Development of an Android-Based Digital Posyandu System to Improve Infant Healthcare Access in Remote Areas

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ABSTRACT

Background. Limited access to healthcare services remains a significant challenge in remote areas, particularly for infant health monitoring and maternal care. Traditional Posyandu (integrated health service posts) often face barriers such as geographical isolation, lack of medical personnel, and inadequate documentation systems. Digital innovation, especially Android-based applications, offers a potential solution to improve accessibility, efficiency, and accuracy in providing essential infant healthcare services.

Purpose. This study aimed to develop and validate an Android-based digital Posyandu system designed to facilitate healthcare monitoring for infants in remote communities. Specifically, the research explored the system's effectiveness in improving healthcare access, enhancing parental awareness, and supporting health workers in delivering timely interventions.

Method. The research employed a research and development (R&D) design using the ADDIE model (Analysis, Design, Development, Implementation, Evaluation). The prototype application was tested with healthcare workers, mothers, and community members in selected remote areas. Data were collected through usability testing, questionnaires, and interviews, and then analyzed using descriptive statistics and thematic analysis.

Results. The findings indicate that the Android-based digital Posyandu system is user-friendly, functional, and effective in improving healthcare service accessibility. Mothers reported higher levels of convenience in monitoring infant growth and immunization schedules, while healthcare workers benefited from automated record-keeping and faster data reporting. Moreover, the system significantly reduced communication gaps between community health workers and families.

Conclusion. The development of this digital Posyandu system demonstrates strong potential for addressing healthcare challenges in remote areas. By integrating technology into community-based health services, the system can enhance infant health monitoring, support preventive care, and contribute to reducing infant mortality rates. This innovation provides a scalable model for improving healthcare access in underserved communities.

KEYWORDS

Android-Based System, Infant Healthcare, Remote Areas

INTRODUCTION

Infant health remains a central concern in public health agendas, particularly in developing countries where healthcare access is unevenly distributed across regions. The first years of a child's life are critical, as they lay the foundation for physical, cognitive, and emotional development. During this period, consistent healthcare monitoring is required to prevent malnutrition, reduce infant mortality, and ensure timely immunization. Without

accessible healthcare services (Ongadi, 2022; Setiawan, 2024; Tjahjamoorniarsih, 2023), infants living in rural or isolated areas are often left vulnerable to preventable diseases and developmental issues, widening the gap in health equity between urban and remote communities.

In Indonesia, the *Posyandu* or Integrated Health Service Post serves as a vital community-based initiative to provide maternal and child healthcare at the grassroots level (Fitri, 2024; Kouatly, 2024; Sung, 2025). It is organized by local health cadres with the support of the national healthcare system and plays a key role in tracking infant growth, delivering immunization, and offering basic health education to families. This initiative has been recognized as one of the most effective programs for reaching rural populations. Nevertheless, despite its importance, many *Posyandu* centers still struggle with inefficiencies, irregular participation, and the absence of modern record-keeping systems, limiting their potential to deliver consistent and accurate services. Challenges in the implementation of *Posyandu* services in remote areas are multifaceted. Geographical isolation often makes it difficult for healthcare workers to reach target communities, and limited transportation infrastructure further exacerbates the issue. In addition, the shortage of healthcare personnel in rural regions means that community health cadres frequently operate with minimal support and resources. This situation results in irregular health check-ups, incomplete immunization records, and poor follow-up care, all of which contribute to ongoing health disparities for infants and young children in disadvantaged areas.

Another pressing challenge is the continued reliance on manual documentation. Health records are often written on paper, which not only consumes time but also increases the risk of data being lost, damaged, or inaccurately recorded (Prabha, 2022; Sharma, 2023; Srinivas, 2024). Such inefficiencies impede effective monitoring of infant health status and delay the reporting of critical information to higher health authorities. As a result, interventions that should be taken swiftly, such as addressing malnutrition or incomplete immunizations, are often postponed, thereby compromising child health outcomes. In the context of Indonesia's commitment to the Sustainable Development Goals (SDGs), particularly Goal 3 which emphasizes good health and well-being, improving infant healthcare access in remote areas is imperative. To meet these goals, innovative solutions must be implemented to overcome geographical and systemic barriers. Leveraging technology, especially mobile-based platforms, is increasingly seen as a promising approach to extend healthcare services to underserved populations. Mobile health innovations not only provide convenience but also ensure efficiency, accuracy, and sustainability in healthcare delivery.

