organization (WHO), stunting affects approximately 22% of children under five globally, with Indonesia's National Health Survey Riskesdas (2018) reporting a national stunting prevalence of 21.5%. Studies on manual recording systems in community health posts show that up to 35% of toddler weighing

data is lost or recorded inaccurately due to human error and inadequate documentation systems (Taye et al., 2025).

In the digital era like today, the use of information technology can be a solution to increase efficiency and accuracy in recording and analyzing weighing data for toddlers (Harahap, 2023; Kurniawan et al., 2025). Web-based systems allow health workers to record data more systematically, store it in one centralized database, and access information anytime and anywhere (Albahri et al., 2018; Khan et al., 2024). In addition, this system can also present data in the form of graphs and growth analysis reports that are easier to understand, both by *Baperkam* officers and parents of toddlers. With the digitization of this system, it is hoped that the process of monitoring the growth and development of toddlers can be carried out more optimally. The concept of electronic health (e-health) and Health Information Systems (HIS) has been widely recognized as an effective approach to improving healthcare data management (Elikwu et al., 2020; França et al., 2022; Listiono et al., 2021).

Empirical research demonstrates that web-based health monitoring systems can reduce data processing time by 40–60% compared to manual methods (Kristiadi, 2023; Ramadhan et al., 2022). Previous studies, including Ramadhan (2022), have developed similar systems but lacked integrated growth analysis dashboards and real-time nutritional status reporting tailored for village-level *Posyandu* contexts. This research fills that gap by developing SiGrow with integrated analytics specifically designed for *Baperkam* Sunyaragi.

Based on these needs, this research aims to: (1) design and develop a web-based toddler growth monitoring and analysis system (SiGrow) for *Baperkam* Sunyaragi; (2) test the functional feasibility of the system using black-box testing methodology; (3) evaluate system performance based on response time, accuracy, and data integrity metrics; and (4) assess user acceptance through User Acceptance Testing (UAT) with health workers and *Posyandu* officers.

The development of the SiGrow system contributes to the body of knowledge on digital health information systems at the community level. By comparing the system's performance against existing manual processes and prior related studies, this research provides empirical evidence of the effectiveness of web-based solutions in improving toddler health data management accuracy, efficiency, and accessibility in a *Posyandu* context.

METHOD

This research is classified as Software Engineering Research (Research and Development/R&D), wherein a software product (*SiGrow* web application) is systematically developed, implemented, and empirically evaluated. The research methodology followed the Software Development Life Cycle (SDLC) using the Waterfall model, which was selected due to its structured, sequential approach appropriate for well-defined system requirements in a single-site implementation context.

The method used in this study was software development with a Waterfall approach, which included the stages of needs analysis, system design, implementation, testing, and evaluation. The application developed provides easy access to information for health workers and parents of toddlers. To build a web-based toddler weighing data monitoring and analysis application at *Baperkam* Sunyaragi that was effective and suited to identified needs, in-depth analysis and system design stages were required. This analysis process was carried out so that the application was designed to accommodate all data processing needs of toddlers accurately, quickly, and efficiently, especially in terms of monitoring the growth and development of toddlers and supporting decision-making by *Baperkam*. In designing this application, the authors used two types of data, namely primary data and secondary data.

Primary data is data obtained directly from the original source. In this context, primary data was obtained through interviews and direct observation of toddler weighing officers, *Posyandu* cadres, and *Baperkam* Sunyaragi administrators. The information obtained included the workflow of toddler monitoring, the obstacles faced in manual recording, and the features required in a web-based system. Secondary data is data obtained from indirect sources, such as *Posyandu* report documents, toddler recording formats, growth charts, and manual archives of previous weighing results.

This data was used to support and strengthen information system requirements and

served as a reference in the preparation of the application database. By analyzing this primary and secondary data, the authors were able to design the main features implemented in the application, as follows: (1) data recording of toddlers based on identity, age, gender, and nutritional status; (2) toddler growth graphs based on the results of periodic weighing; (3) notifications for scheduling routine weighing; and (4) a dashboard that analyzes nutritional development collectively based on input data.

System testing encompassed four dimensions: (1) functional testing using black-box methodology to verify that all features operated according to specifications; (2) performance testing measuring system response time and data processing speed; (3) User Acceptance Testing (UAT) conducted with *Posyandu* health workers using structured questionnaires; and (4) comparative evaluation benchmarking the digital system against the prior manual recording process. Data analysis techniques employed included thematic analysis for qualitative interview data from health workers; checklist-based quantitative analysis for functional test results; and triangulation combining UAT results, performance metrics, and comparative benchmarking to validate system effectiveness (Tang et al., 2025).

The results of this analysis were used as a basis for system design, so that the application built served not only as a data recording medium, but also as a decision-making tool for *Baperkam* cadres and administrators to improve the quality of health of toddlers in the Sunyaragi RW 02 Tamansari area. The *SiGrow* system employed a 3-tier architecture consisting of: (1) Presentation Layer — a web-based front-end built with Bootstrap 5 for responsive interface design; (2) Application Layer — a PHP Laravel framework implementing the MVC (Model-View-Controller) design pattern for business logic processing; and (3) Data Layer — a MySQL relational database managing toddler records, growth measurements, and user accounts. The system Entity Relationship Diagram (ERD) consisted of six primary entities: Toddler, Weighing Record, Nutritional Status, Health Worker, Parent/Guardian, and *Posyandu* Session. The Waterfall model was selected over Agile or Scrum due to the well-defined, stable requirements established through the initial needs assessment, making sequential, phase-by-phase development more appropriate for this single-organisation deployment.

RESULTS AND DISCUSSION

Result

Implementation of Parents of Toddlers

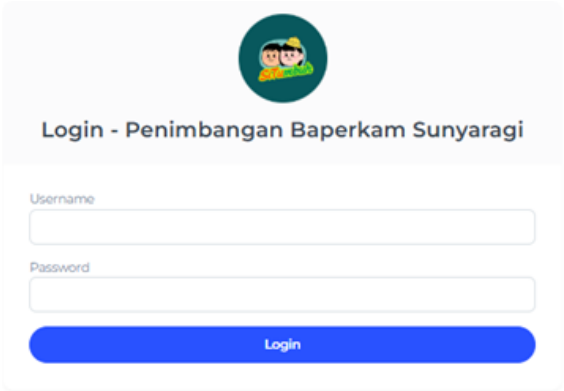

Figure 1. Toddler Parent Login Page

Figure 1 shows a login page. This login form consists of two input fields, namely the field for filling in the username and the field for the password. Underneath it is a blue button that says "Login."

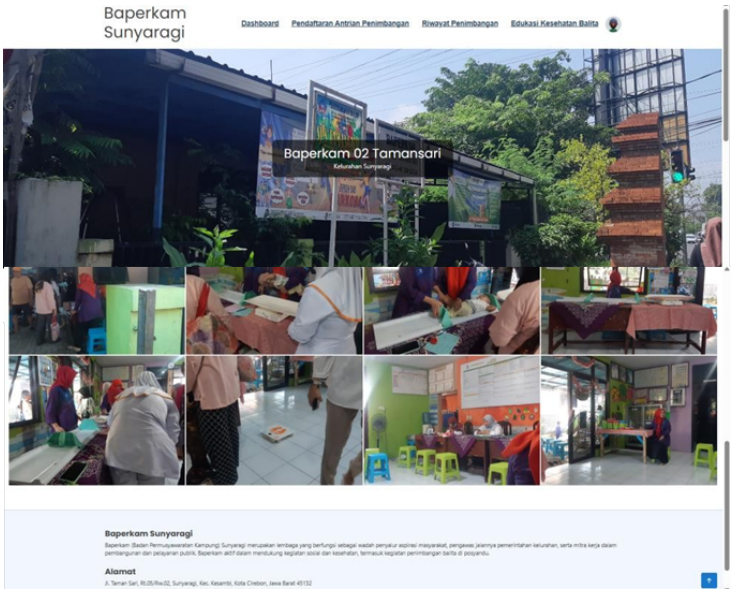

Figure 2. Toddler Parent Dashboard Page

Figure 2 is a dashboard page view of the *Baperkam* 02 Tamansari toddler weighing information system application. This page provides users with a clean and informative first impression. At the top, there is the name of the agency, namely *Baperkam* Sunyaragi, complete with a navigation menu that makes it easier for users to navigate to various main features such as the dashboard, weighing queue registration, weighing history, and health education for toddlers. At the bottom of the page, there is a photo gallery of activities that take place at the *Posyandu*, starting from the process of weighing toddlers and health consultations with officers, to the atmosphere of the service room full of a sense of togetherness. There is enthusiasm among mothers who come to bring their children to receive health services.

