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Short Paper

Data-Driven Monitoring Platform for Barangay Health Workers (BHWs) in Community Health Services

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Abstract

Purpose – This study aims to address inefficiencies in the manual, paper-based processes employed by Barangay Health Workers (BHWs) in Santa Maria, Laguna, by developing a digital monitoring platform integrated with data analytics and geo-mapping capabilities to enhance community health service delivery.

Methods – The researchers employed descriptive and developmental research methods to design and implement a web-based system using PHP Laravel, JavaScript, and Mapbox. The platform facilitates health data collection, automated report generation, and predictive forecasting using Moving Average for deworming and Naive Forecasting with Drift for immunization services. The system's usability and acceptability were evaluated through the Technology Acceptance Model (TAM), measuring perceived ease of use, perceived usefulness, attitude toward use, and behavioral intention to use.

Results – Evaluation results from 84 BHWs and 5 midwives across 25 barangays indicated high acceptability and effectiveness of the platform. The system streamlined data management, enabled identification of high-risk areas, and improved proactive health planning. Integration of forecasting and spatial visualization allowed BHWs to transition from reactive to proactive health service delivery.

Conclusions – The digital monitoring platform demonstrated potential in enhancing the efficiency, responsiveness, and effectiveness of grassroots healthcare operations. BHWs were able to leverage data-driven insights for better health planning, showing that technology integration can significantly improve community health interventions.

Recommendations – Future enhancements should include upgrading the platform into a mobile application, incorporating offline access, applying advanced machine learning for improved forecasting, and establishing integration with Local Government Units (LGUs) and the Department of Health (DOH) to expand usability and impact.

Research Implications – This research highlights the capability of technology-driven solutions that can enhance the efficiency, accuracy, and responsiveness of Barangay Health Workers in providing essential services and will help to transform primary healthcare delivery in rural and underserved communities.

Keywords – Barangay Health Workers, Data Analytics, Geo-Mapping, Health Monitoring System, Predictive Forecasting

INTRODUCTION

Health is a complex and multidimensional concept encompassing physical, mental, and social well-being. Recognized as a fundamental human right essential to individual dignity and societal development, health also represents a critical sector in the global economy. Access to healthcare should be equitable, ensuring that all individuals, regardless of social status, can attain optimal health (Lim, 2022). The World Health Organization (WHO) defines health not merely as the absence of disease but as a complete state of physical, mental, and social well-being (Karhausen, 2023; Conti, 2018). This comprehensive perspective acknowledges that wellness and illness can coexist and that health is a dynamic state requiring continuous attention (Karhausen, 2023).

In the Philippines, Barangay Health Workers (BHWs) play a pivotal role in delivering primary healthcare and health education at the community level. Established by the Department of Health (DOH), BHWs support local government units in providing essential healthcare services, particularly in underserved areas (Baliolaa et al., 2024; Altecin et al., 2023). Their contributions significantly improve community health outcomes by increasing access to medical services and fostering preventive care practices.

Despite their vital role, BHWs face significant challenges in efficiently managing health data, generating timely reports, and optimizing resource allocation. Based on the interview with the BHW Head under one local government unit in the study locale, current practices rely heavily on manual record-keeping, often using logbooks or paper forms, which results in slow, error-prone reporting and limits the ability to make timely, evidence-based decisions (Querri et al., 2020; Baliolaa et al., 2024; Soliman, 2024). Paper-based systems also create risks such as data duplication, loss, and compromised integrity, while reducing the capacity for rapid communication and service coordination (Dahilan & Encarnacion, 2024; Jamis et al., 2022).

The absence of technological tools like geo-mapping and data analytics further hampers BHW effectiveness. Without spatial visualization capabilities, BHWs cannot accurately identify high-risk areas, prioritize communities, or efficiently allocate healthcare resources (Reyna, 2023; Munir et al., 2024). Likewise, the lack of analytics limits their ability to generate actionable insights, forecast health needs, and support strategic planning (Islam & Jin, 2019; Орєхова, 2020; Font-Casaseca & Rodó-Zárate, 2024). Integrating geo-mapping and predictive analytics has been shown to enhance decision-making, improve service delivery, and enable targeted interventions in community health management (Komanpally, 2024; Munir et al., 2023; Sibiya et al., 2014).

To address these limitations, this study proposes the development of an advanced monitoring platform for BHWs. Unlike existing systems that primarily focus on basic record-keeping, the proposed platform integrates data management, geo-mapping, and predictive analytics into a unified system. By visualizing patient distribution and high-risk areas, the system enables BHWs to plan interventions strategically and allocate resources efficiently. Data analytics further allow for forecasting future healthcare needs, such as immunization and deworming requirements, while automated report generation reduces manual errors and improves operational efficiency.

The study presents an efficient and decision-support-oriented approach to BHW monitoring. While traditional systems are limited to storing and retrieving health records, the proposed platform combines spatial visualization, predictive insights, and real-time reporting to enhance planning, coordination, and evidence-based decision-making. This system not only digitizes records but also transforms them into actionable knowledge, enabling more effective and responsive community healthcare delivery. Overall, this study contributes a smart, data- driven, and location-aware monitoring system that not only digitalizes BHW records but also enhances planning, forecasting, and decision-making in community healthcare services.

General Objectives

The objective of this study is to develop a "Data-Driven Monitoring Platform for Barangay Health Workers (BHWs) in Community Health Services"

Specific Objectives:

1. To design a system that can manage Barangay Health Workers (BHWs) services and other related information with the following features:
   a) Census Service
   b) Maternal Care Service
   c) Family Planning Service
   d) Women in Reproductive Age Service
   e) Immunization Service
   f) Deworming Service

2. To develop a system that integrates technologies in the BHWs' health services such as
   a) geo-mapping for identifying specific health services
   b) forecasting using the Moving Average method for deworming
   c) utilize Naive Forecasting with Drift (Average Growth) for child immunization services

3. To evaluate the developed system for its acceptability-based Technology Acceptance Model (TAM).

CONCEPTUAL FRAMEWORK

Figure 1 illustrates the structured process of the BHWs Monitoring Platform, which helps track health services and data-driven decision-making. The system requires BHWs, Midwives, and the BHW President to log in with their respective credentials to access their designated functionalities based on their roles. The BHWs are responsible for data entry and health record updates, including census, family planning, deworming, maternal care, women of reproductive age, and immunization. The system enables them to create reports and manage duty schedules, using a dashboard with graphical outputs of some key health data indicators, such as counts/ statistics of floristic population and immunization coverage.

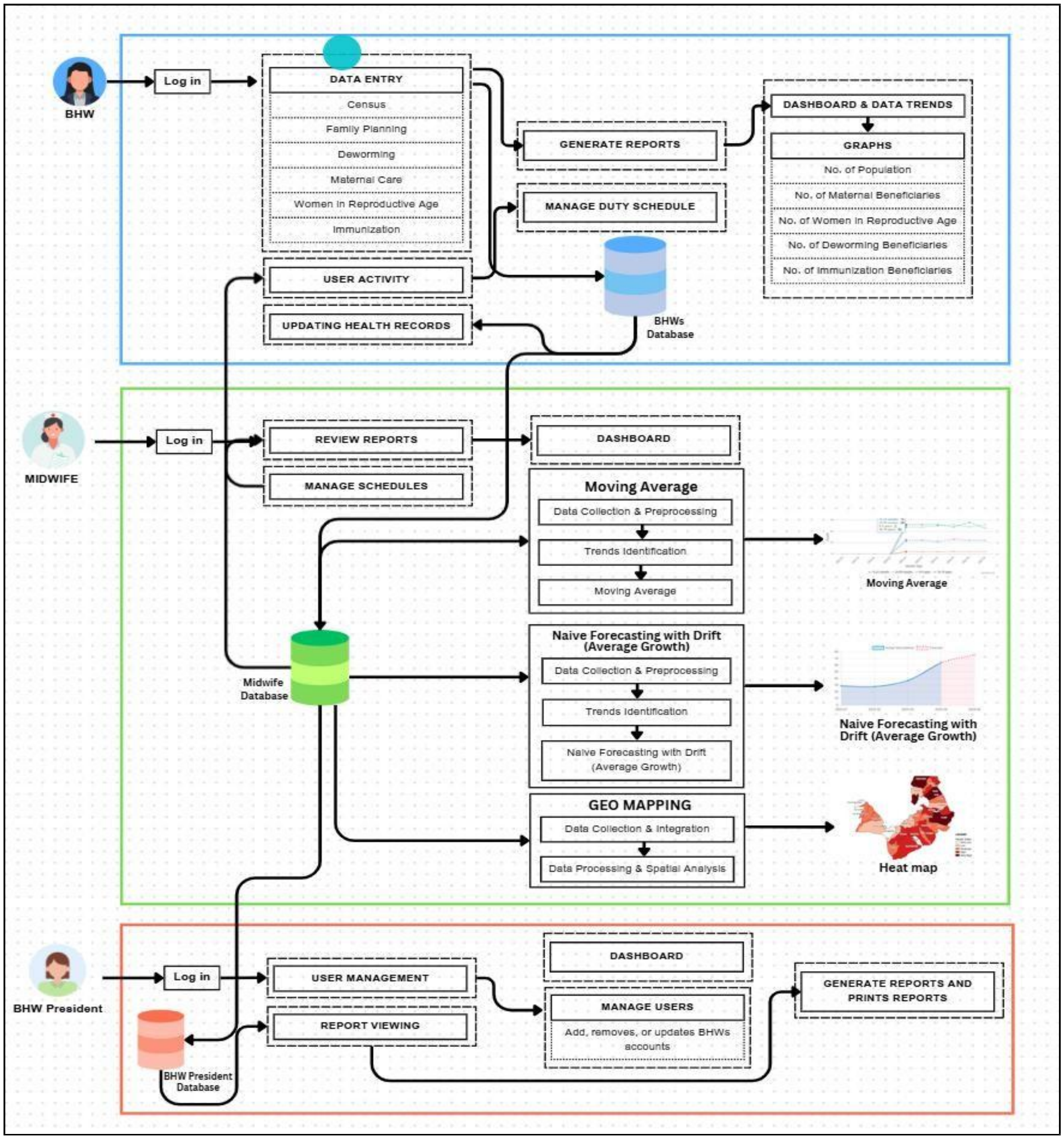


Figure 1. Barangay Health Workers (BHWs) Monitoring Platform

The midwives use the dashboard in undertaking report writing and managing duty schedules, and access the dashboard, with data analytics features that integrate data analytics and linear regression for forecasting to examine the historical Trend in health service demands. The geo-mapping features provide a visual representation of the spatial distribution of health services and the spatial health needs of the population requiring the use of the health service, to improve the efficiency/ sustainable allocation of resources. The BHW President is responsible for the user management and viewing of report activities. The system provides the ability to print the report, which requires an accurately recorded report, and the data is allowed to reflect purposeful evidence in data-driven decision-making. By using predictive and data visualization strategies, the system aims to optimize the potential health monitoring capability, targeted resource allocation, and appropriate health care intervention strategies to address health service demands among the community.