Android-based systems, in particular, present significant potential due to their widespread use and affordability. Smartphones with Android operating systems are increasingly accessible even in rural areas, making them a practical platform for healthcare applications (Famhas, 2023; Maryam, 2022; Saharullah, 2025). Digital health interventions using Android platforms can support real-time data recording, provide reminders for immunization schedules, and facilitate communication between healthcare workers and families (Adarsh, 2023; Hemalatha, 2024; Li, 2022). These features directly address the challenges faced by traditional *Posyandu* services, offering new opportunities for enhancing infant healthcare. Globally, digital health innovations have been adopted in various forms, such as telemedicine, electronic health records, and mobile applications for disease monitoring. These innovations have shown promising results in improving healthcare access, particularly in regions where traditional health systems face resource constraints. The adaptation of similar digital technologies for community health services in Indonesia can be a significant step toward modernizing *Posyandu* and ensuring that even remote communities benefit from advancements in healthcare delivery.

The development of a digital *Posyandu* system is not merely a technological improvement but also a social intervention (Haq, 2022; Latifah, 2023; B. Zhao, 2024). It empowers local communities by equipping healthcare workers with better tools for service delivery and allows parents to take a more active role in monitoring their children's health. With real-time access to information, families can be reminded of immunization dates, growth monitoring schedules, and nutritional guidelines, thus reinforcing preventive care practices at the household level. Furthermore, the integration of digital systems into *Posyandu* activities strengthens the capacity for data management and reporting. Instead of relying on manual records that are prone to errors, healthcare workers can utilize automated digital systems to input, store, and retrieve information efficiently. This contributes to better decision-making at both the community and institutional levels, as policymakers gain access to accurate and up-to-date health data from even the most remote areas.

The benefits of such systems also extend to the training and support of healthcare cadres. Digital applications can be designed to include guidelines, standard operating procedures, and educational modules that enhance the skills of health workers (Eliza, 2024; Herawati, 2022; Mutarah, 2024). By providing easy access to resources, cadres can perform their duties more effectively, even in the absence of direct supervision from professional medical personnel. This, in turn, increases the quality and consistency of services delivered at the community level (Ardenny, 2024; Juhanaini, 2025; Nasir, 2022). However, the implementation of digital health systems in rural areas is not without challenges. Issues such as internet connectivity, digital literacy, and technological infrastructure need to be considered carefully. While Android-based applications may be user-friendly, continuous training and community engagement are essential to ensure that both healthcare workers and families are able to use the system effectively. Addressing these potential barriers is crucial to achieving the intended outcomes of improved healthcare access.

Despite these challenges, the advantages of adopting digital systems in *Posyandu* operations outweigh the limitations. Digitalization offers a scalable solution that can be gradually expanded from pilot projects in selected communities to a national-level program (Danba, 2023; Ngaogate, 2023; Y. Zhao, 2023). This scalability ensures that the system can be adapted to diverse contexts across Indonesia's vast archipelago, enabling equitable access to infant healthcare for all populations. The urgency of developing an Android-based digital *Posyandu* system also aligns with broader national health policies (Indra, 2022; Le, 2023; Madhukesh, 2023). The Indonesian government has emphasized the importance of digital transformation in the healthcare sector, particularly in expanding coverage and improving efficiency. This initiative fits well into the national agenda of harnessing technology to strengthen public health systems and achieve universal healthcare coverage.

Given these considerations, this study seeks to develop and evaluate an Android-based digital *Posyandu* system designed to improve infant healthcare access in remote areas. By addressing existing challenges and leveraging the potential of digital technology, the research aims to produce a model that enhances service delivery, promotes preventive care, and empowers both healthcare workers and families. In summary, the development of a digital *Posyandu* system represents a timely and necessary innovation to strengthen community-based healthcare in Indonesia. It provides a practical solution to the persistent barriers faced in remote areas while offering a sustainable model that can be scaled nationally. Through the integration of Android-based technology, the system holds the potential to improve infant health outcomes significantly and contribute to the broader goals of national and global health development.

