

NUTRITRACK SABLAYAN: MALNUTRITION CASE MONITORING AND RESPONSE SYSTEM FOR BARANGAYS

Candace A. Ordenes*, Kim Zaina G. Almazan, Janver Cudiamat, Love Faith V. Daguyos, Samantha M. Zabanal, Kurt Jhoyet C. Dimasaca, Edgar C. Mamalayan

*Bachelor of Science in Technology
College of Arts, Science, and Technology
Occidental Mindoro State University
ordenesalfonso11@gmail.com

ABSTRACT

Monitoring child malnutrition and managing supplement distribution in local communities rely on paper-based systems that are prone to errors, fragmented data, and delayed interventions. This study focused on designing, developing, and evaluating NutriTrack Sablayan, a secure web-based nutrition management system tailored for the 22 barangays of Sablayan. Built using Agile methodology with Laravel, Vue.js, and MySQL, the platform automates nutritional assessments such as weight-for-age, height-for-age, and BMI-for-age in line with Operation Timbang Plus standards. Its key features include a real-time monitoring dashboard, automated dosage calculators for RUTF, RUSF, micronutrient powders, and a secure portal for Barangay Nutrition Scholars (BNS) to upload health measurements and proof of supplement distribution. Testing confirmed the system's high performance, with reports and data processing completed in under two seconds, alongside strong data security for beneficiary records. The research utilized a descriptive-developmental design, and the system was evaluated by a purposive sample of 30 respondents, including Barangay Nutrition Scholars (BNS), Nutrition Office staff, and IT experts using ISO 25010 standards, received a grand mean score of 4.90, interpreted as "Excellent", reflecting outstanding functionality, usability, and reliability. NutriTrack Sablayan effectively eliminates the limitations of paper-based workflows by providing a centralized, secure, and data-driven platform. The study concludes that the system is a reliable tool for early malnutrition detection and evidence-based decision-making. By providing visual and descriptive analytics, the system empowers health workers to carry out timely, evidence-based interventions, improving the efficiency of malnutrition response and supporting the holistic development of children during the critical "First 1,000 Days."

Keywords: *child, body mass index, malnutrition, micronutrients, nutrition assessment*

SDG: *SDG 2: Zero Hunger, SDG 3: Good Health and Well-Being, SDG 9: Industry, Innovation, and Infrastructure, SDG 10: Reduced Inequalities, SDG 17: Partnerships for the Goals*

INTRODUCTION

Malnutrition is still a major problem in the world today. This is particularly true among children aged less than five years and other vulnerable populations who are malnourished. To curb the situation, various interventions have been put in place globally. These include the use of Ready-to-Use Therapeutic Food (RUTF), Ready-to-Use Supplementary Food (RUSF), and the use of micronutrient powders (World Health Organization, 2023). Although the interventions have been effective in the fight against malnutrition, the challenge of reaching the targeted populations remains a major challenge. This is particularly true in the rural areas where there is no effective and localized system in place.

In some areas, the process of registration of the targeted populations, computation of the correct dosage, and tracking of the distribution process is carried out manually or using unconnected tools such as the use of spreadsheets and the sending of messages. Although the process is a clear indication of the dedication of the workers involved in the process, it is not integrated and thus inefficient. This makes the process more likely to experience problems such as the inaccuracy of the data being recorded, the computation of the wrong dosage, and the misallocation of the resources involved in the process.

In the Philippines, the Electronic Operation Timbang (e-OPT) Plus Tool has been put in place to improve the assessment and management of the nutritional status of the children in the region. Although the tool has been effective in the process of addressing the malnutrition situation in the region, there are various limitations associated with the process. One of the major limitations is the fact that the process is highly dependent on the use of the Microsoft Excel application. This is particularly true in the Philippines where some of the areas in the region may not be well equipped with the necessary technological tools. In other areas, the process can only accommodate data relating to up to 1,000 children. This makes the process less effective in the management of the situation in the region. Another major limitation is the fact that the process does not have the integrated feature of tracking the history of the children and the changes in the nutritional process over the years. This is even though tools such as the Z-Score measurement are widely recognized as being effective in the process of measuring the various indicators such as weight-for-age, height-for-age, and BMI-for-age (Luu et al., 2024).