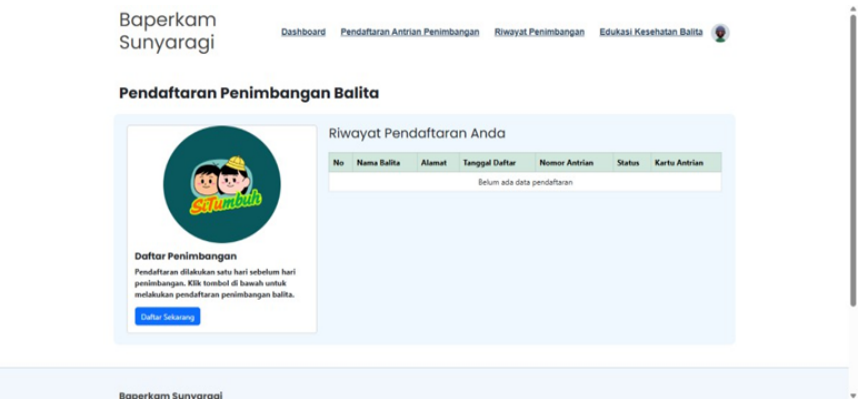

Figure 3. Toddler Weighing Registration Page

Figure 3 shows the registration page for toddler weighing on the *Baperkam* Sunyaragi information system. On the left side, there is an illustration of *Posyandu* activities and a button to register children to the weighing list, which is done one day before the implementation schedule. On the right side, there is a table containing registration data, such as the name of the toddler, date of birth, mother's name, address, registration date, queue number, and the ticket download button. Each entry indicates that the toddler has been registered and obtained a queue number. The page is designed to be simple and informative, making it easier for parents to monitor the registration status and access the weighing ticket.

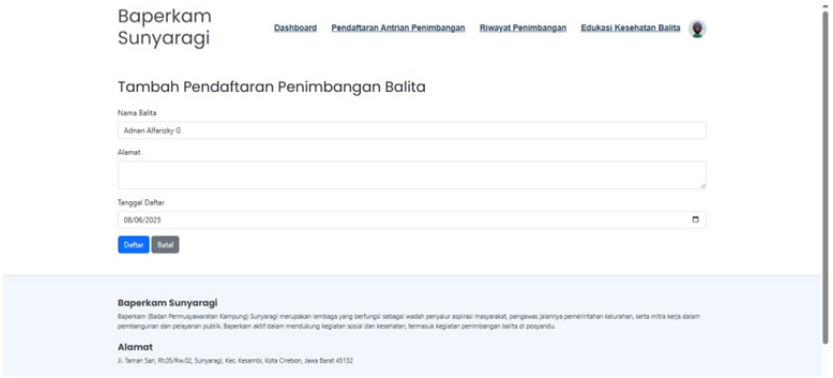

Figure 4. Add Toddler Weighing Data Page

Figure 4 shows the registration form page for the toddler weighing queue on the *Baperkam* Sunyaragi information system. Parents only need to fill in important data such as the name of the toddler, address, and registration date. The form is designed to be simple and easy to understand, with a register button to submit data and a cancel button to clear the form. At the bottom, there is also brief information and the address of *Baperkam* Sunyaragi to increase user confidence in the service.

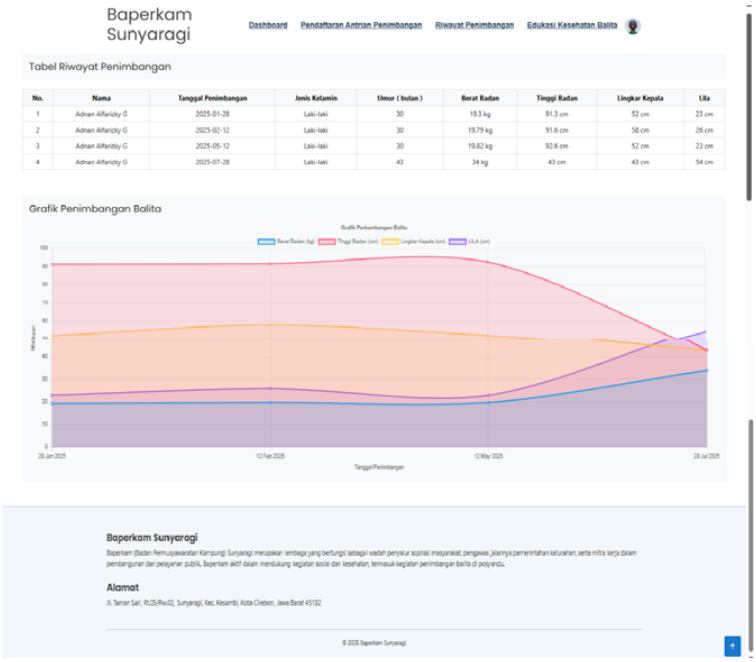

Figure 5. Weighing History Page

Figure 5 shows the history page of weighing toddlers on the *Baperkam* Sunyaragi information system. The table contains Adnan Alfarizky G.'s weighing data, including date, age (month), gender, weight, height, head circumference, and upper arm circumference from January to July 2025. Below it is a progress chart that visualizes the four growth indicators in different colors, making it easier to monitor physical changes over time.

Figure 6. Toddler Health Education Page

Figure 6 shows the toddler health education page on the *Baperkam* Sunyaragi information system. This page provides information on early childhood growth, development, nutrition, and health. At the top, there is a navigation menu to the dashboard, queue registration, and weighing history. The main page is divided into three categories: toddler growth and development guides, food and nutrition guides, and common disease prevention and treatment, which are presented in icon-based boxes for easy user understanding.

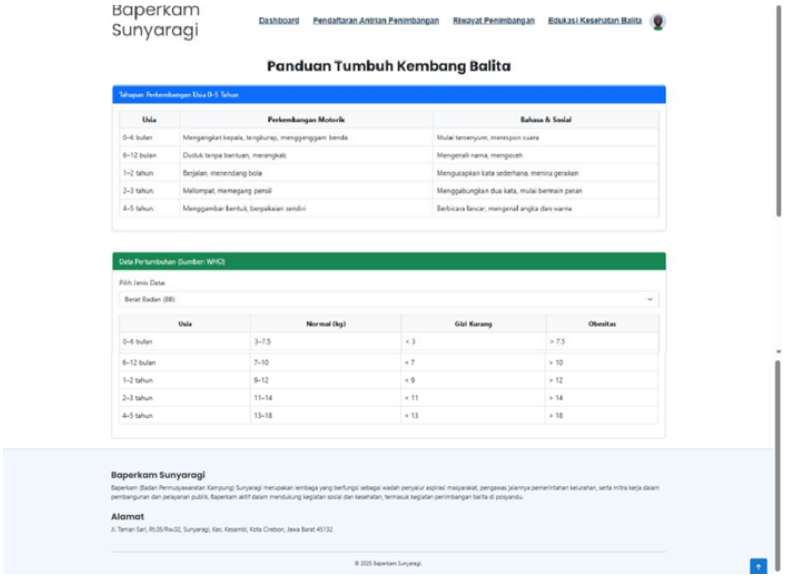

Figure 7. Education Page Growth and Development Category

Figure 7 shows a toddler growth and development guide page that contains information on child development from birth to five years of age. At the top is a table of developmental stages by age, covering motor, language, and social aspects. This page also features growth data based on WHO standards, so parents can see their child's weight categories (normal, underweight, or obese) according to age group through the available weight range tables.