METHODOLOGY

Research Design

The researchers will use descriptive and developmental research designs to create and evaluate the Barangay Health Workers (BHWs) Monitoring Platform. Descriptive research will help understand current BHW workflows through surveys, interviews, and observations (Deckert & Wilson, 2023), while developmental research will focus on user needs, prototyping, and usability testing to ensure the platform is user-friendly and effective (Andrianda & Dhewanto, 2023). The researcher will interview the BHW President to guide the platform's development, which will feature data analytics and geo-mapping to improve health service delivery.

Population of the Study

The study involved 88 participants—84 Barangay Health Workers (BHWs) and 5 midwives—from 25 barangays in Santa Maria, Laguna. It aimed to analyze healthcare monitoring practices and explore how data analytics, including forecasting and geo-mapping, can enhance health interventions. Barangays like Talangka and Bagong Pook had the most BHWs, while others had only one. By incorporating input from both BHWs and midwives, the study captured diverse community health challenges and informed the development of a system to streamline health service delivery.

Sampling Design

This study uses total enumeration, which means that all 84 Barangay Health Workers (BHWs) from 25 barangays in Santa Maria, Laguna will be included as respondents. Instead of selecting a sample, this method collects data from every BHW in the area. Total enumeration is used because the number of BHWs is manageable, and including everyone helps get a complete and accurate understanding of their experiences, challenges, and needs. Since BHWs are the main users of the monitoring platform, it is important to gather their direct feedback to ensure that the system is truly useful for their work.

The study avoids sampling bias and resulting inconsistencies by including all BHWs, rather than only selecting some population members. This strengthens the validity and usefulness of the results for providing better health services in the community. Also, since all BHWs will use the system, they will collectively provide and inform insights on platform refinements and future improvements, based on the actual user experience. This allows the evaluation of the system, user acceptability, and data analytics implementation to be built on actual data from a complete target population of BHWs, enabling more informed decision-making to establish a more effective monitoring system.

Table 1. The population of Barangay Health Workers (BHWs) in Santa Maria, Laguna

BARANGAY	CLASSIFICATION	NO. OF BARANGAY HEALTH WORKERS (BHWS)
Adia	Lowland	4
Bagong Pook	Lowland	8
Bagumbayan	Lowland	5
Bubucal	Lowland	2
Cabuoan	Lowland	6
Calangay	Lowland	1
Cambuja	Lowland	2
Coralan	Lowland	8
Cueva	Upland	5
Inayapan	Lowland	1
JP. Laurel	Upland	3
J. Rizal	Lowland	1
J. Santiago	Upland	4
Kayhacat	Lowland	2
Macasipac	Lowland	2
Masinao	Lowland	3
Matalinting	Upland	1
Pao-o	Upland	3
Para ng Buho	Upland	2
Poblacion Uno	Lowland	2
Poblacion Dos	Lowland	3
Poblacion Tres	Lowland	1
Poblacion Quatro	Lowland	2
Talangka	Lowland	9
Tungkod	Lowland	4
TOTAL		**84**

Data Collection Instrument

The researchers used a combination of methods to gather relevant data for the study. This included conducting interviews with the President of the Barangay Health Workers (BHWs) in Santa Maria, Laguna, to gain insights into their workflows and system needs. Additionally, literature reviews and online research were conducted to explore existing monitoring systems for BHWs. A user acceptability evaluation was carried out using a structured questionnaire based on the Technology Acceptance Model (TAM) to assess the system's effectiveness and user satisfaction.

The study utilized a structured questionnaire to assess four constructs of the Technology Acceptance Model (TAM): Perceived Ease of Use, Perceived Usefulness, Attitude Toward Use, and Behavioral Intention to Use. Respondents provided feedback on the developed system using a five-point Likert scale, ranging from 1 (Strongly Poor Acceptable) to 5 (Highly Acceptable). The collected data were analyzed to evaluate the system's impact on Barangay Health Workers' (BHWs) efficiency in managing health data and to determine the platform's overall usability and acceptance. In addition, Yilmaz and Yalcin (2024) explained that health information systems become more effective when users perceive them as easy to use and helpful in daily operations. Furthermore, Hussain et al. (2025) stated that perceived usefulness and perceived ease of use are strong factors that influence the adoption of technology in healthcare settings.

For interpretation of the Likert-scale responses, the study applied the following acceptability thresholds: 4.21–5.00 as Highly Acceptable, 3.41–4.20 as Moderately Acceptable, 2.61–3.40 as Acceptable, 1.81–2.60 as Fairly Acceptable, and 1.01–1.80 as Poorly Acceptable. This classification provided a standardized framework to measure and interpret user perceptions regarding system usability, usefulness, and behavioral intention to adopt the platform presented in the table.

Table 2. TAM Likert Scale and Interpretation

SCALE	NUMERICAL RATING	VERBAL INTERPRETATION
5	4.21–5.00	Highly Acceptable
4	3.41–4.20	Moderately Acceptable
3	2.61–3.40	Acceptable
2	1.81–2.60	Fairly Acceptable
1	1.01–1.80	Poor Acceptable

Statistical Treatment

Based on the study's questions, descriptive analysis was conducted to analyze the data collected. The Barangay Health Workers (BHWs) Monitoring Platform for Health Services in the Community (including data analytics) was assessed by subjective ease of use, perceived usefulness, attitude toward use, and behavioural intention to use. The researchers used weighted means, rank, and percentage as statistical instruments for the evaluation.

The collected data were sorted into tables and statistically analyzed to interpret/discuss the results. The researchers employed percentage and average weighted mean, both of which are widely recognized statistical methods. This approach is suitable for the study, as it allows for the quantification of participant responses.

Table 3. The researchers' analysis used appropriate statistical methods.

ANALYSIS	STATISTICAL TOOLS
Data Driven Monitoring Platform for Barangay Health Workers (BHWs) in Community Health Services Evaluation in terms of: •Perceived Ease of Use •Perceive Usefulness •Attitude Toward Use •Behavioral Intention to Use	Weighted Mean, Rank

Software Development Model

The researchers utilize Agile Methodology in designing the system for the project. This method includes planning, design, development, testing, deployment, and is followed by review. Each step can be iterated based on user feedback regarding the content, process, and design of the developing application. Meszaros (2024) states that continuous feedback from clients helps ensure that the final product meets user needs, thereby increasing satisfaction. Nur et al. (2025) highlighted that Agile implementation allows healthcare systems to adapt efficiently to changing user requirements and feedback, resulting in better system usability and performance.

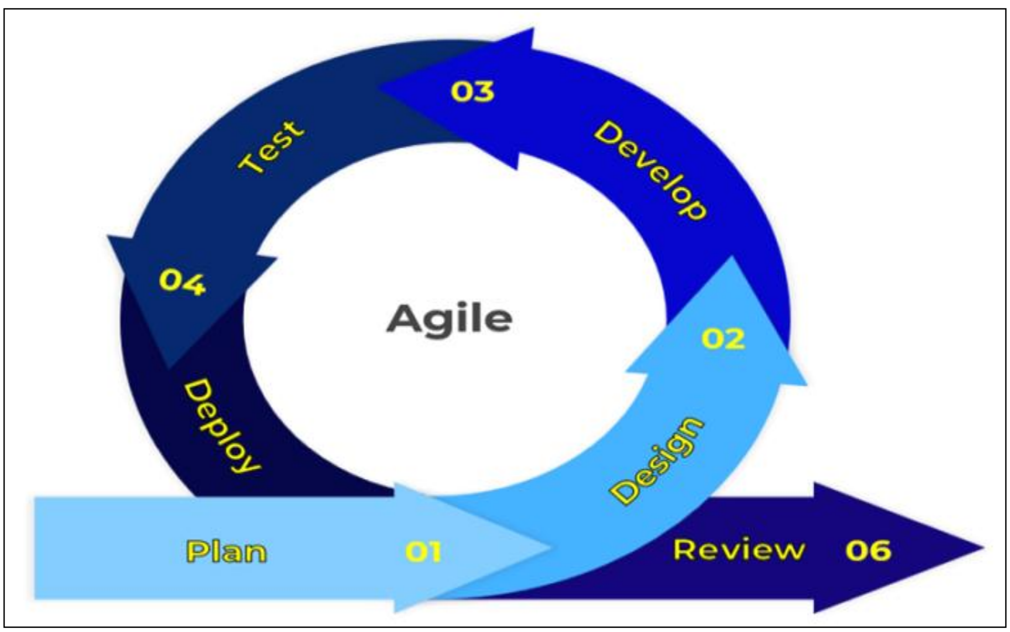


Figure 2. Agile Methodology

Plan Phase

From this phase, the researchers convened brainstorming sessions with all group members on what a new system for health workers and its processes would look like, what barriers and challenges the BHWs would face, and what kind of needs the BHWs would encounter when using the system. Finally, the team evaluated various platforms, tools, and technologies that would provide advantages for the development of the new system, such as software solutions to improve data management, report generation, and overall system efficiency. In order to complement the research output, the team decided to conduct interviews with Barangay Health Workers so that the findings from the interviews could be used to refine the features of the new system. By conducting the interviews with the BIWs, the researchers would be better informed of the work/personalities and issues faced by the BIWs and the expectations they have of a digital platform.

Design Phase

During the system design phase, the Barangay Health Workers (BHWs) Monitoring Platform with Geo-Mapping was meticulously planned to ensure functional robustness, scalability, and usability. The platform was architected to streamline data entry, facilitate report generation, and support data analytics, while leveraging geospatial mapping for enhanced visualization of health service coverage. The initial step involved requirements elicitation, identifying critical system functionalities such as user management, data handling, map-based visualization, reporting, and analytics. Particular emphasis was placed on user-centered design principles to ensure an intuitive and accessible interface for BHWs, Midwives, and the BHW President.

Mockups and wireframes were created using Canva, providing a structured and visually coherent representation of the user interface. This facilitated early validation of the interface flow, layout, and interaction design, enabling stakeholders to provide feedback before development commenced. Additionally, the researchers created the system architecture and data flow diagram, which outlined the structured organization of data content, processes, and inputs within the developed system.