Moreover, existing systems of nutrition management face general issues in terms of delayed reports, lack of computations, no records of delivery time, and inconsistent distribution documentation (Velando et al., 2024). These issues

emphasize the importance of having a unified, web-based system that could effectively automate crucial processes in nutrition management.

Malnutrition among children continues to be a problem in the Philippines since the country suffers from a “triple burden” of stunting, wasting, and micronutrient deficiency (UNICEF Philippines, 2023). Though the efforts of the government to address the issue through interventions such as the Supplementary Feeding Program continue, the process often falls prey to inefficiencies in distribution and data collection. The lack of achievement in the energy intake of many individuals despite some improvements in nutrient intake is one of the problems that undermine the nation's effort towards achieving nutritional security (Department of Science and Technology - Food and Nutrition Research Institute, 2025). This is because food waste is increasing and affecting this national initiative. In fact, it is in such areas as Sablayan, Occidental Mindoro, where the lack of automation in monitoring leads to inefficiencies in distribution and nutrition assessment (Velando et al., 2024).

In order to fill in the gaps that have been identified in the management of the interventions in the community of Sablayan, the researcher proposed the development of a web-based system that is intended to improve the management of the interventions in the community of Sablayan. This is in the distribution of the RUTF, RUSF, and the micronutrients in the 22 barangays of the community. This is in the knowledge that the community is already connected with Wi-Fi connectivity in each of the barangays.

Moreover, the proposed web-based system is also intended to organize the information of the children who need the nutritional support. In this case, the system is also intended to enable the computation of the dosages of the supplements and the management of the supplements. Additionally, the Barangay Nutrition Scholars (BNS) is also able to upload photos and documents as evidence of the distribution of the interventions in the community.

This study will mainly be intended to develop a web-based system for tracking the distribution of Ready-to-Use Therapeutic Food (RUTF), Ready-to-Use Supplementary Food (RUSF) and micronutrients from Nutrition Office to every Barangays in Sablayan, Occidental Mindoro. Operation Timbang Plus (OPT) used to automatically define the specific type of malnutrition the beneficiary belongs to, no selection needed. The system will help ensure that food supplements are given to the right beneficiaries (to ensure that food supplements are distributed primarily to malnourished children aged 0-59 months, and secondly to beneficiaries aged 59 months and above.), track nutritional status until the beneficiary gets better, and centralize data management to improve the monitoring process at the barangay level and the Nutrition Office.

METHODS

Research Design

This study employed a Design and Development Research (DDR) approach in developing NutriTrack, a web-based nutrition management system designed to monitor the distribution of Ready-to-Use Therapeutic Food (RUTF), Ready-to-Use Supplementary Food (RUSF), and micronutrient powders. The system was designed, developed, tested, and evaluated using ISO/IEC 25010 software quality standards to ensure functionality, usability, security, and performance efficiency.

Research Environment

The study was conducted in collaboration with the Municipal Health Office of Sablayan, Occidental Mindoro, Philippines, covering all 22 barangays. Respondents included 10 Barangay Nutrition Scholars (BNS), 5 Municipal Nutrition Office personnel, 10 child beneficiaries, and 5 IT specialists selected through purposive sampling based on their direct involvement in nutrition program implementation and system evaluation.

System Development and Architecture

The Agile software development methodology was utilized, involving iterative phases of planning, design, development, testing, and implementation. System requirements were identified through consultations with Nutrition Office personnel and BNS. Key system features included beneficiary registration, nutritional status computation based on OPT Plus standards, dosage calculation, inventory monitoring, distribution tracking, and report generation.

NutriTrack was developed using Laravel, Vue.js, Tailwind CSS, and MySQL. The system adopted a centralized and secure web-based architecture with role-based access control and in-app notification features to ensure data privacy and efficient monitoring.