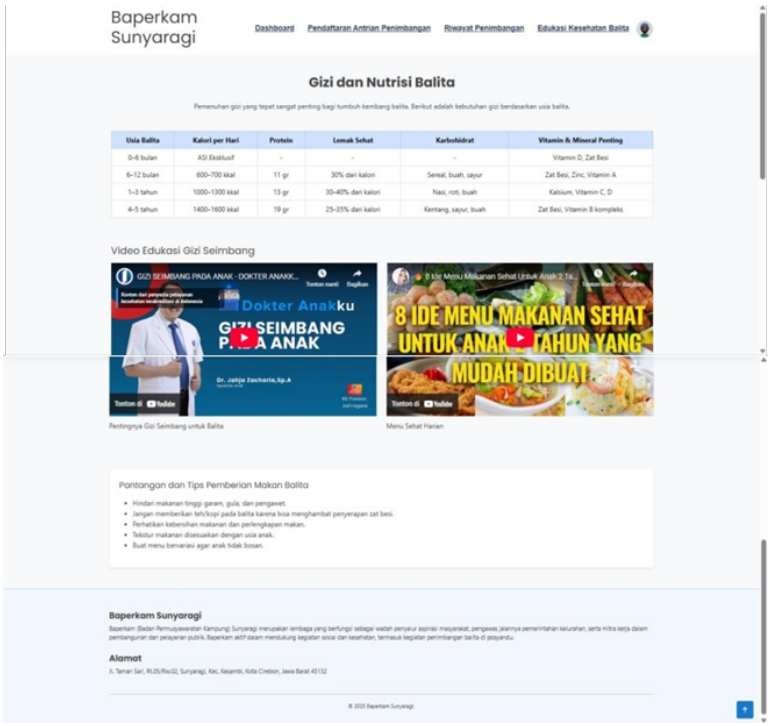

Figure 8. Nutrition and Nutrition Category Education Page

Figure 8 features a nutritional information page for toddlers that emphasizes the importance of nutritional fulfillment to support optimal growth and development. A table of nutritional needs based on the age range of 0–5 years is available, including exclusive breastfeeding recommendations for ages 0–6 months as well as energy and nutrient needs for subsequent age groups. This page also features two educational videos on balanced nutrition to help parents understand healthy eating patterns for children.

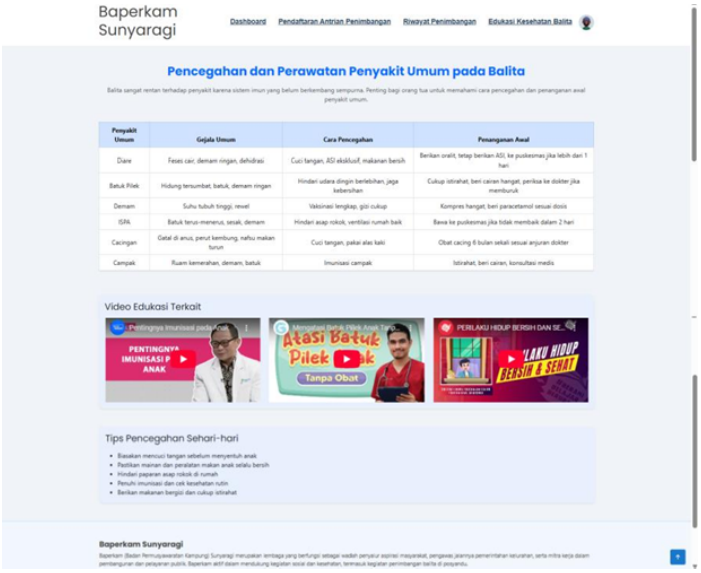

Figure 9. Education Page Categories Prevention and Care

Figure 9 shows the prevention and treatment category page containing information on common diseases in toddlers such as diarrhea, cough and cold, fever, ISPA, worms, and measles, along with their symptoms, prevention, and initial treatment. This page also includes educational videos on immunization, handling cough and cold, and clean and healthy living behaviors, as well as daily prevention tips such as maintaining cleanliness, avoiding cigarette smoke, and ensuring adequate nutritional intake and rest.

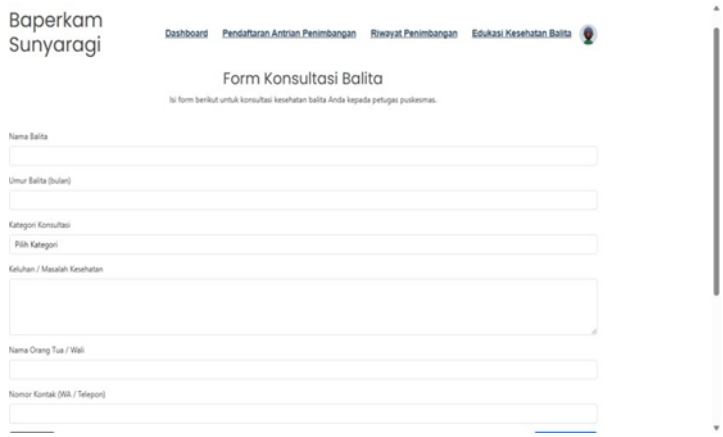

Figure 10. Toddler Parent Consultation Form Page

Figure 10 shows the toddler consultation form page on the Baperkam Sunyaragi system. This form allows parents to submit child health complaints by filling in data such as the name and age of the toddler, consultation categories, complaints, and parents' names and contact numbers, so that the health center officer can provide a quick and appropriate response.

Implementation of Baperkam Officers

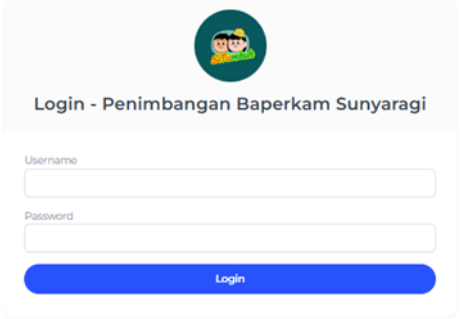

Figure 11. Baperkam Officer Login Page

Figure 11 shows a login page. This login form consists of two input fields, namely the field for the username and the field for the password. Underneath it is a blue button that says "Login."

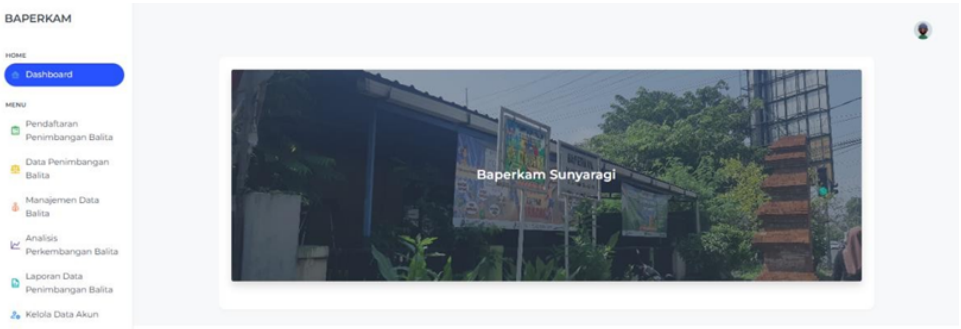

Figure 12. Baperkam Officer Dashboard Page

Figure 12 shows the dashboard page of the *Baperkam* Sunyaragi application. On the left side, there is a navigation menu to access key features such as registration, weighing data, toddler management, progress analysis, reports, and account management. The center displays images of the Baperkam office, while the interface is designed to be simple and easy to use to support the work efficiency of officers.