Figure 3 is the system architecture, which was defined as a web-based platform supporting multi-role access. Users—comprising BHW Presidents, Midwives, and BHWs—interact through a responsive web interface accessible via laptops and mobile devices. Backend operations are hosted on a local server environment using XAMPP, ensuring efficient handling of database interactions and server-side processing. The technology stack includes: (a) Frontend: HTML, CSS, JavaScript, Chart.js, Mapbox for dynamic visualizations and interactive mapping. (b) Backend: PHP Laravel for routing, authentication, and business logic; (c) Database: MySQL managed through phpMyAdmin, ensuring data integrity and relational structure, and (4) Development Tools: Visual Studio Code for integrated coding and version management.

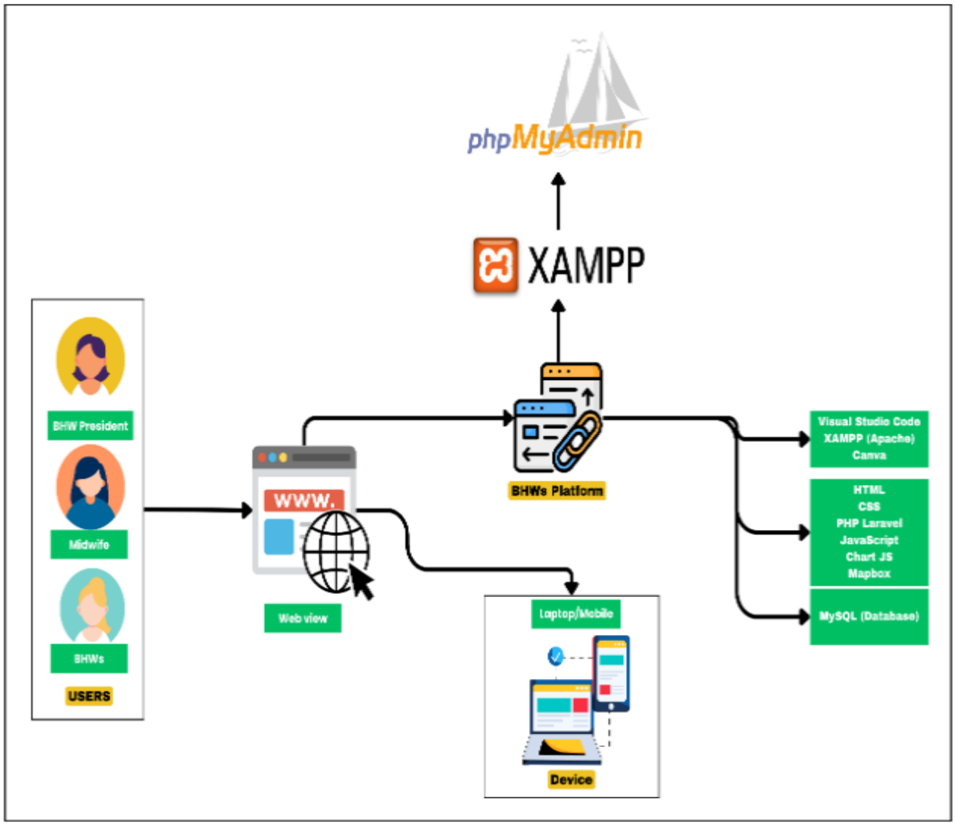


Figure 3. BHW's System Architecture

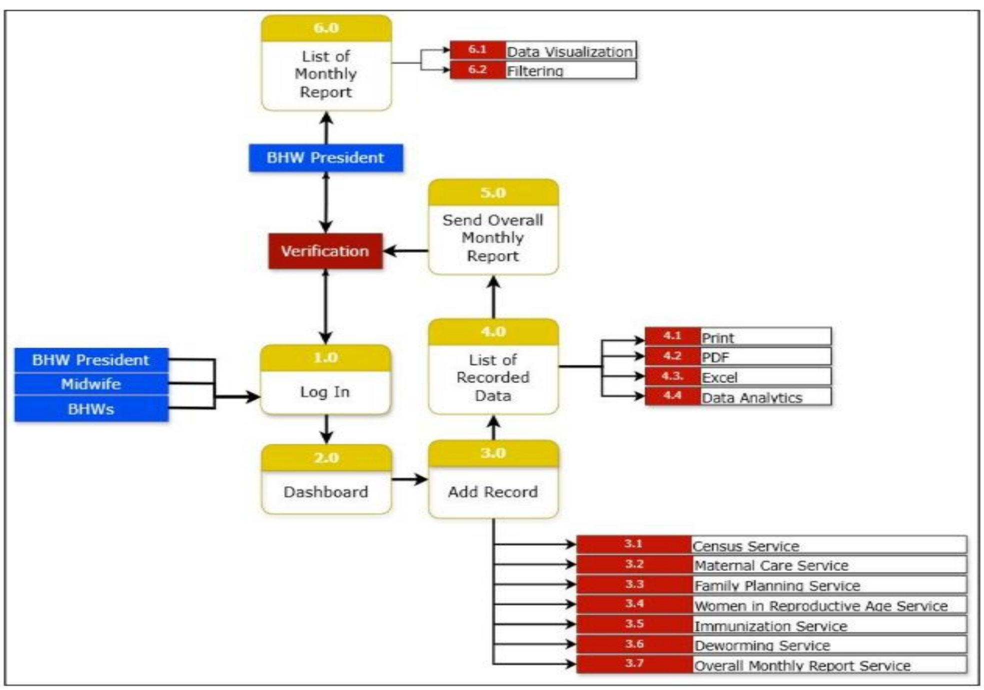
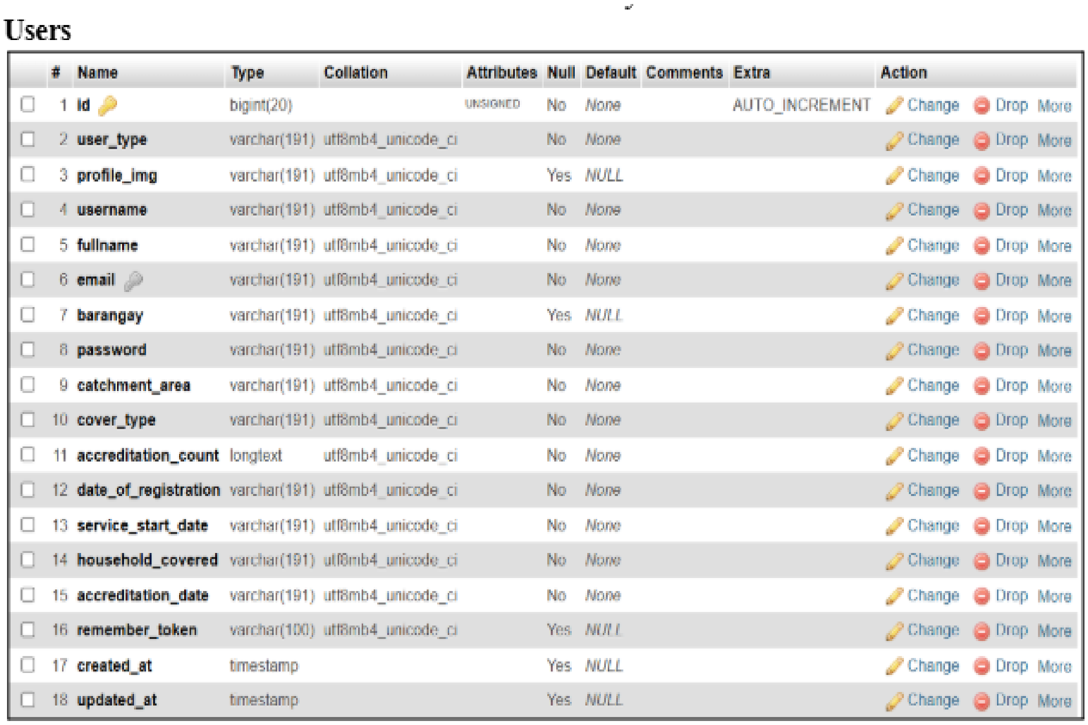


Figure 4. BHW's Data Flow Diagram

The data flow diagram (DFD) represents the logical movement of information within the system as shown in Figure 4. Users begin by authenticating via the login module (1.0) to access a dashboard (2.0), from which they can record health service data (3.0) across multiple modules such as census, maternal care, family planning, and immunizations (3.1–3.7). Entered data is compiled into a centralized records list (4.0), which supports export in multiple formats (PDF, Excel) and drives analytics (4.1–4.4). Before final submission, the BHW President verifies the data, which is then aggregated into a monthly report repository (5.0–6.0). Reports can be filtered, visualized, and analyzed to inform policy and operational decisions.


Users

#	Name	Type	Collation	Attributes	Null	Default	Comments	Extra	Action
1	id	bigint(20)		UNSIGNED	No	None		AUTO_INCREMENT	Change Drop More
2	user_type	varchar(191)	utf8mb4_unicode_ci		No	None			Change Drop More
3	profile_img	varchar(191)	utf8mb4_unicode_ci		Yes	NULL			Change Drop More
4	username	varchar(191)	utf8mb4_unicode_ci		No	None			Change Drop More
5	fullname	varchar(191)	utf8mb4_unicode_ci		No	None			Change Drop More
6	email	varchar(191)	utf8mb4_unicode_ci		No	None			Change Drop More
7	barangay	varchar(191)	utf8mb4_unicode_ci		Yes	NULL			Change Drop More
8	password	varchar(191)	utf8mb4_unicode_ci		No	None			Change Drop More
9	catchment_area	varchar(191)	utf8mb4_unicode_ci		No	None			Change Drop More
10	cover_type	varchar(191)	utf8mb4_unicode_ci		No	None			Change Drop More
11	accreditation_count	longtext	utf8mb4_unicode_ci		No	None			Change Drop More
12	date_of_registration	varchar(191)	utf8mb4_unicode_ci		No	None			Change Drop More
13	service_start_date	varchar(191)	utf8mb4_unicode_ci		No	None			Change Drop More
14	household_covered	varchar(191)	utf8mb4_unicode_ci		No	None			Change Drop More
15	accreditation_date	varchar(191)	utf8mb4_unicode_ci		No	None			Change Drop More
16	remember_token	varchar(100)	utf8mb4_unicode_ci		Yes	NULL			Change Drop More
17	created_at	timestamp			Yes	NULL			Change Drop More
18	updated_at	timestamp			Yes	NULL			Change Drop More

Figure 5. BHW's Data Dictionary

A data dictionary serves as a centralized repository detailing all system data elements, including data names, types, formats, constraints, and relational mappings as presented in Figure 5. Key entities include user profiles, census records, child immunizations, maternal care, family planning activities, and activity logs. This ensures consistency, clarity, and integrity across system modules, and facilitates communication among developers and end-users. The development adopted a modular approach, separating concerns between frontend interactivity and backend data management. PHP Laravel orchestrates backend operations such as routing, database queries, and session management, while JavaScript enhances client-side interactivity, including dynamic charts and geospatial visualizations. The integration of Mapbox enables geocoded mapping of service areas, improving spatial analysis and operational oversight.

