



MONITA: ANDROID SYSTEM FOR MONITORING EMERGENCY RESPONSE FOR MOTHERS AND BABIES

Sumarti Endah Purnamaningsih Maria Margaretha¹, Dhiya Urrahman^{1*}, Chrisnawati², Yohakim Marwanta³, Fahmi Baiquni⁴

¹Applied Undergraduate Program of Nursing, Politeknik Kesehatan Karya Husada Yogyakarta, Gg. Kantil No.11b, Bumijo, Jetis, Yogyakarta 55231, Indonesia

²Departement of Public Health, Faculty of Medicine and Health Sciences, Universitas Lambung Mangkurat, Jalan Brigjen H, Jl. Brigjend H. Hasan Basri Jl. Kayu Tangi, Banjarmasin Utara, Banjarmasin, Kalimantan Selatan 70123, Indonesia

³Department of Information Systems, Faculty of Information Technology, Universitas Teknologi Digital Indonesia, Jl. Raya Janti Jl. Majapahit No.143, Jaranan, Banguntapan, Bantul, Yogyakarta 55198, Indonesia

⁴Applied Undergraduate Program of Health Promotion, Politeknik Kesehatan Karya Husada Yogyakarta, Gg. Kantil No.11b, Bumijo, Jetis, Yogyakarta 55231, Indonesia

*dhiyar.du@gmail.com

ABSTRACT

Maternal and neonatal mortality remain significant public health challenges in Indonesia, particularly in regions with limited access to health services. This study presents the MONITA (Monitoring Ibu dan Bayi Tanggap Darurat) application, an Android-based platform designed to enhance early detection of maternal and neonatal complications and strengthen emergency response coordination. MONITA integrates a rule-based screening module following WHO standards, real-time GPS tracking, automatic emergency notifications, and a spatial dashboard for monitoring critical cases. The development process involved system architecture design, UI/UX implementation, prototype testing, and integration of local health data. Preliminary deployment demonstrated that MONITA enables faster identification of high-risk cases, improves communication between field health workers and referral facilities, and supports timely decision-making in emergency situations. The application has the potential to contribute to reducing maternal and neonatal mortality rates and optimizing emergency care in remote or resource-limited areas.

Keywords: digital health; emergency response; maternal mortality; MONITA application; neonatal mortality

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INTRODUCTION

Maternal mortality rates (MMR) and neonatal mortality rates (NMR) remain major challenges in efforts to improve the quality of public health in Indonesia. The MMR is considered an indicator of development success because improvements in women's quality of life are directly related to the strengthening of human resources (Arifin, 2023). Community welfare can also be monitored through a decline in maternal mortality rates, which indicates the effectiveness of the health care system (Hakim, 2024). In America, four out of five maternal deaths are caused by preventable conditions, and American Indians/Alaska Natives in the United States are two to three times more likely to die from pregnancy-related causes (Malloy, 2024; WHO, 2021). Pregnant women in Lebanon face high maternal mortality rates and various pregnancy-related complications, including anaemia, haemorrhaging, urinary tract infections, and gestational diabetes (Dimassi et al., 2023; El Kak et al., 2022; El-Kak et al., 2020). These complications are greatly influenced by limited access to essential maternal services, including antenatal care (ANC), which plays a crucial role in preventing and managing complications during pregnancy (Amponsah-Tabi et al., 2022; Lincetto et al., 2006). In Southeast Asia, the maternal mortality rate was recorded at around 134 per 100,000 live births in 2020, with Indonesia ranking fourth highest at 173 deaths per 100,000 live births (Susilowati et al., 2025).

The latest data shows a significant decline in the last two decades, but the national MMR is still around 177 per 100,000 live births and the NMR is around 20 per 1,000 live births in 2023, far above the Sustainable Development Goals (SDGs) targets of <70 and <12 respectively (Badan Pusat Statistik, 2024). The number of maternal deaths increased from 4,005 cases in 2022 to 4,129 in 2023, while infant deaths increased from 20,882 to 29,945 cases in the same period (Redaksi Mediakom, 2024). In Indonesia, maternal mortality rates are also a serious problem. According to the (International Agency for Research on Cancer, 2025), Indonesia ranked second in ASEAN for the highest MMR in 2023, with an MMR per 100,000 live births in the range of 305.

In Tanah Laut Regency, South Kalimantan Province, sharp fluctuations in the MMR over the past five years indicate irregularities in the maternal emergency response system. The MMR rose from 123 per 100,000 live births in 2020 to 267 in 2021, dropped sharply to 50 in 2022, rose again to 158 in 2023, and fell to 118 in 2024 (Dinas Kesehatan Provinsi Kalimantan Selatan, 2024). This trend emphasises the need for more adaptive monitoring mechanisms to detect maternal complications early. Meanwhile, maternal mortality in this district also shows an increased risk due to factors such as asphyxia, infection, and prematurity, which are often detected too late.