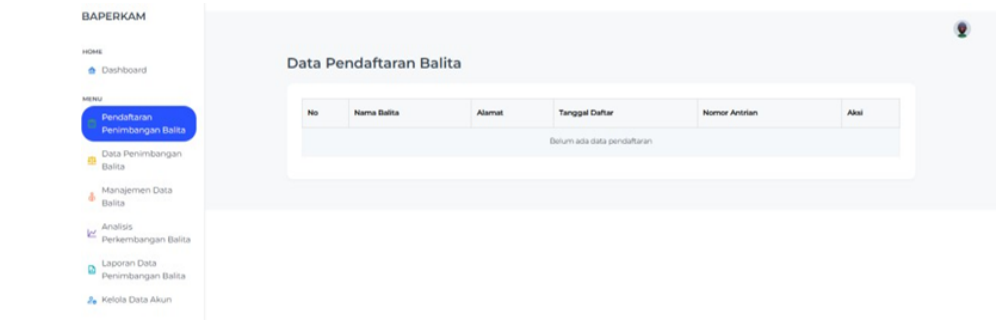

Figure 13. Weighing Registration Data Page

Figure 13 shows the registration data page for toddlers on the *Baperkam* Sunyaragi admin system. The table contains the sequence number, toddler's name, address, registration date, queue number, and an action button labeled "Confirm" to approve registration. The display is designed to be simple and easy to read so that officers can process data quickly.

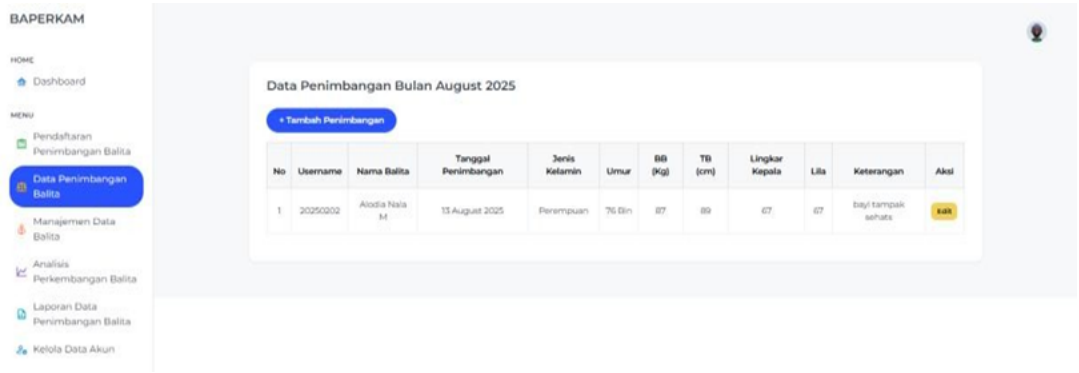

Figure 14. Toddler Weighing Data Page

Figure 14 shows the August 2025 toddler weighing data page on the *BAPERKAM* admin system. The table contains the name of the toddler, date of weighing, gender, age, weight, height, head circumference, LILA (*Lingkar Lengan Atas*, meaning upper arm circumference), and condition information. There is an "Edit" button to update the data. The neat appearance makes it easier for officers to monitor the growth and development of toddlers on a regular basis.

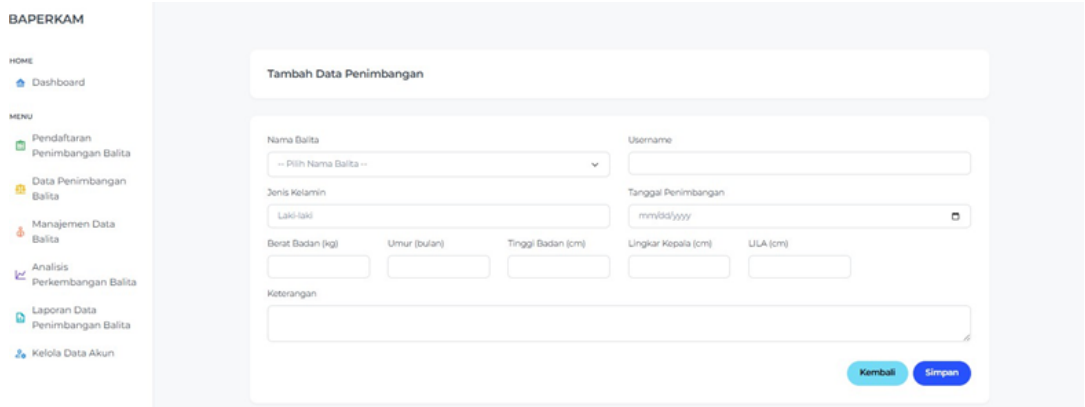

Figure 15. Add Weighing Data Page

Figure 15 shows the add weighing data page of the system. This form allows officers to input toddler data in a structured manner, including the toddler's name, weighing date, gender, age (months), weight, height, head circumference, LILA, and additional information. "Back" and "Save" buttons are available for easy data management. The clean display supports efficient routine data recording.

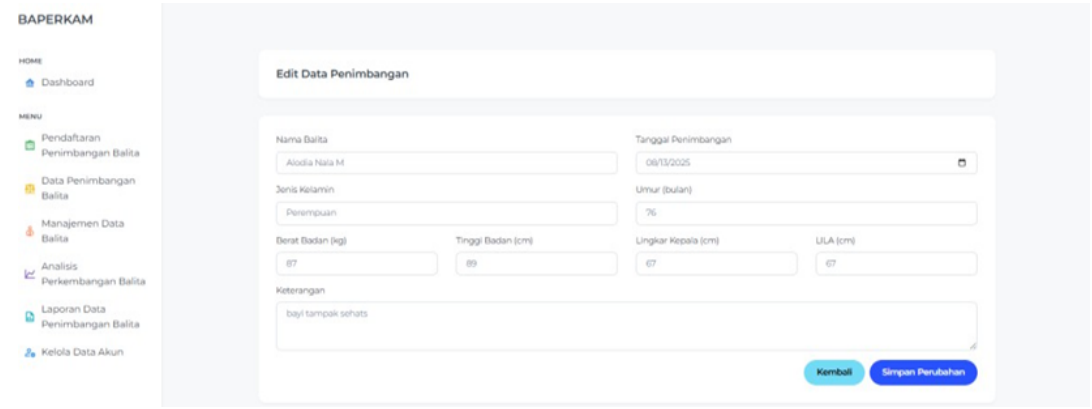

Figure 16. Weigh Data Edit Page

Figure 16 shows a page to edit the weighing data of toddlers in the *Baperkam* Sunyaragi admin system. This page allows officers to update information that has been previously recorded, in case of corrections or additional data. The form that appears contains data such as the name of the toddler, gender, weighing date, age in months, as well as the measurement results for weight, height, head circumference, mid-upper arm circumference, and descriptions. All columns have been filled in automatically based on previously stored data, so the officer only needs to make changes if necessary.

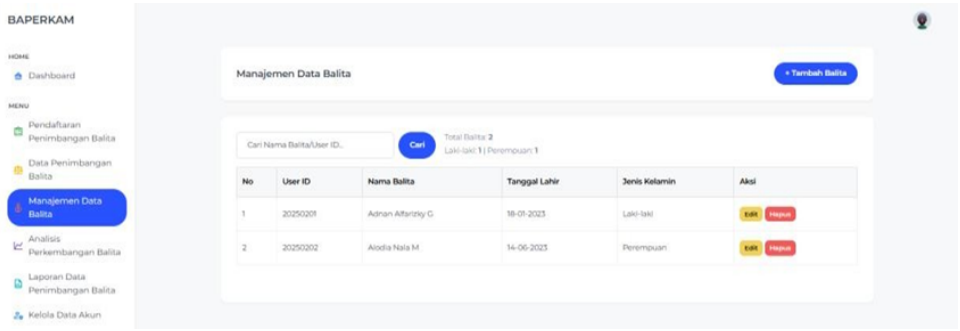

Figure 17. Toddler Data Management Page

Figure 17 shows the data management page of toddlers on the *Baperkam* Sunyaragi admin system. The table contains the sequence number, toddler's name, date of birth, gender, and mother's name, along with edit and delete buttons. At the top, there is a search field and buttons to add new toddler data, making it easier to manage data efficiently.