Develop Phase

During the Develop phase, the researchers employed a combination of modern development tools and technologies to construct the Barangay Health Workers (BHWs) Monitoring Platform, ensuring full compliance with functional requirements and technical specifications. Visual Studio Code (VS Code) served as the primary Integrated Development Environment (IDE), facilitating efficient code writing, debugging, testing, and project organization. The system was implemented using PHP Laravel for backend development and JavaScript for dynamic, client-side functionality. Laravel handled core backend processes including user authentication, authorization, database operations, and business logic, while JavaScript enhanced the interactivity, responsiveness, and user experience of the frontend interface. For data management and hosting, a local environment was established using XAMPP, integrating Apache as the web server and MySQL as the relational database management system. Structured dataset such as health records, census logs, and user profiles was stored within MySQL databases, deployed and tested in the local Apache environment to ensure data integrity, security, and seamless retrieval.

To support predictive analytics and operational planning, the platform incorporated time-series forecasting techniques. The Moving Average method was applied to estimate the target population requiring deworming based on historical trends, while Naive Forecasting with Drift projected future vaccine stock levels, factoring in previous distributions and temporal patterns. These forecasting modules enabled proactive resource planning and evidence-based health management. Geospatial visualization was implemented through Mapbox, enabling users to map and analyze the geographic distribution of health service data. This feature provided insights into outreach coverage across barangays, facilitating data-driven decisions for resource allocation and service optimization.

Test Phase

After the system was developed, the researchers tested the platform with the intended users to identify any errors that needed to be fixed during the testing phase, allowing for quick improvements. They followed a structured process to design both the database and the system functionalities. Testing was conducted through a face-to-face setup, assessing perceived ease of use, perceived usefulness, attitude toward use, and behavioral intention to use to determine if the application met user needs. The platform was also tested on different devices to evaluate its compatibility. During this phase, several issues were identified, including a login malfunction on mobile devices where the login button became unresponsive, slow loading times on low-bandwidth connections, and data submission errors where form entries were not consistently saved due to validation problems. These bugs were documented for resolution to enhance the platform’s overall performance and reliability.

Deploy Phase

After receiving the results of the validation of the system's effectiveness and the positive impact on the MHWs, the researchers subsequently deployed the monitoring platform for the MHWs in Santa Maria, Laguna, through a face-to-face installation to enable proper orientation and hands-on assistance to users of the monitoring platform. After the deployment of the monitoring platform, the researchers conducted a survey on the experience of users of the monitoring platform to guide future enhancements.

Review Phase

Once the system was deployed, the researchers evaluated each module to confirm that it was functioning correctly. They also inspected the scripts and routing to ensure they were working as intended and recorded any feedback.

Data Analytics Application

The Barangay Health Workers (BHWs) Monitoring Platform is a data analytics system that seeks to enhance the delivery of health services in communities. The system begins with descriptive analytics, which describe and visualize the information BHWs enter into the system. The information consisted of census, maternal health, family planning, immunization, and deworming data. The platform describes and visualizes this data through charts and summary boxes on a dashboard that allows BHWs and midwives to visualize and quickly identify what is occurring in their area. This functionality allows BHWs and midwives to monitor their progress, identify the most used services, and plan their activities.

Also, descriptive analytics provides not only the past or current state of data but also provides predictive analytics, which forecasts or predicts future data. For example, the system uses a Moving Average forecasting method to predict how many people will need deworming next time.

A moving average is represented mathematically as (Equation 1):

Formula: WMA= $$\frac{\sum_{i=1}^{n} w_i \cdot y_i}{\sum_{i=1}^{n} w_i}$$ *Equation 1*

Where:

- y_i = Data value at position i
- w_i = Weight assigned to value y_i
- n = Number of data points

The platform also uses another forecasting technique: Naive Forecasting with Drift to estimate how many vaccines will be needed for immunization. This formula for this method is shown in Equation 2. These forecasting tools help the health workers prepare ahead of time, like making sure enough medicine or vaccines are available and deciding where to focus their efforts. This forecasting technique makes health services more organized and ready for future needs.

Formula: Forecast at $t + h = X_{t} + h \cdot \left(\frac{X_t - X_1}{t-1}\right)$ *Equation 2*

Where:

- X_t= Latest observed value
- X_1= First value
- *t* = Number of observed periods
- *h* = Number of steps ahead to forecast

The data used for these analytics comes from 25 barangays in Santa Maria, Laguna. BHWs enter the data into the system every day using digital forms. This becomes the process data, which means it is the information that the system uses to create reports and forecasts. Everything is saved in one place, making it easy to track and analyze. With this system, BHWs no longer need to rely on paper records, and they can make better decisions based on accurate and updated information. This leads to faster service and better healthcare for the community.

RESULTS AND DISCUSSIONS

The system enables Barangay Health Workers (BHWs) to transition from paper- based records to a web-based health information system, which improves speed, accuracy, and accessibility of health data entry and monitoring.

BHW Service Management System

The inclusion of real-time dashboards and analytics allows users to immediately view key health indicators. Figure 6 shows summary metrics like population, maternal care, and immunization, plus charts for deworming and family planning, giving BHWs clear insights into service coverage and community health trends. It shows the sidebar menu of the BHW Monitoring Platform, providing easy access to key features. Under "My Services," users can manage data for Census, Maternal Care, Family Planning, and more. Quick links for lists, reports, and schedules support efficient navigation and task management.

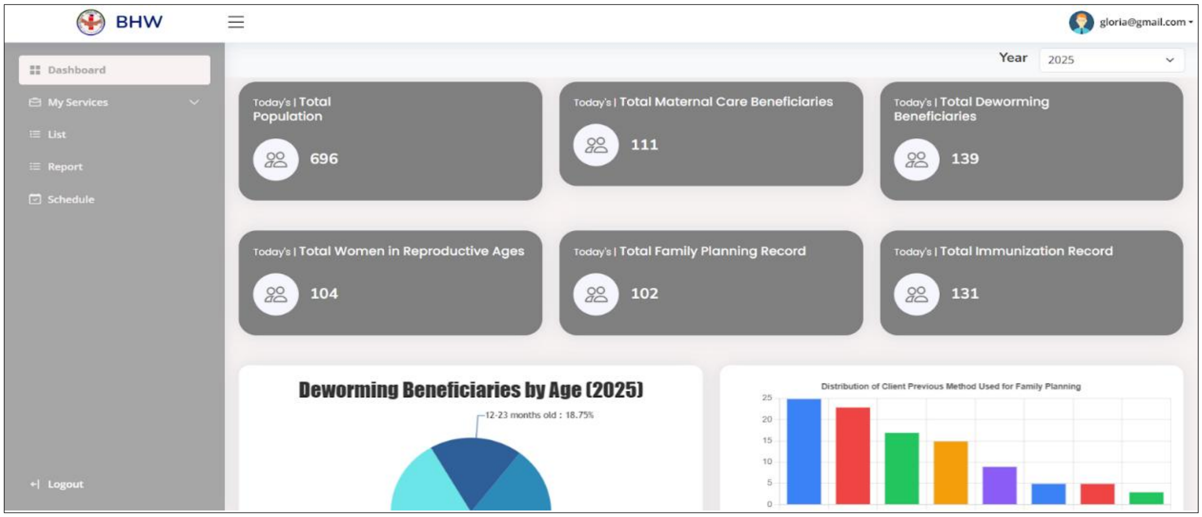


Figure 6. Dashboard

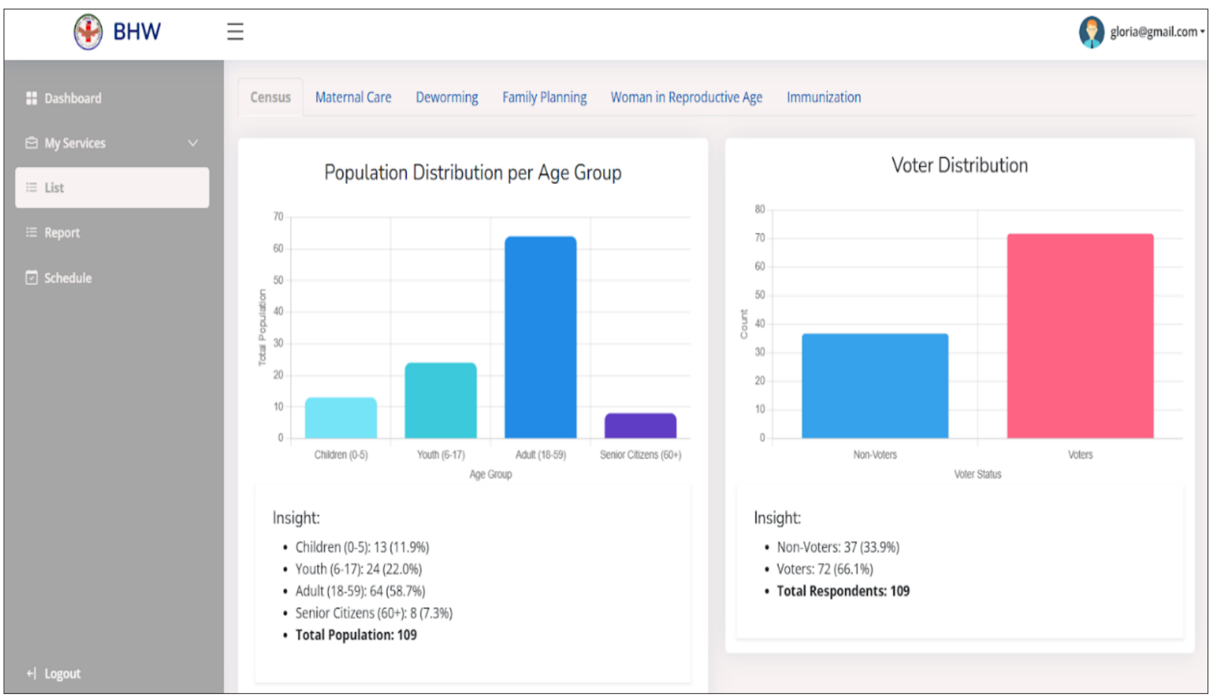


Figure 7. List of Reports

List of Reports section in the Barangay Health Workers (BHWs) Monitoring Platform, where users can access summarized data for various health services. At the top of the interface, there is a navigation menu that allows users to view lists and reports for services such as Census, Maternal Care, Deworming, Family Planning, Women in Reproductive Age, and Immunization. Each report includes visual representations of the data to support easier interpretation and analysis. In this example, the left chart shows the Population Distribution per Age Group, with adults (18-59 years old) representing the largest portion of the population. The right chart presents the Voter Distribution, showing a higher number of voters compared to non-voters. These visualizations help BHWs understand community demographics more clearly, which supports better planning and delivery of health services, as shown in Figure 7.