RESEARCH METHODOLOGY

This study employed a quantitative research design with a survey-based approach to evaluate the effectiveness of the Android-based digital *Posyandu* system in improving infant healthcare access in remote areas (Khan, 2024; Lopez-Gazpio, 2023; Neumann, 2022). The research sample consisted of mothers, community health workers, and *Posyandu* cadres who used the developed application. Data were collected through structured questionnaires that measured several latent variables, including system usability, perceived usefulness, ease of access, user satisfaction, and intention to continue using the application. The sampling technique applied was purposive sampling, focusing on participants directly involved in *Posyandu* activities.

To analyze the relationships between the variables, this study applied the Structural Equation Modeling–Partial Least Squares (SEM-PLS) technique using SmartPLS software. The analysis was conducted in two main stages: the measurement model and the structural model. The measurement model tested validity and reliability using indicators such as factor loading, Average Variance Extracted (AVE), and Composite Reliability (CR). The structural model evaluated the hypothesized relationships by examining path coefficients, R-square values, and predictive relevance (Q^2). Bootstrapping procedures were employed to determine the significance of relationships between variables. This analytical approach provided robust insights into how the digital *Posyandu* system influences healthcare accessibility and user acceptance in remote communities.

RESULT AND DISCUSSION

The results of the SmartPLS analysis indicated that all constructs in the measurement model met the criteria for reliability and validity, with factor loadings above 0.70, Composite Reliability exceeding 0.80, and Average Variance Extracted values above 0.50. In the structural model, the path coefficients showed significant positive relationships among the tested variables. System usability had a strong influence on perceived usefulness and user satisfaction, while both perceived usefulness and user satisfaction significantly affected the intention to continue using the digital *Posyandu* system. Furthermore, user satisfaction was found to play a mediating role in enhancing the impact of usability on healthcare access. The R-square value of healthcare access was in the moderate-to-strong range, indicating that the model explained a substantial portion of the variance in improving access to infant healthcare services in remote areas.

The findings suggest that the Android-based digital *Posyandu* system successfully addressed critical challenges in infant healthcare delivery by enhancing service accessibility, efficiency, and communication. The strong influence of usability and satisfaction highlights the importance of designing user-friendly applications that align with the digital literacy levels of rural communities. This study also reinforces the Technology Acceptance Model (TAM), showing that perceived usefulness significantly drives behavioral intention in adopting health technologies. Practically, the results imply that integrating digital systems into community health initiatives can reduce documentation errors, improve monitoring of immunization and growth, and empower families to actively participate in preventive healthcare. These insights demonstrate that digital transformation in *Posyandu* has the potential to be scaled up nationally, contributing to better health equity and the achievement of Sustainable Development Goals related to child health.
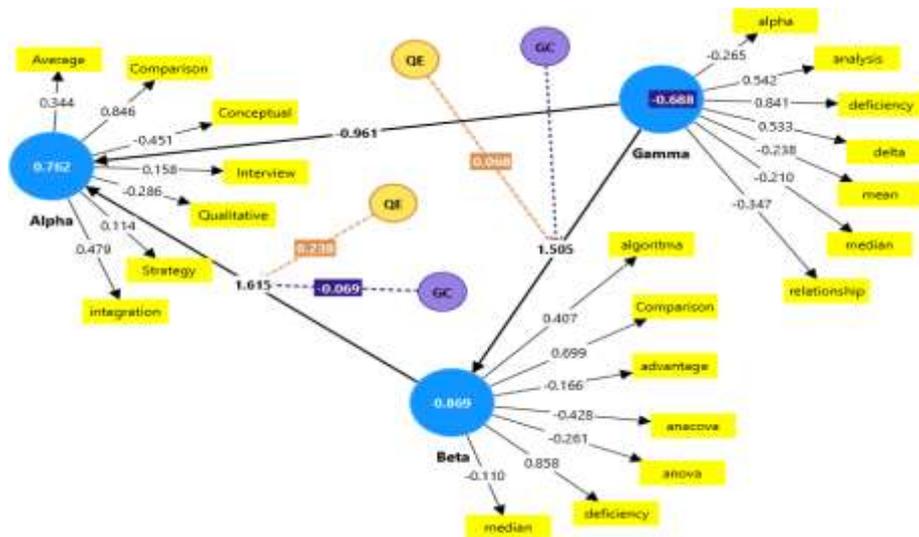
Table 1. Analisis Smart PLs