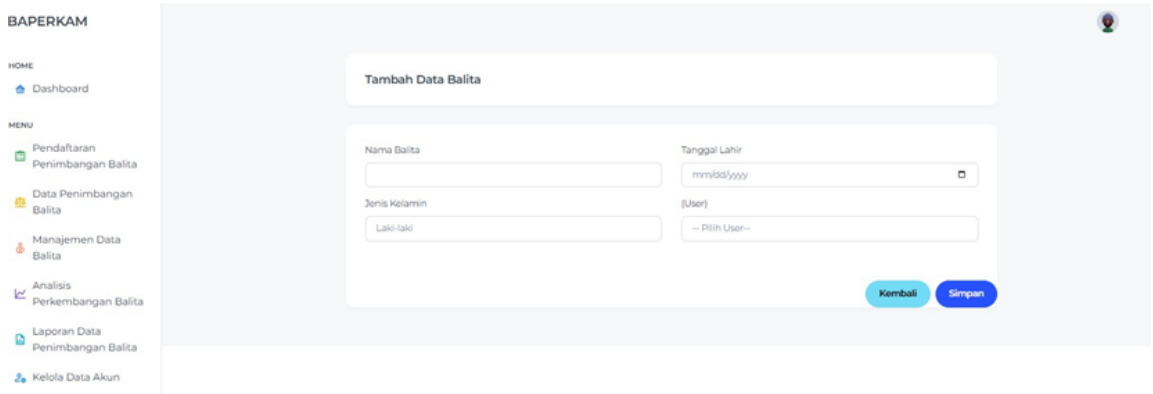

Figure 18. Add Toddler Data Page

Figure 18 shows the page to add toddler data to the *Baperkam* Sunyaragi admin system. This form is used to enter new toddler data, such as name, date of birth, gender, and mother's name. At the bottom, there is a Back and Save buttons. The simple and clean design makes it easier for officers to record data quickly and accurately.

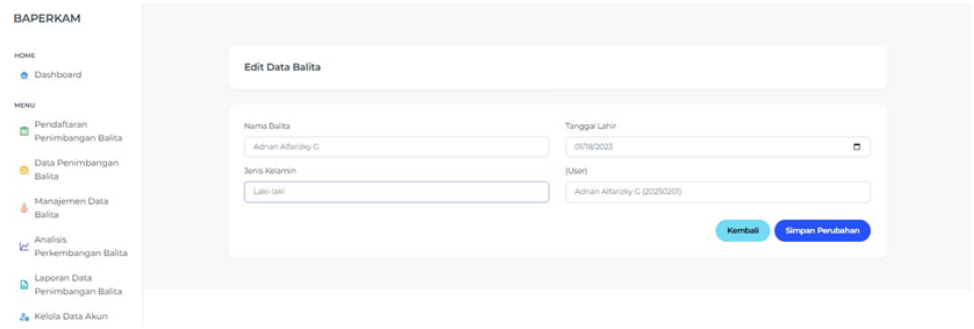

Figure 19. Toddler Data Edit Page

Figure 19 shows the toddler data edit page on the system. Officers can update information such as name, date of birth, gender, as well as connected accounts. There are "Back" and "Save Changes" buttons for easy navigation and data saving. This feature ensures that toddler data remains accurate and up-to-date for continuous health monitoring.

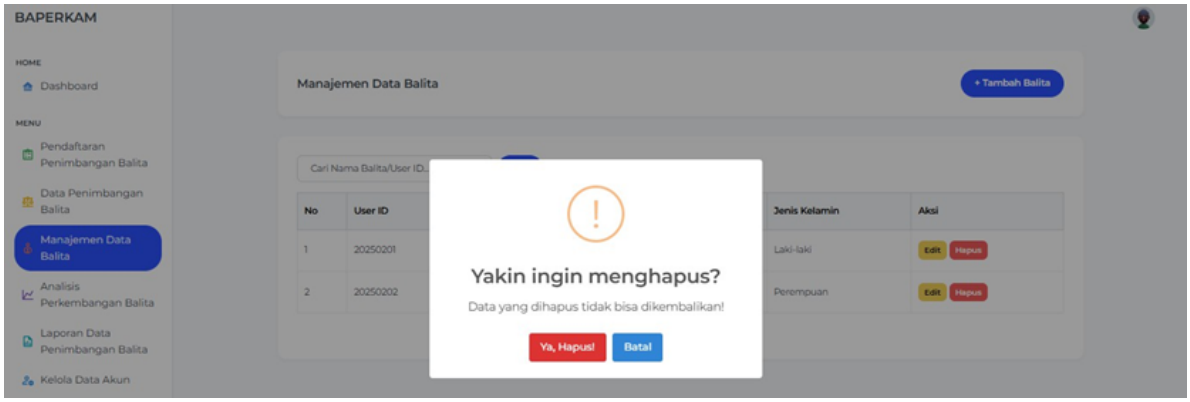

Figure 20. Clear Toddler Data Page

Figure 20 shows the Clear Toddler Data page on the system. This feature allows officers to delete irrelevant data or incorrect inputs, with prior confirmation to prevent accidental deletion.

Figure 21. Toddler Development Analysis Page

Figure 21 shows a toddler's developmental analysis page that helps officers visually monitor growth and development. After selecting the toddler's name from the dropdown menu, the system displays a graph of four indicators, namely weight, height, head circumference, and LILA with different colored lines. The graph shows the development trend over time, making it easier to identify normal, stagnant, or declining conditions as the basis for health decision-making.

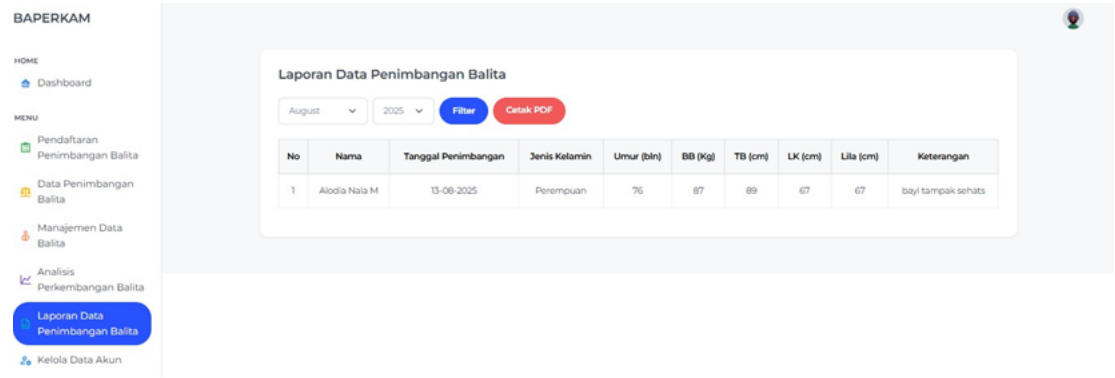

Figure 22. Toddler Weighing Data Report Page

Figure 22 shows the toddler weighing data report page, which presents a complete recap of the weighing results in the form of a table. The data include the toddler's name, date, gender, age, weight, height, head circumference, LILA, and descriptions. The system provides a filter feature based on month and year, as well as a PDF print button for easy documentation and reporting.