Figure 8 shows the interface of the BHW (Barangay Health Worker) Activities Monthly Report for April 2025. This digital form is part of an online reporting system developed to monitor and document health-related activities at the barangay level. It serves as a summary of the BHWs' monthly accomplishments. The report is automatically generated using data submitted by BHWs through service forms and daily input entries. This system streamlines data collection and reporting, ensuring that the information reflected is accurate and up to date.

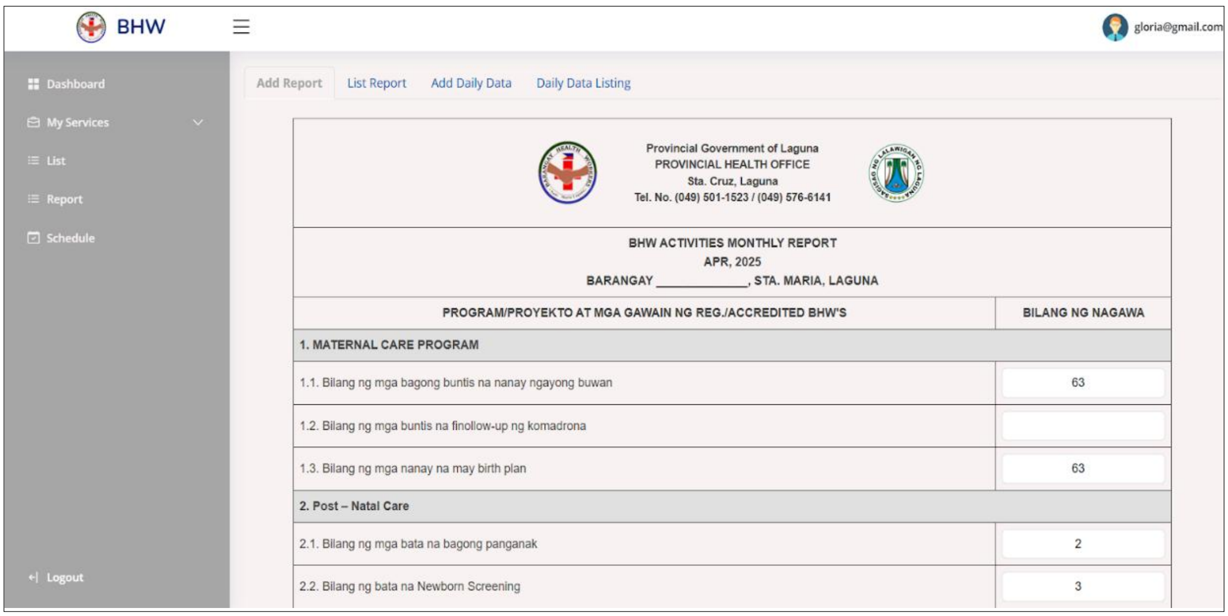


Figure 8. Monthly Report

The developed system successfully transitions Barangay Health Workers (BHWs) from traditional paper-based processes to a centralized web-based platform that improves data entry, storage, retrieval, and reporting of health services. The system integrates dashboards and automated reporting features that allow real-time monitoring of key health indicators such as maternal care, immunization, deworming, and family planning, making health data easier to organize and interpret. This is supported by Amer et al. (2022), who found that mobile and digital health systems improve accessibility of health information and enhance efficiency in community health reporting. In addition, Wang et al. (2022) explained that technology acceptance in mobile health systems is strongly influenced by perceived usefulness and ease of use, which leads to better adoption among health workers. Furthermore, Aljedaani et al. (2020) emphasized that mobile health systems improve service delivery by increasing accessibility and reducing delays in health-related information processing.

However, a limitation of the system is that its accuracy still depends on correct user input, meaning that incomplete or incorrect encoding may affect report reliability, as well as its dependence on stable internet connectivity, which may reduce usability in remote barangay areas. Despite these limitations, the system aligns with recent studies showing that digital health platforms improve efficiency, usability, and decision-making while strengthening community health monitoring and reporting systems.

BHW Generating Report Module

The BHWs Monitoring Platform features input forms that simplify data collection and enhance health service delivery, as shown in Figure 9. These include forms for Census, Maternal Care, Family Planning, Women in Reproductive Age, Child Immunization, and Deworming. Each form captures essential health and demographic data to support accurate records, efficient tracking, and improved decision-making in community healthcare.

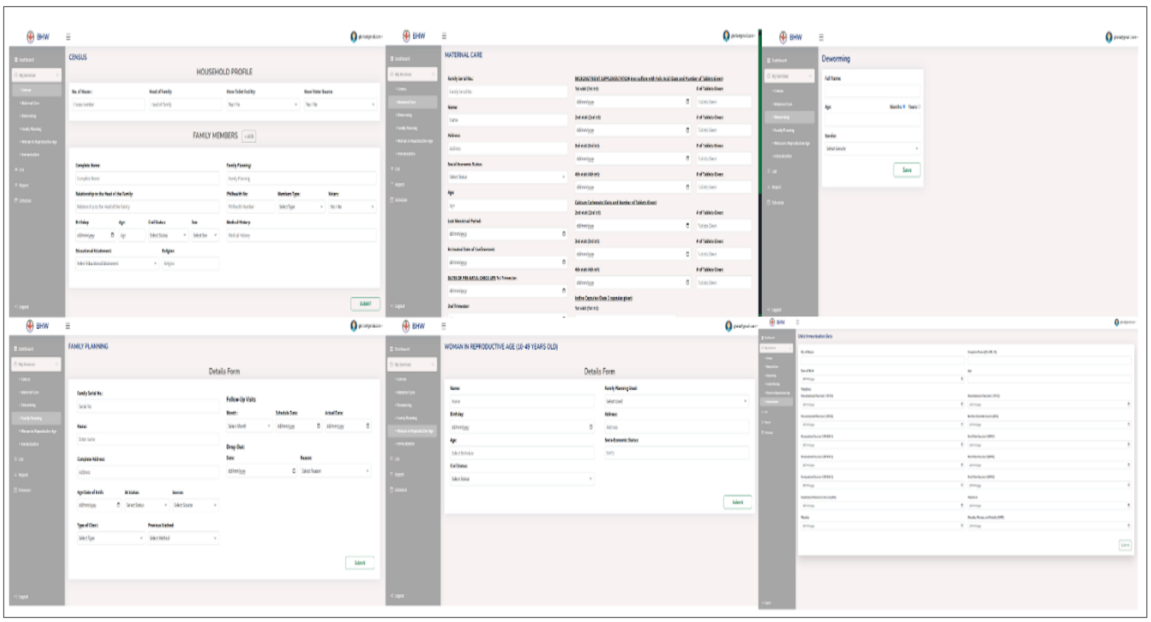


Figure 9. BHW Monitoring Platform forms

The BHW Monitoring Platform provides visual and tabular reports across health services to support data-driven decisions, as shown in Figure 10. It includes summaries for census, maternal care, infectious diseases, family planning, women of reproductive age, child immunization, and deworming. The integration of charts and tables allows Barangay Health Workers (BHWs) to easily interpret trends, compare distributions, and monitor individual records, which improves planning and early identification of health concerns.

The system aims to develop a platform that enables BHWs to efficiently generate accurate and comprehensive health reports. This helps improve the encoding process and organizing data into a structured digital form, reducing duplication and minimizing errors. Odeh et al. (2023) reported that digital data collection systems enhance healthcare efficiency by ensuring consistent and reliable health records for community-based services. Similarly, Abdelwahab et al. (2022) demonstrated that structured electronic health forms improve data completeness and accuracy by guiding users through standardized input fields.

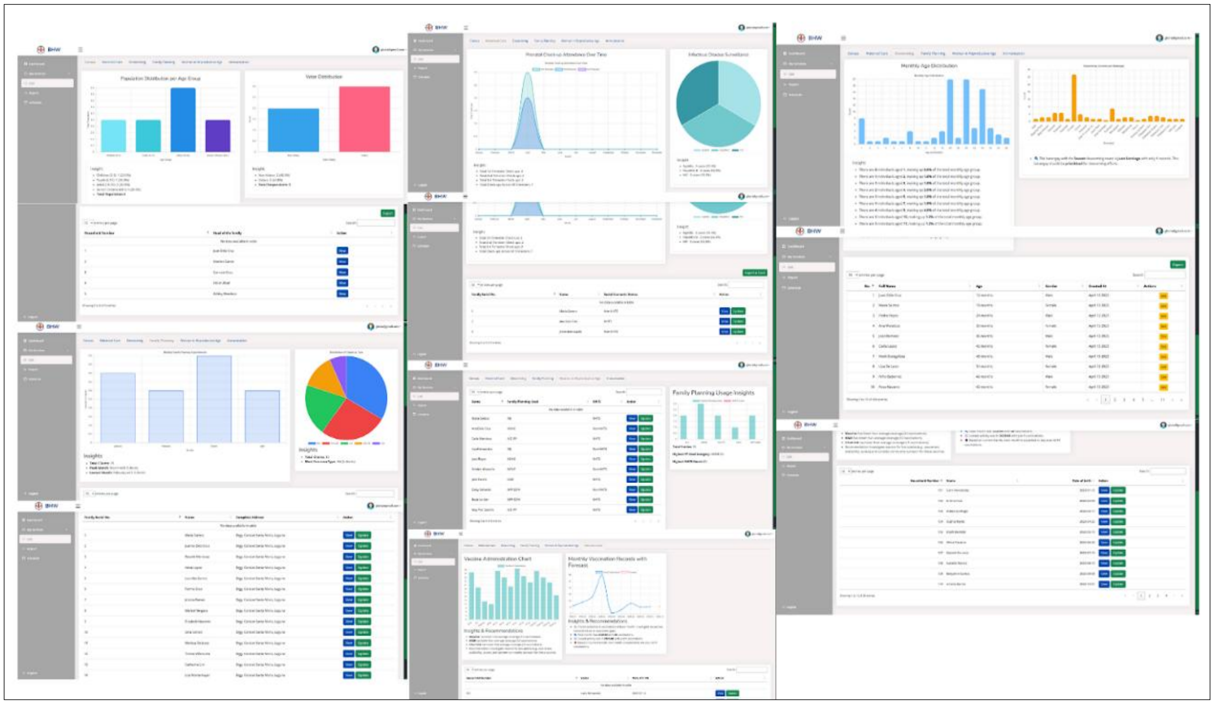


Figure 10. Data Analytics with summary report list in BHW Platform Monitoring

The integration of charts and tables allows Barangay Health Workers (BHWs) to easily interpret trends, compare distributions, and monitor individual records, which improves planning and early identification of health concerns. According to Zhuang et al. (2022), healthcare dashboards enhance decision- making by transforming complex health data into visual representations that improve usability and task performance. Furthermore, Schulze et al. (2023) emphasized that public health dashboards strengthen situational awareness and improve communication of health trends through real-time visualization tools. Therefore, the system provides a significant improvement over traditional manual documentation by enhancing organization, reducing workload, and supporting faster and more reliable health services.