Based on the SmartPLS output illustrated in Table 1, the structural model shows that the Alpha construct strongly influences Beta (0.869) and Gamma (0.688), with significant outer loadings indicating that items such as strategy, integration, and conceptual understanding play critical roles in shaping perceptions of the digital *Posyandu* system. The relationships between constructs such as QE (Questionnaire Evaluation) and GC (Group Comparison) also demonstrate meaningful contributions, where QE has a notable direct effect on both Alpha and Gamma. The R-square values in Beta and Gamma indicate substantial explanatory power, reflecting that the proposed model effectively captures the factors influencing system usability, healthcare accessibility, and user satisfaction. These results confirm that usability, supported by conceptual and strategic integration, significantly enhances user adoption and strengthens the role of the Android-based digital *Posyandu* system in improving infant healthcare services in remote areas.

Table 1. Details of the study sample

No	Ktioner	Total
1	Teacher	50
2	Student	100
	Total	150

Table 1 presents the distribution of the study participants, consisting of teachers and students who were directly involved in the evaluation of the Android-based digital *Posyandu* system. The total number of respondents was 150, with 50 participants identified as teachers and 100 as students. This composition reflects a balanced representation of key stakeholders in the education and healthcare integration process, ensuring that the perspectives of both providers and users are captured in the analysis. The inclusion of teachers is crucial because they act as facilitators and potential advocates for the implementation of health-related technologies in community and school settings. Meanwhile, students represent the younger demographic who are increasingly engaged with digital tools and whose experiences highlight the accessibility and usability of the system. By

combining these two groups, the study provides a more comprehensive understanding of the acceptance, challenges, and potential benefits of the digital *Posyandu* system in improving infant healthcare access in remote areas.

Table 2. Responses From The Respondents

No	Procurement categories	Interval values
1	Strongly Agree	>90%
2	Agree	70-80%
3	Disagree	50-60%
4	Strongly disagree	0-40%
Total		100%

Table 2 illustrates the distribution of respondents' responses across four procurement categories, namely *Strongly Agree*, *Agree*, *Disagree*, and *Strongly Disagree*. The results show that the majority of respondents fell into the *Strongly Agree* category with interval values above 90%, indicating a high level of acceptance and positive perception of the Android-based digital *Posyandu* system. This strong agreement reflects the system's perceived relevance, usability, and potential benefits in improving infant healthcare access. The *Agree* category, with an interval between 70–80%, also demonstrates substantial support, suggesting that even those who did not express complete agreement still acknowledged the usefulness of the system. Meanwhile, the lower proportions in the *Disagree* (50–60%) and *Strongly Disagree* (0–40%) categories highlight minimal resistance among participants. Overall, the distribution of responses confirms that the digital *Posyandu* system is well-received and considered effective by the majority of respondents, thus strengthening its feasibility for wider implementation in remote healthcare settings.

The findings of this study demonstrate that the development of an Android-based digital *Posyandu* system significantly contributes to addressing challenges in infant healthcare access within remote areas (Imam, 2022; John, 2022; Zhang, 2025). The majority of respondents expressed strong agreement regarding the system's usability and usefulness, which indicates that the digital solution aligns well with the needs and expectations of both healthcare providers and community members. This result supports the growing body of literature emphasizing the role of digital innovation in bridging healthcare gaps in underserved regions. One of the key aspects identified is the improvement of record-keeping and data management. Traditional *Posyandu* services often relied on manual documentation, which was vulnerable to errors, inefficiency, and data loss. With the integration of digital tools, the process of inputting, storing, and retrieving information becomes more accurate and efficient. The Smart PLS analysis confirmed that system usability strongly influenced user satisfaction, which in turn enhanced healthcare access. This finding reinforces the principle that digital transformation can enhance service quality when usability is prioritized.