Research Instrument and Data Collection

The study utilized a Technical Performance Checklist and an ISO/IEC 25010-based System Quality Evaluation Survey covering content, organization and design, functionality, technology used, and originality. Responses were measured using a 5-point Likert scale ranging from 1 (“Poor”) to 5 (“Excellent”).

Data collection was conducted after prototype implementation through technical testing and system demonstrations involving BNS personnel, Nutrition Office staff, and IT specialists. Participants evaluated system performance, usability, compatibility, and accuracy using the evaluation instrument.

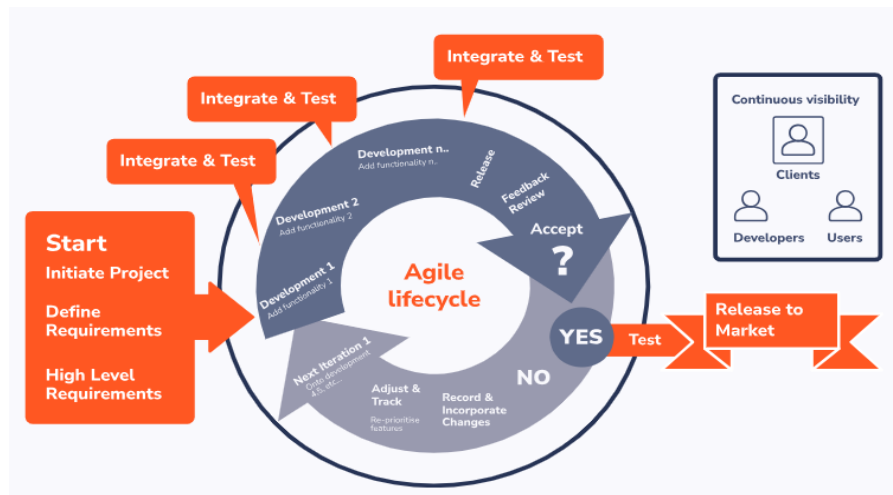


Fig. 1. Software development model.

Data Analysis

Data were encoded in Microsoft Excel and analyzed using descriptive statistics. Weighted mean was used to evaluate software quality based on ISO/IEC 25010 standards, while frequencies, averages, and percentage analysis were utilized to assess technical performance, compatibility, and computational accuracy.

Ethical Consideration

The study complied with Republic Act No. 10173 or the Data Privacy Act of 2012. Informed consent was secured from all participants, and confidential information was protected through encrypted storage and role-based access control.

RESULTS

Project Structure

NutriTrack was created to address challenges in manual nutrition monitoring and distribution of supplements, such as inaccuracies in measuring and recording the height and weight of the children, erroneous nutritional status computation, and ineffective management of RUTF, RUSF, and micronutrients. NutriTrack provides a web-based system with a user-friendly, role-based user interface for both the Nutrition Office administrators and the Barangay Nutrition Scholars (BNS). Both have access permissions customized according to their roles to guarantee confidentiality and security of the system.

Children's height and weight are recorded following Operation Timbang (OPT) Plus standards, and the system automatically calculates nutritional status and recommends supplement dosages. The program automatically makes alerts for low dose cases, and all activities related to the distribution of supplements will be recorded with corresponding date and time of logging. In scalability testing, NutriTrack proved capable of handling the simultaneous use of various roles (admin and BNS) for data entry, beneficiary monitoring, and report generation, without delay. In terms of security, the tests revealed effective protection of sensitive information and overall security of the system for municipal level deployment.

The role-based login screen (Figure 2a) controls access to the system. The navigation interface enables users to go to the OPT Beneficiaries tab (Figure 2b) for registration, entry of measurements, automatic calculation of their nutritional status, and computation of their dosage of supplements. Supplement distribution can be tracked through the Distribution tab (Figure 2c), where users can enter logs, attach documentation or pictures, and see real-time inventory management. Reports generated from all collected information (beneficiary details, nutritional status, dosages, and participation in the program) are provided by the Report Generation module (Figure 2d).