The majority of maternal deaths are caused by complications during pregnancy, childbirth, and the postpartum period, including pre-eclampsia, haemorrhage, infection, and other obstetric complications. Midwives, as the spearhead of maternal and child health services, have a strategic role in the early detection of high risks, initial emergency treatment, and referral to advanced health facilities. However, field practice faces significant obstacles, including limited resources, geographical and transport access, and limited coordination between village facilities and referral centres.

Tanah Laut has a large area with 11 subdistricts, 130 villages, and 5 urban villages, supported by 3 regional public hospitals (1 operating on a limited basis), 1 private hospital, 1 maternity hospital, 2 inpatient health centres, 20 non-inpatient health centres, 62 auxiliary health centres, and 90 village health posts. The presence of 6 mobile health units and 22 mobile health centres is insufficient to respond quickly to obstetric emergencies. In terms of human resources, out of 457 midwives, only 265 are assigned to health centres, while most public health and environmental health workers are stationed at the district level. There are only 36 specialist doctors, none of whom are directly assigned to health centres, limiting the capacity for rapid referrals and on-site clinical support.

Smartphones are currently the most widely used form of ‘personal computer’ and have significantly changed the way people communicate. Rapid developments in hardware have enabled smartphones to display rich content and be easy to operate, with faster processors, greater memory capacity, and more efficient data communication capabilities. These advantages make smartphones a highly potential tool for supporting healthcare services. Mobile-based healthcare service models, which combine smart terminal devices with mobile internet networks, have emerged as a new approach to healthcare and are beginning to be widely accepted by the public (Liu & Wang, 2021; Tejashwini et al., 2023). As an important part of the public health care system, maternal and child health facilities generally serve young parents, who are active smartphone users. Therefore, the development of mobile-based maternal and child health services is becoming an increasingly relevant trend (Chen et al., 2020). Pregnant women generally have a high level of curiosity about their health conditions and maternal and child care needs. Smartphones, which are easy to carry anywhere and always available, are the ideal tool to support these needs. Through these devices, pregnant women can monitor physical signs in real time, access health information as needed, and conduct remote medical consultations and diagnoses more practically and conveniently.

Pregnancy is an important period in a woman's life that requires constant monitoring and prompt and appropriate medical action when necessary (Tejashwini et al., 2023). To respond to these challenges, a system is needed that is capable of observing these dynamics, a system that can

accelerate the detection of danger signs and strengthen real-time coordination of field responses, rather than simply adding physical infrastructure. Applications are an effective and innovative solution to improve the quality of health services, especially in areas with limited access (Novianto & Sanjaya, 2024). According to Gayesa et al. (2023), mobile-based health interventions have been shown to increase the use of health services during labour and postpartum. Therefore, the MONITA (Monitoring Ibu dan Bayi Tanggap Darurat or Emergency Response Monitoring for Mothers and Babies) system application was developed as an innovative technology-based solution designed to help cadres and families of pregnant women recognise high-risk symptoms using WHO-standard screening (WHO, 2024), monitor the location of mothers and estimate the travel time to the nearest health facility using GPS, activate automatic emergency response notifications to the Health Department or designated officers, and provide a spatial monitoring dashboard to view the distribution of emergency cases and delay patterns. This article aims to describe the development and key features of the MONITA application as an innovative system to accelerate the detection of hazard symptoms and strengthen real-time field response coordination, so that it can be used as a reference in the preparation of operational SOPs and implementation strategies at the village to district levels.

METHOD

The development of the MONITA application was carried out through a series of systematic stages, beginning with the identification of system requirements. The development team mapped the functional and non-functional requirements of the application based on WHO standards for early detection of maternal and neonatal complications, and adapted them to the operational procedures in place in Tanah Laut District. The results of this identification formed the basis for the design of the application architecture and user interface (UI/UX), with the aim of making the application easy to use by cadres and midwives, including those with minimal experience using Android devices.

After the design was completed, the clinical screening module and location monitoring feature were implemented. The screening module allows for the input of high-risk symptoms in pregnant women and neonates, while the GPS feature monitors the mother's location in real-time and calculates the estimated travel time to the nearest health facility. The system is also equipped with automatic notifications that inform the nearest Health Office officer or midwife when a critical condition is detected.

Prior to public release, the application was tested on a limited basis through alpha testing to ensure that all features functioned properly, including notification accuracy, location updates, and data visualisation on the monitoring dashboard. Based on the results of these trials, improvements and refinements were made, and then the beta version of the APK was prepared for distribution to Android devices. The application can be installed via the Play Store and comes with technical guidelines so that cadres and midwives can operate the system smoothly. All stages of development were carried out by a multidisciplinary team involving information technology experts, practising midwives, and representatives from the Health Department as a technical review panel. This approach ensures that the MONITA application is ready for use in the field, supporting the coordination of maternal and neonatal emergency response, and providing real-time spatial monitoring data.