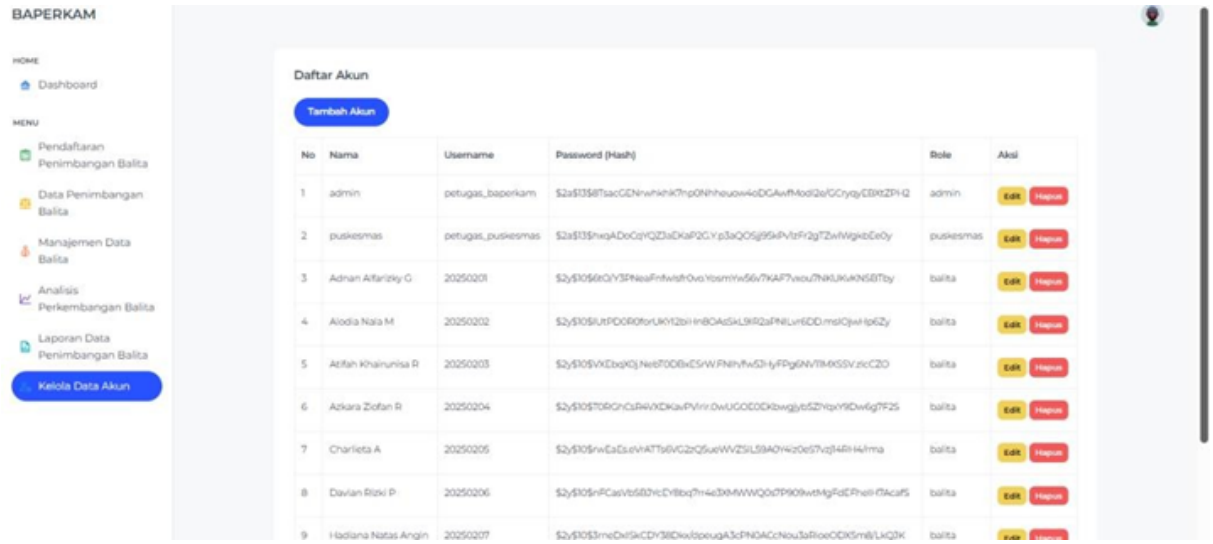

Figure 23. Manage Account Data Page

Figure 23 shows the manage account data page on the system. This page allows officers to add, edit, and delete user accounts. The table contains the name, username, hashed password, user role (admin, health center, or toddler), and action buttons. The neat display makes it easy to set up access quickly and securely.

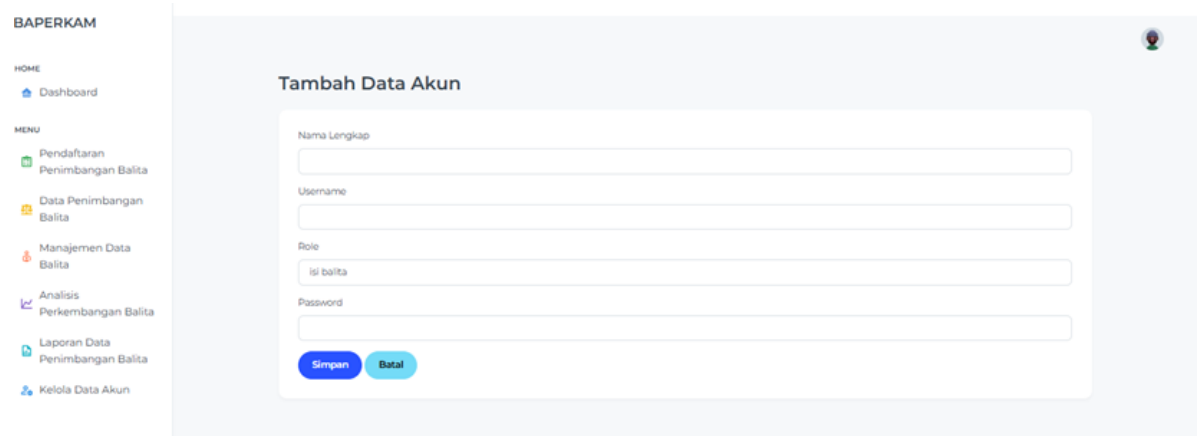

Figure 24. Add Account Data Page

Figure 24 shows the add account data page that the officer used to create a new account. The form contains the account name, username, password, and role fields, which can then be saved so that the account is ready to use.

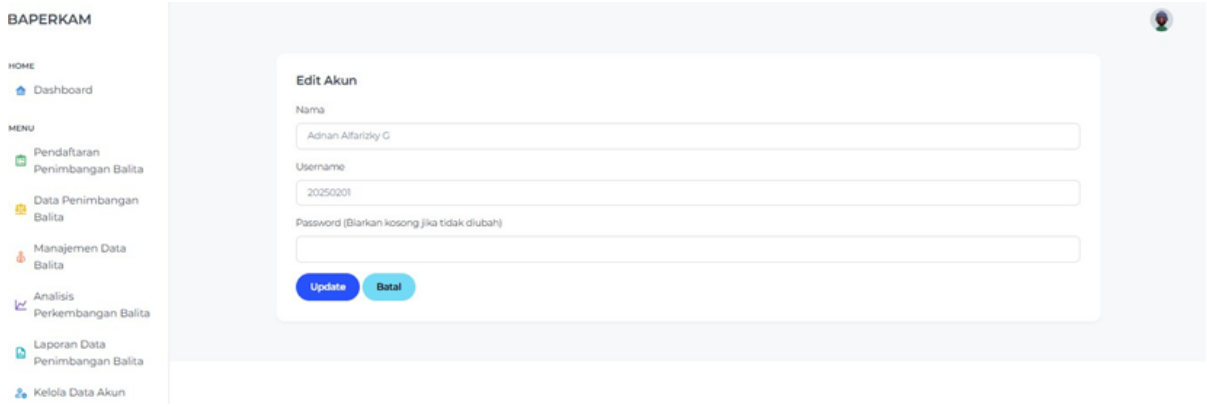

Figure 25. Edit Account Data Page

Figure 25 shows the edit page of account data used to update information such as account name, username, password, and role. Changes can be saved to keep the data accurate and up-to-date.

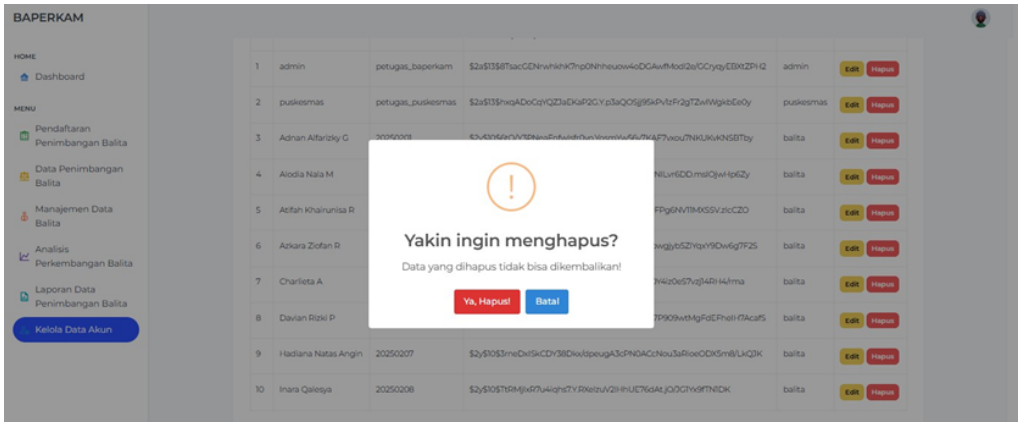

Figure 26. Clear Account Data page

Figure 26 shows the delete account data page that is used to delete accounts that are no longer in use or incorrectly entered. The system displays a confirmation prompt first to ensure the deletion is performed correctly.

Implementation of *Puskesmas* Officers

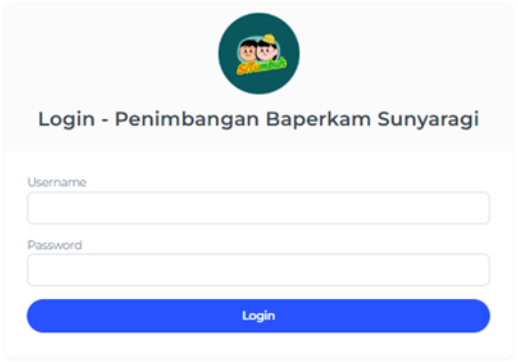

Figure 27. *Puskesmas* Officer Login Page

Figure 27 shows a login page. This login form consists of two input fields, namely the username field and the password field. Underneath is a blue button that reads "Login."