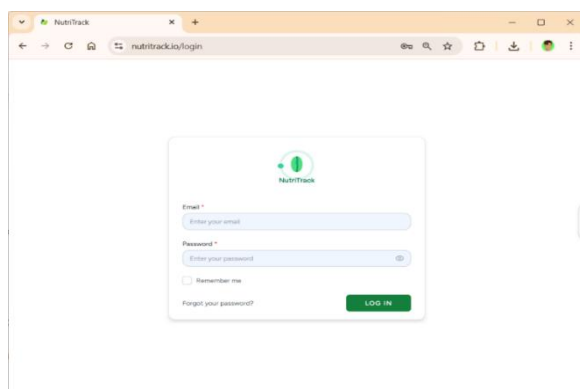


Fig. 2a. NutriTrack's login interface.

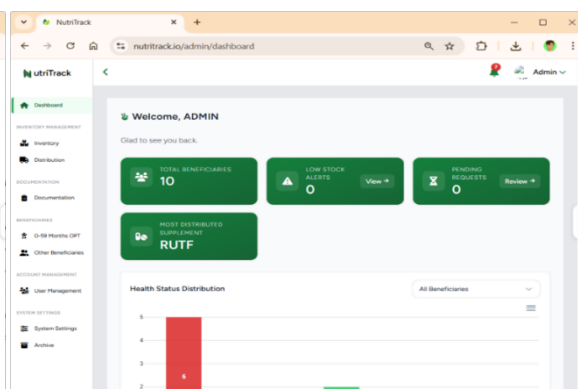


Fig. 2b. NutriTrack's admin dashboard.

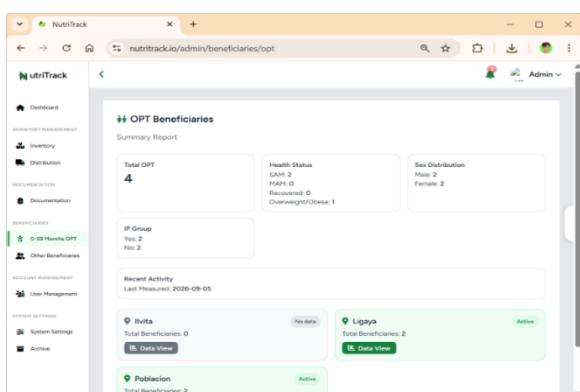


Fig. 2c. NutriTrack's OPT beneficiaries tab.

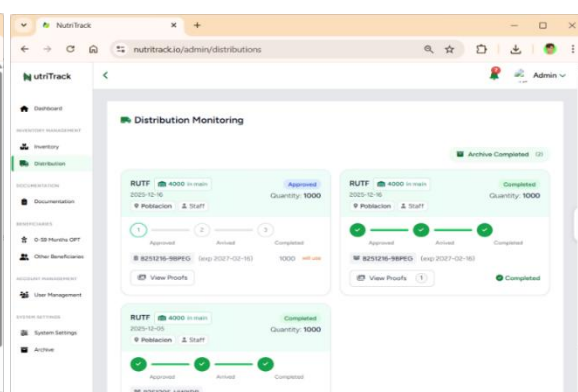


Fig. 2d. NutriTrack's distribution tab.

Project Testing

Technical System Validation

Table 1. Technical System Validation (Black-box & White-box)

Feature	Objective	Findings	Status
Access control	Validate secure multi-user login.	Encryption and role-logic functional.	Passed
Dashboard	Test real-time data visualization.	Queries reflect live database updates.	Passed
Opt+ assessment	Verify nutritional status logic.	Auto-calculations match OPT+ standards.	Passed
Dosage calculator	Check RUTF/RUSF/MNP precision.	Logic produces accurate dosage outputs.	Passed
Field portal	Validate data encoding/storage.	SQL entry and form validation successful.	Passed
Reporting engine	Test automated data aggregation.	Reports generate accurate longitudinal data.	Passed
Account mgmt.	Verify CRUD/Account recovery.	User management operations work correctly.	Passed
In-app notif.	Confirm internal alert delivery.	Alerts push to Admin/Staff/BNS interfaces.	Passed