BHW Geo-mapping Application

The system uses digital forms completed by Barangay Health Workers (BHWs) to collect health data from various barangays, covering services like maternal care, immunization, family planning, and deworming. Figure 11 shows areas with no health or demographic data from Barangay Health Workers (BHWs), highlighting gaps in service or reporting. Spotting these zones helps improve data collection and ensures health services reach all barangays fairly.

Figure 11. Baseline Map with No Health or Demographic Data Displayed

The data input form utilized by Barangay Health Workers (BHWs) is specifically related to entering client information for family planning services. The form serves as a structured interface where BHWs can systematically input relevant data as shown in Figure 12. Once the information is accurately filled out and submitted, it is securely recorded and stored within the system's database. This collected data plays a vital role in the following processes, as it is used for analysis, monitoring, and visualization.

Figure 13 displays a geo-mapped view of Santa Maria, highlighting the active data points corresponding to various health services reported by Barangay Health Workers (BHWs). The colored markers represent different service categories: red for family planning, green for immunization, blue for census, yellow for maternal care, and white for women in reproductive health. The clustered distribution of these markers indicates areas with active BHW engagement and extensive health service delivery. This visualization aids in understanding service concentration and gaps, enabling more targeted and equitable planning for health interventions within the municipality.

Overall, the use of geo-mapping in the BHWs Monitoring Platform proved to be a valuable tool in identifying areas that require immediate health interventions. By transforming raw health data into a visual map, the system provided a clear and accessible way for Barangay Health Workers to assess which barangays had the highest health service needs. This allowed for better planning, prioritization, and allocation of resources, ensuring that efforts are directed to where they are most needed. The results demonstrate that integrating data analytics with geographic visualization can significantly enhance the efficiency and effectiveness of community health programs.

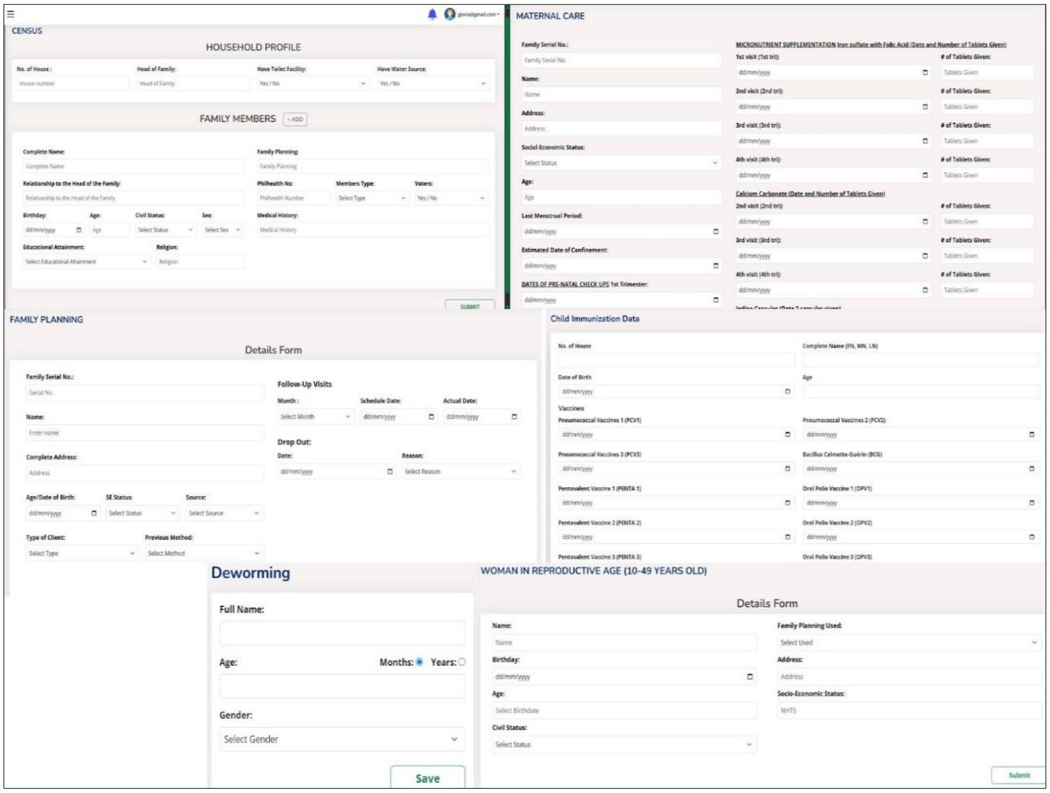


Figure 12. Data Input Forms

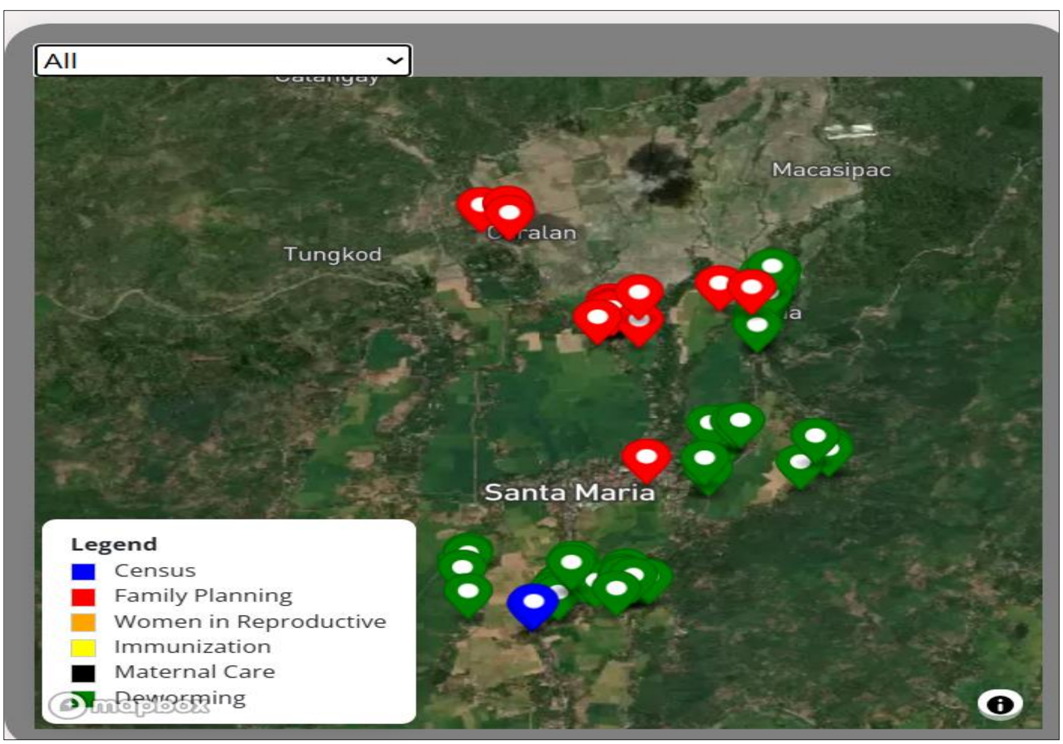


Figure 13. Geographical Distribution of Health Services with Active Data Points

This idea is supported by Kienberger and Steinbruch (2021), who explain that spatial health mapping helps local health systems identify vulnerable populations by clearly showing where health services are lacking. In the same way, Zhou et al. (2022) found that geospatial dashboards improve local health decision-making by making health data easier to understand and helping health workers respond faster to community needs.

Geo-mapping encourages community participation by providing visual tools that enhance the understanding of local health issues, empowering residents to engage in health initiatives. It also helps identify community assets and resources that can improve health services (Loaiza & Alvarez, 2023). Other studies use the mapping features (Abante et al., 2023) to easily locate the exact location of the report, so the response team can provide assistance, while Goh et al. (2023) integrate mapping that analyzes data as a basis for the development of policy areas to reduce risk and give priorities and needs of the community.

Moving Average Method for Deworming

The system enhances health service planning by using the Moving Average method to forecast deworming needs across age groups. This data-driven approach helps BHWs identify trends, service gaps, and seasonal patterns for better resource allocation. Forecasts are visualized in dashboards, enabling informed, targeted outreach. For example, a projection of 32 deworming services for July 2025 helps identify priorities, while revealing low coverage in the 10–19 age group. Figure 14 shows the Deworming Input Form, where BHWs enter data that feeds into the forecasting model for accurate planning and analysis.

Figure 15 visualizes the deworming forecast from 2025 to 2027 by age group, showing a total of 68 projected beneficiaries. The 5–7 years group had the highest turnout, while July 2025 is projected to have 50 services, confirming Moving Average trends. The 10–19 years group remains the lowest, highlighting the need for targeted intervention.

The dashboard visualization further strengthens its usefulness by turning numerical forecasts into clear graphs, allowing BHWs to quickly interpret trends and make informed, data- driven decisions for deworming programs. Data quality issues, such as incomplete or delayed encoding by BHWs, can also affect forecast accuracy. Using the Moving Average method, the system forecasts deworming needs by analyzing past deworming records across different age groups, helping Barangay Health Workers (BHWs) plan, prepare sufficient medicine supplies, and allocate resources more efficiently. The method works by averaging past values over a specific time period, which reduces random fluctuations in the data and clearly shows underlying trends, especially in the 10–19 age group where service gaps are more noticeable.