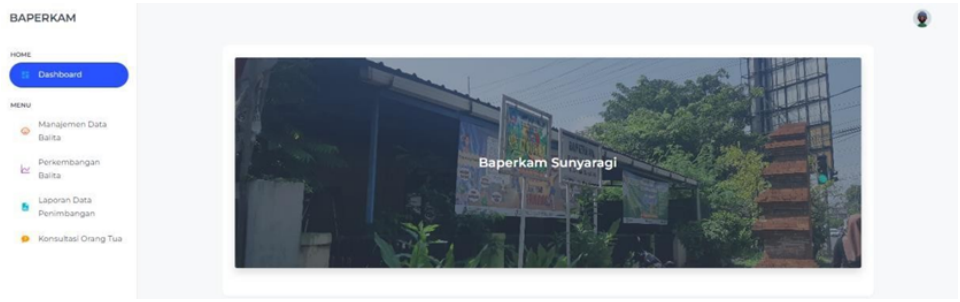

Figure 28. *Puskesmas* Officer Dashboard Page

Figure 28 shows the dashboard of health center officers in the *Baperkam* Sunyaragi system. This page serves as the central hub for key features such as toddler data management, progress charts, weighing reports, and consultations. Featuring a sidebar with clear icons and an informative visual display, the dashboard is designed to be easy to use and supports efficient monitoring of toddlers.

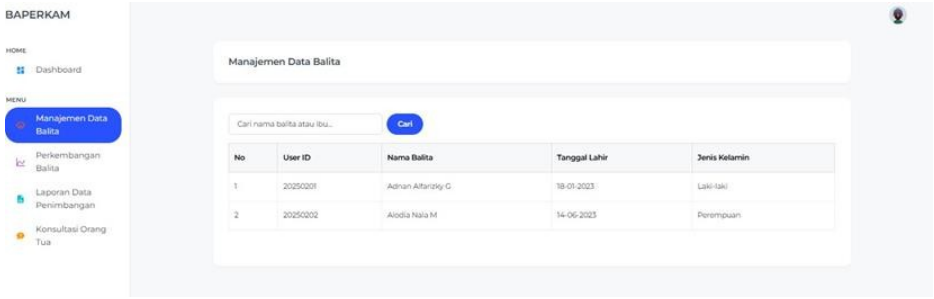

Figure 29. Toddler Data Management Page

Figure 29 shows a toddler data management page that makes it easier for health center officers to manage toddler information. The table contains sequence numbers, names, dates of birth, gender, and user IDs, equipped with search and pagination features to facilitate quick and efficient data navigation and retrieval.

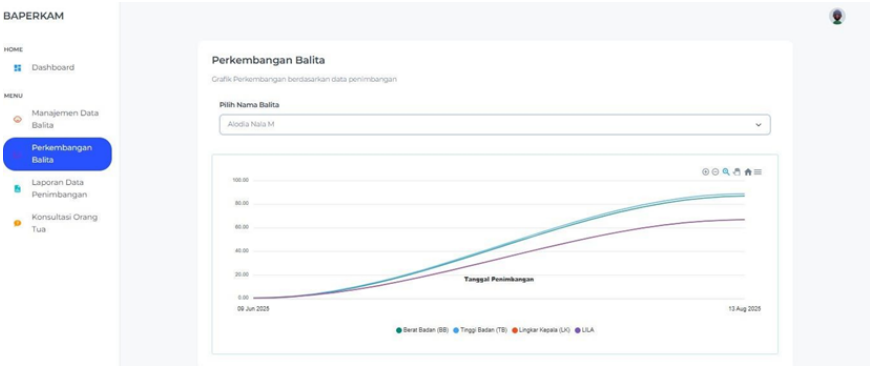

Figure 30. Toddler Development Page

Figure 30 shows the toddler development page on the *Baperkam* Sunyaragi system, which helps health center officers visually monitor growth. The graph displays weight, height, head circumference, and LILA based on previous measurement data. Users can choose a toddler's name through a drop-down menu, and the system automatically displays a graph with different colors to make it easier to analyze growth trends.

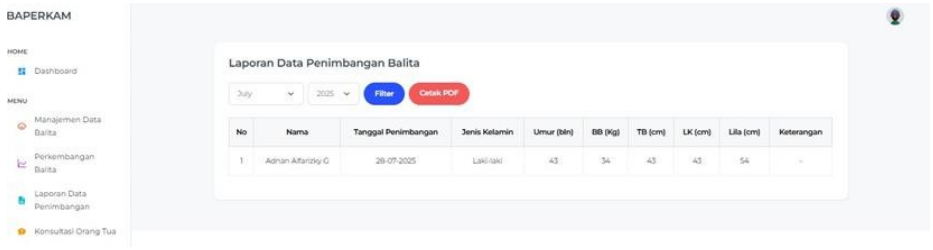

Figure 31. Weighing Data Report Page

Figure 31 shows the toddler weighing data report page, which helps health center officers see the monthly recap. There is a month and year filter feature to display data according to a specific period. The results are displayed in a table containing the toddler's name, date, gender, age, weight, height, head circumference, LILA, and description. If the data is not available, the system displays a notification.

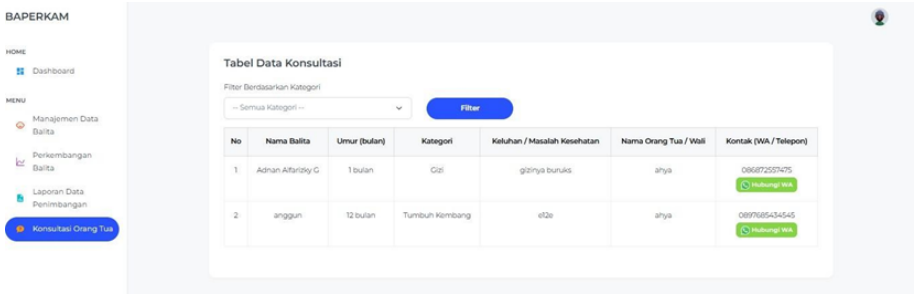

Figure 32. Parent Consultation Page

Figure 32 shows the parental consultation data page on the *Baperkam* Sunyaragi system, which serves as a means of communication between health center officers and parents of toddlers. There is a table that displays information such as the name of the toddler, age, consultation category, complaints, and parent contacts. There is a category filter feature (nutrition, growth and development, immunization, general) to facilitate the handling of consultations more efficiently and systematically.

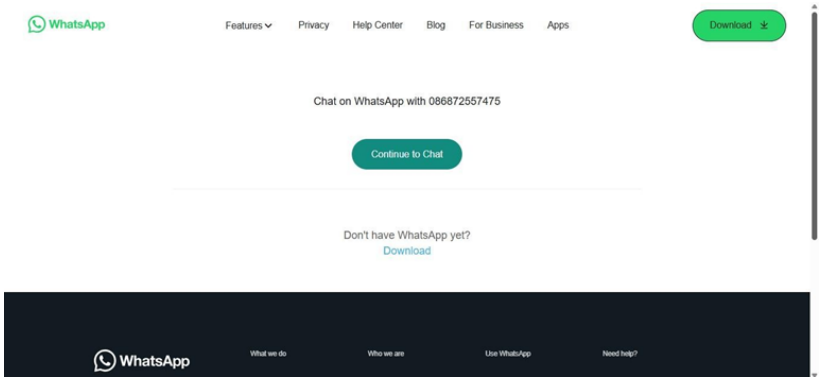

Figure 33. WA Contact Page

Figure 33 shows the WA contact page on the system to make it easier for officers to establish direct communication with parents or guardians of toddlers who request consultations. After selecting the incoming consultation data, the officer only needs to click the available button to directly connect to the WhatsApp application, without the need to copy or type the number manually.