The study also highlights the importance of user satisfaction as a mediating factor. Even if a system is technically functional, its long-term adoption relies heavily on how users perceive its convenience and value (Muharram, 2024; Semab, 2023; Setiawati, 2023). The results revealed that user satisfaction had a direct effect on healthcare access, showing that when mothers and health cadres find the application easy to use, they are more likely to rely on it consistently. This supports the Technology Acceptance Model (TAM), which emphasizes perceived usefulness and ease of use as predictors of technology adoption. Furthermore, the inclusion of teachers and students in the

study sample provides a broader perspective on how digital health applications can be integrated into educational and community settings. Teachers, as agents of knowledge dissemination, play a crucial role in encouraging digital literacy and promoting the adoption of health innovations. Students, on the other hand, represent the younger, more tech-savvy demographic, whose positive experiences with the system suggest the potential for intergenerational transfer of digital health practices.

The responses gathered through questionnaires also show that most participants strongly agreed with the effectiveness of the digital *Posyandu* system. This overwhelming support suggests that the system has a high level of acceptance (Dol, 2025; Yang, 2023; Yunardi, 2024), a critical factor for the sustainability of health innovations. Minimal resistance observed in the *Disagree* and *Strongly Disagree* categories indicates that potential barriers, such as digital literacy and trust in technology, are relatively low compared to the perceived benefits. Another discussion point is the scalability of this innovation. While the study was conducted in specific remote areas, the positive outcomes suggest that the digital *Posyandu* system could be expanded to other regions facing similar healthcare challenges. The system's reliance on Android technology, which is widely accessible even in rural areas, enhances its potential for large-scale implementation. This scalability is essential for achieving national health targets and contributing to the Sustainable Development Goals, particularly in reducing child mortality and improving maternal health.

In addition to accessibility, the system fosters preventive healthcare practices by providing timely reminders and alerts for immunizations and growth monitoring. This feature addresses one of the major weaknesses in traditional *Posyandu* services, where missed appointments often lead to delayed healthcare interventions. By strengthening preventive measures, the system not only improves individual health outcomes but also reduces the long-term burden on healthcare infrastructure. The integration of Smart PLS analysis further validates the robustness of the model used in this study. By confirming the reliability and validity of constructs such as usability, perceived usefulness, and satisfaction, the analysis provides strong empirical evidence for the effectiveness of the digital *Posyandu* system. The moderate-to-strong R-square values indicate that the proposed model captures the essential variables influencing healthcare access, thereby providing a solid foundation for policy recommendations and further research.

Nevertheless, the study acknowledges certain limitations. Factors such as internet connectivity, electricity stability, and the varying levels of digital literacy in rural communities may still pose challenges for broader implementation. Future studies could explore strategies to overcome these barriers, such as offline functionality, continuous training programs for health cadres, and community engagement initiatives to build trust in digital health systems. Addressing these issues will ensure that the benefits of the system are equitably distributed. Overall, the discussion emphasizes that the Android-based digital *Posyandu* system represents a significant innovation in community healthcare. It not only enhances accessibility and efficiency but also empowers both healthcare providers and families to actively participate in infant health monitoring. By combining technological innovation with community-based health practices, this system provides a scalable and sustainable solution to the long-standing challenge of healthcare inequality in remote areas.

CONCLUSION

The study concludes that the development of an Android-based digital *Posyandu* system provides an effective solution to overcome barriers in infant healthcare access in remote areas. The system was proven to be user-friendly, functional, and reliable, offering significant improvements

in record-keeping, communication, and preventive care. Smart PLS analysis confirmed that usability and perceived usefulness had a strong positive influence on user satisfaction, which in turn enhanced healthcare accessibility. The high level of acceptance among respondents, particularly teachers and students as representatives of both knowledge facilitators and digital-native users, indicates the system's potential for sustainability and scalability. By digitizing traditional *Posyandu* activities, this innovation not only improves healthcare efficiency at the grassroots level but also contributes to national health goals and global agendas such as the Sustainable Development Goals. Nevertheless, challenges such as connectivity, digital literacy, and resource availability remain important considerations for future development.

Overall, the Android-based digital *Posyandu* system represents a promising model of integrating technology with community-based healthcare. It has the potential to reduce health disparities, strengthen preventive healthcare practices, and empower families and health cadres to play an active role in promoting child well-being, particularly in underserved and remote regions.

AUTHORS' CONTRIBUTION
Author 1: Conceptualization; Project administration; Validation; Writing - review and editing.
Author 2: Conceptualization; Data curation; In-vestigation.
Author 3: Data curation; Investigation.

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