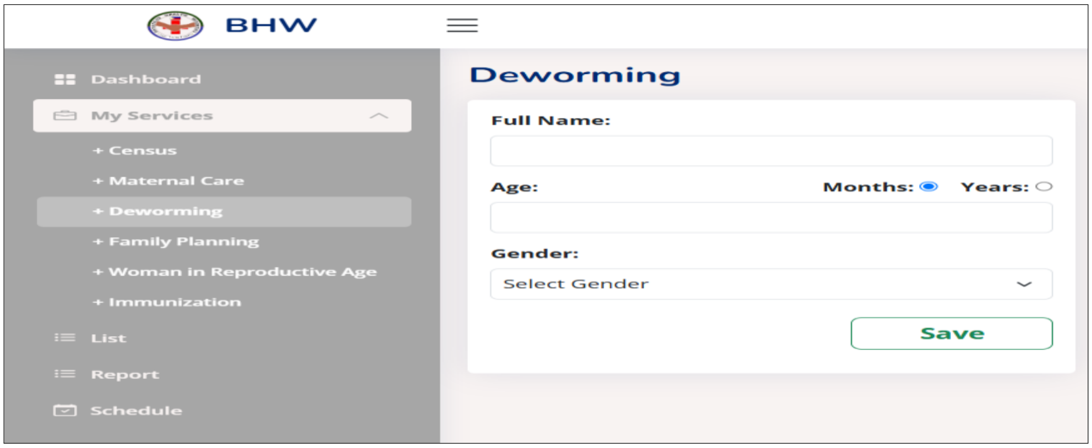


Figure 14. Deworming Input Form

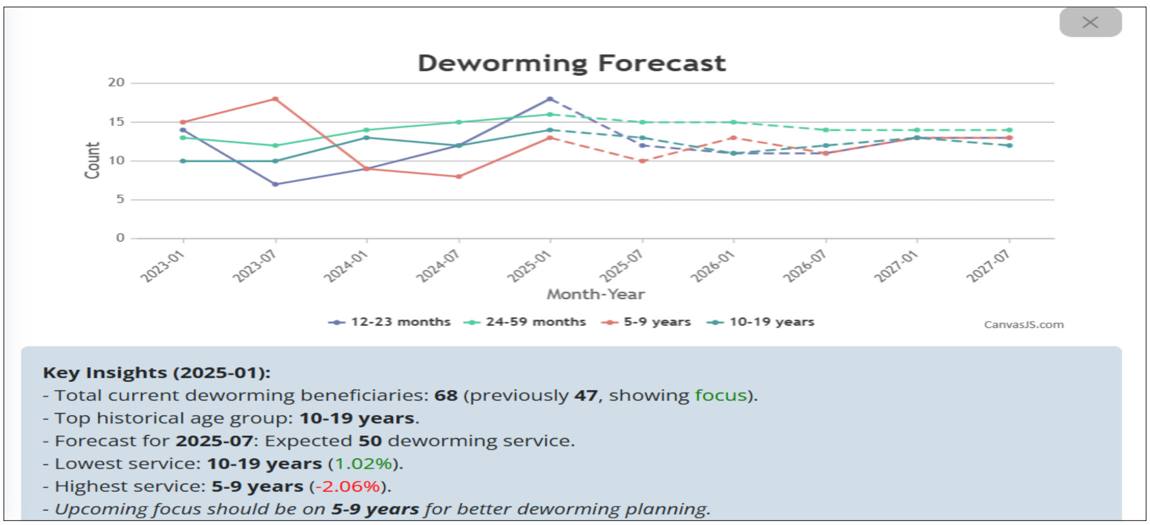


Figure 15. Deworming Forecast

This approach is supported by Arora et al. (2021), who explain that moving average models are effective for short-term public health forecasting because they are simple, stable, and useful even when data is limited or inconsistent. Visual dashboards make insights easy to interpret, enabling data-driven decisions that improve community health services (Jalalpour et al., 2015).

Naive Forecasting with Drift (Average Growth) for Child Immunization Services

The system uses Drift (Average Growth) forecasting to predict monthly child immunization needs by vaccine type, enabling better planning and resource allocation. Interactive dashboards let BHWs filter data by age and vaccine, supporting targeted interventions. Figure 16 shows the Immunization Input Form, where submitted data feeds into forecasts to guide service delivery more effectively.

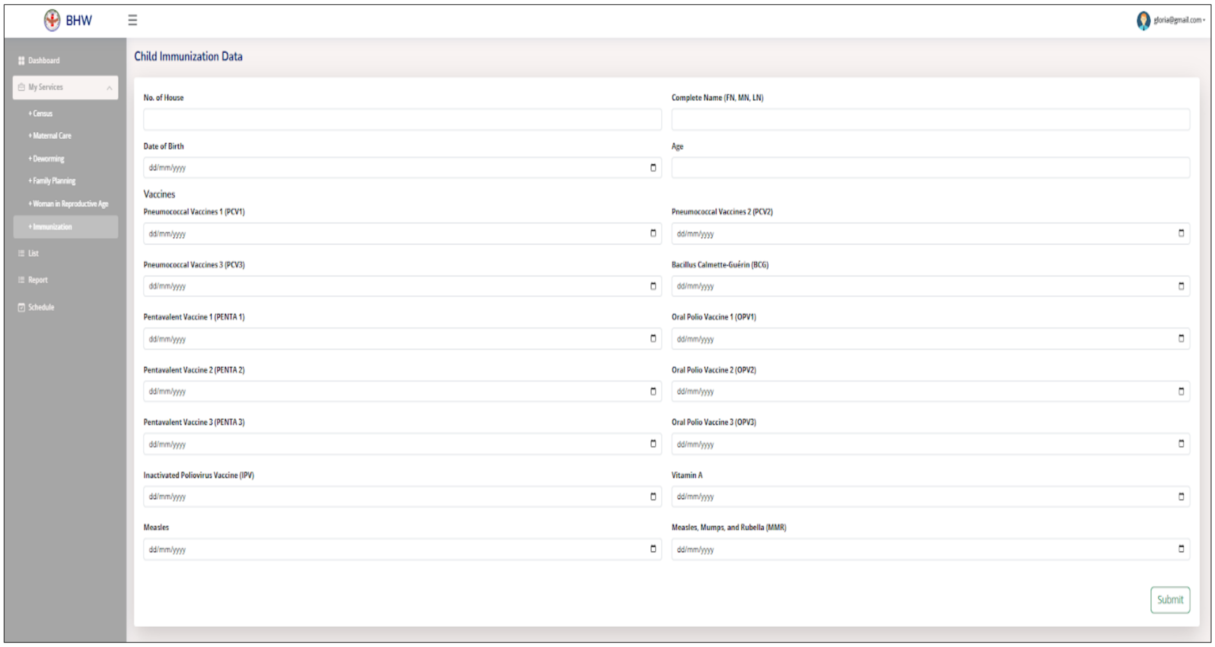


Figure 16. Immunization Input Form

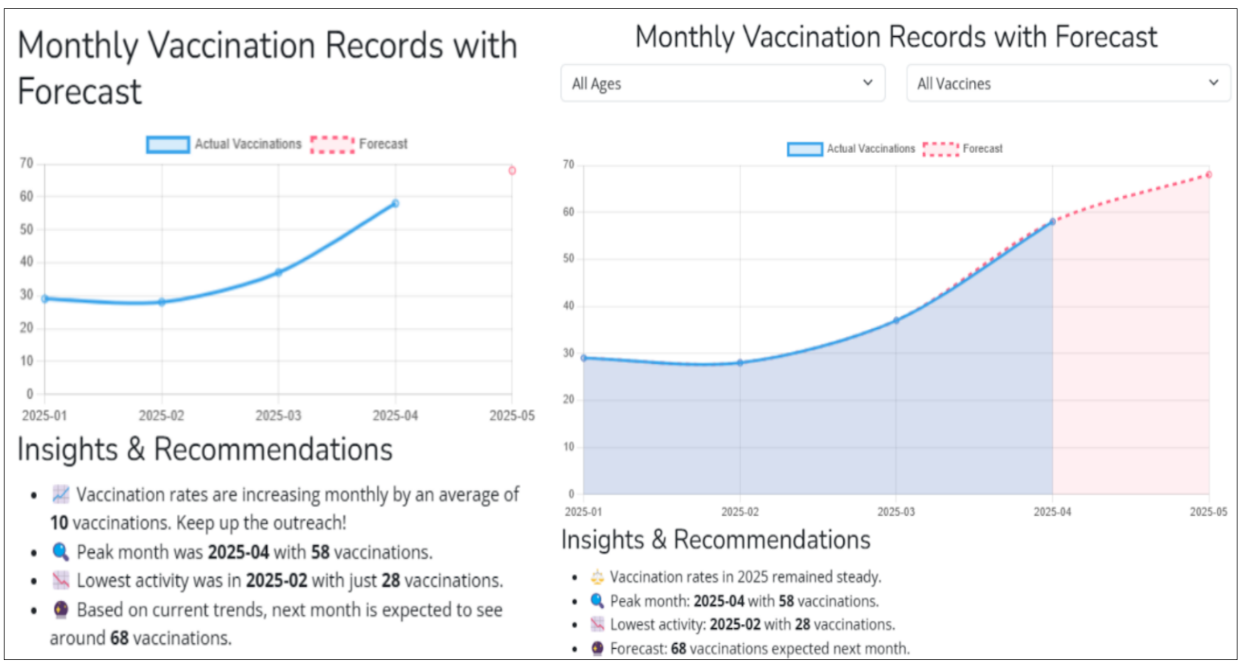


Figure 17. Immunization Forecast

Figure 17 illustrates monthly vaccination records and forecasts for 2025, highlighting trends such as a peak in April and a dip in February. Both figures project around 68 vaccinations for the upcoming month, confirming the model's accuracy. The other one, located in the dashboard, includes interactive filters for age and vaccine type and also suggests further investigation into declining rates, supporting proactive, data-driven planning.

The forecasting feature in the BHW Monitoring Platform effectively supports data-driven health planning. Using Naive Forecasting with Drift, it provides reliable immunization projections, helping BHWs anticipate demand, manage supplies, and ensure timely vaccinations. This process helps Barangay Health Workers (BHWs) anticipate vaccine demand, prepare adequate supplies, and schedule immunization activities more efficiently, ensuring that no barangay is left underserved. The approach is supported by Makridakis et al. (2022), who explain that simple forecasting methods such as naive and drift models remain highly competitive for short-term prediction because they are stable, interpretable, and effective even with limited health data. Similarly, Petropoulos et al. (2021) emphasize that baseline forecasting models are valuable in real-world public health systems because they provide strong benchmark predictions that are easy for non- technical users to understand and apply in decision-making.

However, data inconsistencies from incomplete or delayed encoding by BHWs may also affect prediction reliability. The system with visual dashboards further enhances its usefulness by translating forecast outputs into clear graphs, allowing BHWs to quickly understand immunization trends and make timely, evidence-based decisions for better community translating forecast outputs intro clear graphs, allowing BHWs to quickly understand immunization trends and make timely, evidence-based decisions for better community health service delivery.