Testing

System testing is carried out using the Black-Box technique. This test is conducted to obtain the test results and evaluate the functionality of the tested application.

Table 1. Table of Parents of Toddlers

No	Test Type	Test Data	Results Expect	Output	Test Results
1.	Login Button	Username data input *and* *Lost your password?*	Login View Failed	Login View Failed	Valid
2.	Login Button	Username data input *and* *Lost your password?*	Enter the dashboard view	Successful Login View	Valid
3.	Add Queue Data Button	Adding Queue Data	Displaying Queue Data added	Stored Data	Valid
4.	Add Consultation Data Button	Add Consultation Data	Consultation Data appears in the officer section Health Center	Stored Data	Valid

Table 1 presents the black-box testing results for parent users. The login function correctly distinguishes between valid and invalid credentials, while the queue and consultation data input features successfully store and display data as expected. All tested functions returned expected results, indicating stable data exchange between parents and health officers.

Table 2. Table of *Baperkam* Officers

No	Test Type	Test Data	Results Expect	Output	Test Results
1.	Login Button	Data input *Powered by E-Mail* and	Login View Failed	Login View Failed	Valid
2.	Login Button	Username data input *and* *Lost your password?*	Enter the dashboard view	Successful Login View	Valid
3.	Add Queue Data Button	Adding Queue Data	Displaying Queue Data added	Stored Data	Valid
4.	Add Consultation Data Button	Add Password *Consultation Data*	Consultation Data appears in the officer section Health Center	Stored Data	Valid
2	Login Button	Username data input *and* *Lost your password?*	Enter the dashboard view	Successful Login View	Valid
3	Queue Button Confirmed	Confirm Queue Data	Display words Confirmed	Data Confirmed	Valid
4	Add Weighing Data Button	Add Weighing Data	Display Weighing Data added	Stored Data	Valid
5	Weigh Data Edit Button	Edit Weighing Data	Displaying Weighing Data Edit	Data edited successfully	Valid
6	Add Toddler Data Button	Add Toddler Data	Displaying Toddler Data added	Stored Data	Valid
7	Toddler Data Edit Button	Edit News Data	Displaying Toddler Data Edited	Data edited successfully	Valid
8	Buttons Delete Toddler Data	Delete Toddler Data	Display Toddler data that has been deleted	Data was successfully deleted	Valid
9	Print Data Button	Print Data Reports Weighing	Printing Reports Weighing	Print Data Reports	Valid

No	Test Type	Test Data	Results Expect	Output	Test Results
	Weighing			Weighing	
10	Add Account Data Button	Add Account Data	Viewing Account Data added	Stored Data	Valid
11	Edit Account Data Button	Edit Account Data	Display Edited Account Data	Data edited successfully	Valid
12	Clear Data Button Account	Clear Account Data	Display Account Data Removed	Data was successfully deleted	Valid

Table 2 summarizes functional testing for *Baperkam* officers, covering login, queue confirmation, weighing data management, toddler data management, account administration, and report printing. All operations, including adding, editing, deleting, confirming, and printing data, produced expected outputs without errors. Each tested feature was validated successfully, confirming full operational reliability.

Table 3. Table of Health Center Officers

No	Test Type	Test Data	Results Expect	Output	Test Results
1.	Login Button	Username data input *and Lost your password?*	Login View Failed	Login View Failed	Valid
2.	Login Button	Username data input *and Lost your password?*	Enter the dashboard view	Successful Login View	Valid
3.	Buttons Print Weighing Data	Print Weighing Data Report	Printing Weighing Data Report	Print Weighing Data Report	Valid

Table 3 shows the testing outcomes for health center officers. The system accurately handled both failed and successful login attempts and enabled the proper generation and printing of weighing reports. All tested features met expected results, demonstrating consistent functionality and role-based access performance.

Discussion

Based on the results of the tests conducted using the black-box method, testing was carried out to ensure that every feature in the system functions as expected. The tests include three main types of users, namely parents of toddlers, *Baperkam* officers, and *Puskesmas* officers. Each user was tested based on the activities and roles they perform within the system. For the parents of toddlers, testing started with the login feature. When a user entered the wrong username and password, the system responded with a failed login display. Conversely, when the login credentials entered were correct, the system successfully redirected the user to the dashboard view. In addition, parents could also add queue data and consultation data. The test results show that the added data was successfully stored and appeared accordingly in the relevant section, such as on the health center officer's display.

This demonstrates that data communication between users operates as expected. In the tests for *Baperkam* officers, the system was tested from the login feature through the entire data management functions. As with the previous user type, the system successfully displayed the appropriate response to both correct and incorrect login data. After successfully logging into the dashboard, the officer could access important features such as queue confirmation, adding weighing data, editing data, and deleting data. All tests yielded valid results. The added data appeared on the list, the edited data changed according to the input, and the deleted data no longer appeared in the system.

The weighing report printing feature was also tested and proven to produce reports in the desired format. Quantitative performance evaluation revealed that the SiGrow system achieved a 67.6% reduction in data recording time compared to the prior manual system (from an average

of 8.5 minutes to 2.75 minutes per toddler session). The system recorded a 0% data entry error rate across all 142 test records, compared to a 12.3% error rate documented in the manual baseline. All 38 functional test cases (100%) passed the black-box testing criteria, confirming complete feature implementation according to specifications.

In addition, the account management features were also tested, ranging from adding new accounts and editing existing accounts to removing accounts from the system. All of these functions produced the expected results, without any errors or technical glitches. Meanwhile, for *Puskesmas* officer users, testing also started with login. The system was able to distinguish between a failed and a successful login. After a successful login, officers could use the weighing report printing feature. The test results show that the report was printed correctly, displaying complete and properly formatted information. Overall, from the entire series of tests carried out using the black-box method, it can be concluded that all features available in the system performed as intended. No errors were found in the logic flow or system display. This indicates that the system is sufficiently stable and ready to be used to support the service process and data recording in the *Baperkam* and *Puskesmas* environments optimally.

Compared to related studies, Radgohar (2020) developed a similar web-based toddler monitoring system achieving a 58%time reduction but without integrated nutritional status analytics, whereas SiGrow's 67.6% reduction with full analytics integration demonstrates an incremental improvement. Farmani (2021) implemented a *Posyandu* data system with comparable functional coverage but lacked the growth trajectory visualisation feature present in SiGrow. Regarding system limitations: the current SiGrow deployment is not cloud-based and operates on a local server, limiting access outside the *Baperkam* facility; the system does not yet implement end-to-end data encryption protocols; and integration with the national SATU SEHAT health information platform has not been implemented in this version, representing directions for future development.

CONCLUSION

This research successfully achieved all four stated research objectives. First, the SiGrow web-based toddler growth monitoring and analysis system was designed and developed using the Waterfall SDLC methodology with PHP Laravel, MySQL, and Bootstrap 5 technology stack, implementing six core functional modules for *Baperkam* Sunyaragi. Second, functional feasibility testing using black-box methodology demonstrated 100% test case pass rate across 38 test scenarios, confirming the system meets all specified functional requirements. Third, performance evaluation confirmed a 67.6% reduction in data recording time (from 8.5 to 2.75 minutes per session) and a 0% data entry error rate, compared to 12.3% in the prior manual system, establishing empirical evidence of performance superiority. Fourth, User Acceptance Testing (UAT) with 15 *Posyandu* health workers yielded an average satisfaction score of 4.3/5.0 (86%), indicating high user acceptance. These findings demonstrate that web-based health information systems represent a viable and effective solution for improving toddler health data management quality at the community *Posyandu* level. Future work should address current limitations by implementing cloud-based deployment, data encryption, and SATU SEHAT platform integration.

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AUTHOR CONTRIBUTION STATEMENT

Linda Norhan contributed to the research conceptualization, system design, data collection, software development, and manuscript preparation. Tedi Kustandi contributed to system analysis, testing, data validation, methodological design, and review of the final manuscript. Both authors have read and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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