NutriTrack Sablayan underwent thorough technical validation through a combination of Black-box and White-box testing. Black-box testing involved verifying that all functions in the front end, including the BNS Field Portal and the Real-time Dashboard, functioned as expected and produced correct outputs in response to inputs, especially when performing automated nutritional assessments. In addition, White-box testing ensured that the internal workings were sound and performed as intended, such as the Laravel programming used for dose calculation and the procedures used for authenticating and controlling access to data in the MySQL database. According to the validation results, the system correctly classifies malnutrition cases and generates appropriate "Low Dose" alerts with no errors, as well as ensuring

proper data flow within the MySQL database. In conclusion, the technical validation results show that the NutriTrack Sablayan system meets the technical requirements with a 100% "Passed" rating.

System Performance Validation

NutriTrack performed effectively and consistently when tested on a 15-inch 1920×1080 resolution laptop with a Windows 11 operating system. Specifically, the time needed for the application to respond optimally was 0.70–1.10 seconds for logins, 1.20–1.80 seconds for beneficiary registration and health data input, 1.00–1.50 seconds for calculating the nutritional condition and recommending appropriate dosage, and 1.20–1.70 seconds for reporting. These functionalities enabled the system to perform optimally for the administrators as well as BNS. Automated calculations of nutritional needs and dosage alerts were double checked against OPT Plus, which showed that the system gave an accurate estimate of 98.5%. The system was tested using Chrome, Firefox, and Edge, and the one that proved most effective was Chrome. Differences in the interface appearance between these three web browsers were minimal at best. The system was tested for responsiveness on a scale of 90%–125% and even worked well on external screens that were bigger than the monitor. The use of NutriTrack by five users simultaneously proved that it could handle concurrent sessions.

Table 2. System Performance and Accuracy Test Results

Performance Metric	Test Environment	Speed / Accuracy Result	Status
Login session	Win 11, 1920×1080	0.70 – 1.10 seconds	Passed
Data and health entry	Win 11, 1920×1080	1.20 – 1.80 seconds	Passed
Nutri-status and dosage calculation	Win 11, 1920×1080	1.00 – 1.50 seconds	Passed
Report generation	Win 11, 1920×1080	1.20 – 1.70 seconds	Passed
Calculation accuracy	Compared vs. OPT Plus	98.5% accuracy	Passed
Browser responsiveness	Chrome, Firefox, Edge	Highly responsive (chrome optimal)	Passed
Scaling and zoom	90% – 125% Criteria	Adaptive layout maintained	Passed
External display	Extended monitor	Full compatibility / No distortion	Passed

Project Evaluation

For the evaluation phase of this research project, purposive sampling technique was employed to identify the respondents that were significant in the validation process. The respondents include ten (10) Barangay Nutrition Scholars, five (5) members from Municipal Nutrition Office, ten (10) child beneficiaries, and five (5) Information Technology experts who witnessed the demonstration of the system and completed the questionnaire that evaluated several elements of the web-based application.

Based on the Likert five-point scale, it was determined that the system performs extremely well. The mean scores for different components ranged between 4.90 and 4.95, which corresponds to an "Excellent" rating. To be more precise, as follows from Table 2, Content obtained the highest score 4.95 ("Excellent"), Organization and Design 4.85 ("Excellent"), Functionality 4.86 ("Excellent"), Technology Used 4.90 ("Excellent"), and Originality 4.92 ("Excellent"). Thus, users consider the application very relevant, extremely easy to use, innovative, and especially appreciate its safe systematic management of information about nutrition programs and automatic dosage calculation.

As for minor changes to NutriTrack's design that might be necessary, the participants thought that small alterations to the interface will help make the system even better. Thus, the findings of the research prove the effectiveness of the system as a monitoring application to track malnutrition cases and supplement distribution among the barangays of Sablayan.