TAM Evaluation for the Developed System

To assess the adoption of the BHW Monitoring Platform, the study used the Technology Acceptance Model (TAM), focusing on Perceived Usefulness and Perceived Ease of Use. This helped evaluate how Barangay Health Workers (BHWs) and midwives viewed the system in terms of efficiency, usability, and its contribution to healthcare service delivery.

The results showed that the Table 4 BHW Monitoring Platform achieved a high level of acceptance among BHW respondents. Perceived Usefulness obtained a mean score of 4.19 with a standard deviation of 0.58 and was interpreted as "Acceptable." This indicates that respondents believed the system could improve healthcare monitoring and data management, while the standard deviation shows that the responses were fairly consistent among users. Perceived Ease of Use obtained a mean score of 4.24 with a standard deviation of 0.52 and was interpreted as "Highly Acceptable," indicating that respondents found the platform easy to learn and operate. Meanwhile, Attitude Toward Use and Behavioral Intention to Use both obtained the highest mean score of 4.26, with standard deviations of 0.49 and 0.50, respectively. These results indicate that respondents had a very positive attitude toward the system and showed willingness to continue using and recommending the platform. The overall grand mean of 4.24 with a standard deviation of 0.52 further confirms that the BHW Monitoring Platform was highly accepted by the respondents. Overall, the grand mean of 4.24 with a standard deviation of 0.55 confirms that the platform is highly acceptable in terms of usability, usefulness, and adoption potential.

These results show that the BHW Monitoring Platform is effective and well-received by midwife respondents, supporting its potential for wider implementation in community healthcare services. The relatively low standard deviation values across all criteria suggest that the respondents shared similar positive evaluations regarding the platform’s usability, usefulness, and effectiveness in supporting healthcare service delivery. According to Wang et al. (2024), positive user attitude and behavioral intention are key indicators of successful healthcare system adoption.

Table 4. Results of TAM (BHWs Respondents)

CRITERIA	MEAN	STANDARD DEVIATION	INTERPRETATION	RANK
Perceived Usefulness	4.19	0.58	Moderate Acceptable	4
Perceived Ease of Use	4.24	0.52	Highly Acceptable	3
Attitude Toward Use	4.26	0.59	Highly Acceptable	1
Behavioral Intention to Use	4.26	0.52	Highly Acceptable	2
Grand Mean	**4.24**	**0.55**	**Highly Acceptable**	

Table 5 presents the Technology Acceptance Model (TAM) results from the midwife respondents. All four criteria, Perceived Usefulness, Perceived Ease of Use, Attitude Toward Use, and Behavioral Intention to Use scored between 4.36 and 4.52 and were all interpreted as "Highly Acceptable." Perceived Usefulness obtained the highest mean score of 4.52 with a standard deviation of 0.41, indicating that the respondents strongly agreed that the system improves healthcare monitoring and efficiency, with closely similar responses reflected by the low standard deviation. Perceived Ease of Use recorded a mean of 4.36 with a standard deviation of 0.47, showing that the system is easy to use and understand. Behavioral Intention to Use also scored 4.36 with a standard deviation of 0.45, indicating that respondents are willing to continue using and recommending the platform.

Meanwhile, Attitude Toward Use obtained a mean score of 4.44 with a standard deviation of 0.39, reflecting a very positive perception of the system among midwives and a high level of agreement in their responses. Overall, the grand mean of 4.42 with a standard deviation of 0.43 confirms that the platform is highly acceptable in terms of usability, usefulness, and adoption potential. These results show that the BHW Monitoring Platform is effective and well-received by midwife respondents, supporting its potential for wider implementation in community healthcare services. This is supported by Garcia et al. (2023), who stated that high acceptance scores in healthcare systems suggest readiness for full-scale deployment in public health programs.

Table 5. Results of TAM (Midwives Respondents)

CRITERIA	MEAN	STANDARD DEVIATION	INTERPRETATION	RANK
Perceived Usefulness	4.52	0.41	Highly Acceptable	2
Perceived Ease of Use	4.36	0.47	Highly Acceptable	3
Attitude Toward Use	4.44	0.39	Highly Acceptable	1
Behavioral Intention to Use	4.36	0.45	Highly Acceptable	4
Grand Mean	**4.42**	**0.43**	**Highly Acceptable**	

Table 6 compares TAM results between BHWs and midwives across four criteria. BHWs rated Attitude Toward Use and Behavioral Intention highest (4.26), while midwives rated Perceived Usefulness highest (4.52) and had a higher overall mean (4.42 vs. 4.24). This indicates stronger platform acceptance among midwives.

Table 6. Comparison of Results Between BHWs and Midwives

CRITERIA	BHWs' MEAN	RANK	MIDWIVES' MEAN	RANK
Perceived Usefulness	4.19	4	4.52	2
Perceived Ease of Use	4.24	3	4.36	3
Attitude Toward Use	4.26	1	4.44	1
Behavioral Intention to Use	4.26	2	4.36	4
Grand Mean	**4.24**		**4.42**	

The TAM results show that the BHWs Monitoring Platform received a "Highly Acceptable" rating from both BHWs and midwives. BHWs rated Perceived Usefulness at 4.19, while midwives gave it 4.52. For Perceived Ease of Use, BHWs scored 4.24 and midwives 4.36. Both groups showed positive attitudes, with BHWs scoring 4.26 and midwives 4.44 for Attitude Toward Use, and similar scores for Behavioral Intention to Use (4.26 for BHWs, 4.36 for midwives). These results reflect strong acceptance of the platform's usability and potential for improving healthcare services. TAM is widely used to assess technology adoption in sectors like healthcare and education (Shania & Paramarta, 2024), as Liu et al. (2022) explain that higher acceptance scores indicate readiness for real-world implementation of mobile health systems.

CONCLUSIONS AND RECOMMENDATIONS

The study successfully developed and implemented the BHWs Monitoring Platform, achieving the primary objectives of enhancing health service data management and delivery in Local Government Units and Rural Health Services. System testing and user evaluation demonstrated that the platform effectively addressed challenges in data organization by providing a centralized, real-time, and dependable interface for recording, accessing, and coordinating health-related information. The platform streamlined manual workflows, improved performance efficiency among BHWs, and facilitated comprehensive monitoring of census, maternal care, immunization, family planning, deworming, and women of reproductive age services. Usability testing confirmed that the system's intuitive input forms strengthened accurate and consistent data entry while reducing cognitive load for users.

The system also includes geo-mapping with color-coded indicators, which helps BHWs visually locate and monitor health service coverage in different barangays. This makes it easier to identify areas that need immediate attention and helps improve decision-making in health service delivery. In addition, the system has forecasting features that help estimate future health service needs, especially for immunization and deworming programs. This allows health workers to prepare resources in advance and plan the delivery of community health services.

For future improvement, the system should be made more advanced and practical by adding a mobile application version. This will allow BHWs to access and update health records using smartphones or tablets, especially during fieldwork or home visits. The system should also include offline functionality so users can still input data even without an internet connection, and automatically sync once a connection is available. Automated alerts can also be added to notify BHWs about possible health risks or urgent cases. Machine learning or predictive features can also be enhanced to better identify health trends and potential outbreaks. Collaboration features should also be improved so that the system can easily share reports and data with Municipal Health Offices, Local Government Units (LGUs), and the Department of Health (DOH), improving coordination and response to health concerns.

IMPLICATIONS

The developed system can enhance the efficiency, accuracy, and responsiveness of Barangay Health Workers in providing essential services. Its capacity to visualize health coverage, identify high-risk areas, and anticipate future service needs supports evidence-based decision-making, better resource allocation, and proactive intervention planning. Moreover, the system's user-friendly design reduces cognitive burden and ensures consistent data entry, strengthening overall data quality. This data-driven monitoring system will transform primary healthcare delivery in rural and underserved communities.

DECLARATIONS

Conflict of Interest

The authors declare that they have no conflict of interest.

Inform Consent

Informed consent was obtained from the participants.

Ethics Approval

The authors' institution does not have a formal research ethics committee. This study involved minimal risk to participants and followed ethical principles for research involving human participants. Participation was voluntary, informed consent was obtained from all participants, and no personally identifiable information was collected.

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Author's Biography

Julius Ivy B. Tena is a graduate of Laguna State Polytechnic University (LSPU) in 2025 with a Bachelor of Science in Information Systems (BSIS) degree from the College of Computer Studies. In the same year, he became a full-time faculty member (non-plantilla) at LSPU, where he teaches Information Technology Education courses, mainly for students in the Bachelor of Science in Information Systems (BSIS) program. He is currently pursuing a Master of Information Technology degree at Laguna State

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Giselle D. Perida is a graduate of Laguna State Polytechnic University (LSPU)–Siniloan Campus, where she earned her Bachelor of Science in Information Systems (BSIS) degree under the College of Computer Studies in 2025. During her academic journey, she was recognized as a Dean's Lister from 2022 to 2024 and gained valuable experience through her internship as an office assistant at the Office of Program Coordinators and as a Cash-for-Work Program Participant at the Information and Communication Technology Services (ICTS) of LSPU. She believes that perseverance, integrity, and dedication are essential to achieving success and aspires to apply her knowledge and skills to make meaningful contributions to the organization she serves and to the community.

Rachelle Mabras is a graduate of Laguna State Polytechnic University (LSPU), where she earned her Bachelor of Science in Information Systems (BSIS) degree under the College of Computer Studies in 2025. She is a hardworking, responsible, and goal-oriented individual. Rachelle Mabras embodies hard work, responsibility, and a goal-oriented mindset, demonstrating her commitment to continuous learning and personal growth. During her academic journey, she gained valuable experience in administrative tasks, documentation, and teamwork through her on-the-job training, where she was recognized with the Best in OJT Award for her outstanding performance. She believes that perseverance, dedication, and a positive attitude are essential in achieving success. As she pursues her professional career, she aims to apply her knowledge and skills while making meaningful contributions to her profession and the community.

Francis Balahadia currently serves as Dean of the College of Computer Studies at Laguna State Polytechnic University, having previously held key roles as Program Coordinator for the BS Information Technology and Master of Information Technology programs, as well as Chairperson of the Innovation Technology Service Office (ITSO). He is also an active member of various professional organizations and has established a strong research profile, with more than 70 published papers, including Scopus (38), ISI-indexed (1), and peer-reviewed journal publications, which have garnered over 545 Google Scholar citations. He also serves as a research reviewer, journal editorial board member, and accreditation expert, reflecting his enduring dedication to excellence in information technology education, research, and academic quality assurance.