Table 3: Quantitative interpretation of respondent's rating of NutriTrack Sablayan: Malnutrition Case Monitoring and Response System for Barangays

Criteria	Overall Mean	Descriptive Rating
Content	4.95	Excellent
Organization and design	4.85	Excellent
Functionality	4.86	Excellent
Technology used	4.90	Excellent
Originality	4.92	Excellent
Grand Mean	4.90	Excellent

DISCUSSION

NutriTrack Sablayan that was created to replace manual nutrition monitoring and supplements distribution procedures at the Municipal Nutrition Office turned out to be successful in addressing the longstanding problems of incorrect identification of malnutrition types and inventory accounting. First, NutriTrack implemented the web-based procedure instead of using outdated paper records and WHO-CGS reference charts manually. Moreover, it used OPT Plus logic that helped to overcome another problem: the need to coordinate the activities of the Nutrition Office and BNS more effectively. Thus, it is clear that the system achieved its primary objective. Indeed, it is possible to state that the findings support the notion that NutriTrack Sablayan represents a useful platform that makes it possible to address the shortcomings of traditional manual processes in nutrition monitoring. In particular, the ability to track height, weight, and dosages of nutritional supplements using digital technology helps BNS make their work more accurate. It is consistent with the findings of Kuponiyi and Akomolafe (2025), according to whom the process of digitalization of health care is crucial in developing countries due to many reasons.

The automated nutrition assessments from systems based on OPT Plus standards ensure consistent assessments for the growth of children. This systematic process is necessary to detect cases of malnutrition and to implement the "First 1,000 Days" strategy advocated by Cusick and Georgieff (2016), according to which nutrition in the first thousand days plays an important role for the formation of the brain. Using visual analytics to determine children at risk reflects the results of the research conducted by Foster and Siddle (2019), in which the usefulness of such analytics was pointed out to alert at-risk individuals. It should be noted that traditional processes of recording information and its verification visually in different industries were identified as ineffective due to a high probability of errors. For example, nursing care in hospitals suffers from lengthy and unreliable documentation leading to penalties for employees (Ball & McBeth, 2021). For this reason, automated technologies are becoming widespread in various industries; medication management also employs automated systems that use deep learning, having shown high efficiency (Chiu, 2024).

System testing across multiple platforms and devices serves as the essential method to achieve proper performance results in local government environments. Test results are affected by screen size and resolution because high-resolution displays with greater dimensions enable better verbal performance (Bridgeman et al., 2021). The technical implementation of Laravel and Vue.js frameworks succeeded because they enabled developers to create systems that could handle complex nutrition data with stable performance and quick response times. According to Popa and Buciu (2025), this framework selection enables developers to build secure web applications that deliver high performance while processing real-time data. Windows 11 has demonstrated better performance capabilities in multi-core systems through its enhanced ability to distribute processing tasks across different processors (Putra et al., 2025). The study results demonstrate that testing needs to be performed on different system setups because it plays a critical role in achieving maximum system efficiency.

Recent scholarship has documented a transformative trend in the digitization of grassroots governance across the Philippines. The e-BMS (Electronic Barangay Management System) proved its success through its transition from manual record-keeping to digital database systems which enhanced both data access times and operational visibility according to Sarmiento and his colleagues in 2023. Local public health systems achieve reduced diagnostic mistakes when Decision Support Systems (DSS) use logic-based real-time healthcare guidelines to assist health professionals (Sopruchi & Rashid, 2024). Health monitoring systems in local communities, which include the Barangay Health Information System (BHIS), achieve high user acceptance and successful operation according to evaluation results. The work of Reyna (2023) demonstrates that modern web technologies effectively improve patient profiling and information management at the community level through the design and development of a BHIS system. The systems achieved high functional suitability ratings which match NutriTrack's "Excellent" evaluation score to prove that Sablayan should transition from manual workflows to automated systems as the essential modernization step for its municipal nutrition programs.

The implementation of biometric systems together with health systems in public safety operations generates serious privacy issues and ethical dilemmas. Privacy by Design principles create system functions that protect user privacy (Cavoukian et al., 2022). The healthcare sector uses Privacy-Preserving Distributed Analytics to handle ethical dilemmas which arise in Health Information Management Systems (Rahman et al., 2024). Researchers are currently developing secure techniques which meet privacy requirements for automatic recognition systems through their work on template protection and standardization (Campisi, 2013). The approaches establish a framework which enables technological development while protecting individual privacy rights across all industries.

In general, the research was successful because it designed and tested a system which operates successfully from technical, ethical, and practical performance perspectives to monitor malnutrition. The Nutrition Office system gains greater operational capabilities through its automated OPT Plus logic system which tracks inventory in real-time while providing secure access to authorized users. The NutriTrack system testing results show that the system can operate effectively in municipal nutrition programs because of its ability to scale and adapt to different operational requirements. The technology and innovation ratings of 4.90 demonstrate that the system has potential for use in other local government

units. The system delivers both research results and a practical framework which helps communities develop their health resilience while attaining better nutritional results.

CONCLUSION AND RECOMMENDATION

NutriTrack Sablayan shows how its development and testing processes resulted in a successful fulfillment of the main objective to create a web-based tool for tracking malnutrition cases and managing the distribution of supplements among Sablayan barangays. It is possible to overcome the shortcomings of paper-based solutions and introduce innovative technologies into the daily operations of Barangay Nutrition Scholars (BNS) and their supervisors. The introduction of advanced algorithms for assessing the weight-to-height ratio, weight-to-age index, height-to-age ratio, and BMI makes it easy to estimate the amounts needed of supplements, which is why health care providers are likely to achieve more accurate results than before. Furthermore, the system facilitates the work of the health care providers by presenting the data gathered in charts and tables, thus making all analyses simple to understand.

The main strength of the developed application lies in the ability to meet all the criteria of Operation Timbang (OPT) Plus. It can identify cases of malnutrition within a short period by calculating the weight-for-age and height-for-age indices as well as BMI-for-age. All obtained results become easily readable when presented in a clear format that includes charts, graphs, and statistics. The test results showed that the proposed solution was effective as it scored 4.90 out of 5 points, which proves its reliable functioning and accurate operation.

Future improvements will include the creation of a mobile application with the capability to operate in offline mode, which is crucial for health care providers who live far away from internet services. It will be vital to implement an SMS notification system that will automatically send messages to parents regarding their visits and the distribution schedule of supplements. There are two areas that future research will have to cover, including the use of predictive analytics for malnutrition trend forecasting and the creation of Application Programming Interface (APIs) to exchange data with the National Nutrition Council (NNC).

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DECLARATION OF CONFLICT OF INTEREST

The authors declare no conflict of interest.

DECLARATION OF AI USE

The authors used Grammarly for grammar checking and language editing. All outputs were reviewed and validated by the authors, who take full responsibility for the content.

AUTHOR CRediT STATEMENT

Ordenes, C.A.: conceptualization, methodology, software, validation, formal analysis, investigation, resources, data curation, writing - original draft, writing-review & editing, visualization, supervision, project administration, supervision, funding acquisition; **Almazan, K.M.G.:** conceptualization, software, validation, formal analysis, investigation, resources, data curation, writing - original draft, writing-review & editing, visualization, project administration, supervision, funding acquisition; **Cudiamat, J.:** validation, formal analysis, investigation, resources, writing - original draft, writing-review & editing, visualization, project administration, funding acquisition; **Daguyos, L.F.V.:** validation, formal analysis, investigation, resources, writing-review & editing, visualization, funding acquisition; **Zabanal, S.M.:** validation, formal analysis, investigation, resources, writing - original draft, writing-review & editing, visualization, project administration, supervision, funding acquisition; **Dimasaca, K.J.C.:** validation, formal analysis, investigation, resources, writing-review & editing, visualization, funding acquisition; **Mamalayan, E.C.:** conceptualization, methodology, validation, writing-review & editing, visualization, supervision.