The MONITA (Monitoring Ibu dan Bayi Tanggap Darurat) application presents a novel approach to maternal and neonatal emergency management by integrating WHO-standard risk screening, real-time GPS tracking, automatic emergency notifications, and a spatial monitoring dashboard into a single Android-based platform. In contradistinction to antecedent systems, which have typically concentrated on a single facet of emergency response, MONITA facilitates real-time coordination between midwives, health cadres, and referral facilities. Moreover, it is able to adapt to local conditions through the integration of village maps, health facility references, and emergency SOPs. The interface has been designed to be user-friendly, thus ensuring that personnel with minimal experience of using Android devices can still operate the system effectively. The present study aims

to describe the development, key features and potential impact of MONITA as an innovative tool to accelerate maternal and neonatal emergency response, strengthen field coordination and support timely decision-making in areas with limited resources.

RESULT

The development of the MONITA application has reached the release of APK Beta v1.0, which is ready to be installed on Android devices. This application provides a maternal and neonatal risk screening module, GPS-based location tracking, automatic emergency response notifications, and a spatial monitoring dashboard to view case distribution and estimated response times. Internal testing (alpha test) involved the development team and five health cadres with 30 critical scenarios to ensure screening accuracy, notification smoothness, and location data integration. Complete technical documentation, including user guides and developer manuals, has been prepared to support field implementation. Local data in the form of village maps, health facility references, and emergency response SOPs were integrated into the system, ensuring the operational suitability of the application to the conditions in the Tanah Laut region.

Table 1.

Monita module and function

Module/ Feature	Main Function	Implementation Status	Evidence/ Notes
Maternal & Neonatal Risk Screening	Detects danger signs in mothers and babies based on WHO standards.	Completed	Alpha test of 30 critical scenarios; test report
Location Tracking (GPS)	Determining the mother's location and estimated time to reach a health facility	Completed	Google Maps SDK integration; alpha tested
Emergency Response Notifications	Sending automatic alerts to the Health Department or relevant officials	Completed	Tested in scenarios involving bleeding and shortness of breath
Spatial Monitoring Dashboard	Displaying case distribution and response delay times	Completed	Dashboard mockup available; ready for pilot
Technical Documentation	User guide and developer manual	Completed	Initial version of developer manual and user guide
Local Data Integration	Village maps, facility references, emergency response SOPs	Completed	Data from the Tanah Laut Health Office.

The maternal and neonatal risk screening module is capable of detecting danger signs in mothers and babies in accordance with WHO standards. Internal testing (alpha test) with 30 critical scenarios showed high detection accuracy, enabling midwives and cadres to identify early complications such as postpartum haemorrhage and neonatal respiratory distress. This confirms MONITA's potential to improve rapid response to emergencies.

The Location Tracking or GPS module enables the system to determine the location of pregnant women in real time and estimate the travel time to the nearest health facility. Integration tests showed accurate location data, enabling faster coordination of evacuations. This module is key to minimising delays in maternal and neonatal emergency care. GPS dengan kemampuan pelacakan lokasi merupakan kemajuan signifikan dalam perawatan kesehatan ibu (Tejashwini et al., 2023)

In the Emergency Response Notification Module, the system will automatically send alarm notifications to the Health Office or relevant officials when an emergency case is detected. Critical scenario testing shows that notifications are sent on time, confirming the system's readiness to accelerate response coordination. The Dashboard Module visually displays case distribution and response delay patterns. Initial interpretation of mockup data indicates that this module can help stakeholders identify high-risk areas, enabling more efficient prioritisation of interventions.

The technical documentation module contains user and developer manuals prepared to support field implementation. This documentation facilitates knowledge transfer to midwives and cadres and

serves as the basis for training prior to pilot deployment. Village maps, health facility references, and emergency response SOPs are integrated into the system. This ensures that MONITA operates in accordance with the actual conditions in Tanah Laut Regency, strengthening the relevance of the application in the local context and facilitating data-driven decision-making.

In addition to emergency response features, MONITA includes an educational module that provides pregnant women and families with information on maternal and neonatal health. This module covers guidance on pregnancy care, recognition of danger signs, and tips for healthy maternal and child practices. According to (Jones et al., 2020), knowledge about danger signs among women in the intervention group using the educational module was significantly higher than among women who only received routine maternal care. By integrating education directly into the application, MONITA empowers users to increase awareness, engage in preventive care, and make informed decisions regarding their health.

DISCUSSION

The results of MONITA's development show that this application has significant potential in strengthening the maternal and neonatal emergency response system in Tanah Laut Regency. The maternal and neonatal risk screening module has been proven to be capable of detecting danger signs in mothers and babies in accordance with WHO standards with high accuracy, based on alpha testing of 30 critical scenarios. This enables midwives and cadres to identify complications early, such as postpartum haemorrhage and neonatal respiratory disorders, thereby accelerating emergency response in the field. Communication does indeed provide convenience for mothers and nurses. (Chen et al., 2020). The health assistant application provides a convenient, personalised, fast, effective, and spatio-temporal service mode for continuous care, which is suitable for clinical implementation and promotion.

The location tracking feature (GPS) provides the ability to determine the real-time position of pregnant women and estimate the travel time to the nearest health facility. Accurate location data integration speeds up evacuation coordination and minimises delays in treatment, especially in large and remote areas such as Tanah Laut. The automatic emergency notification module ensures that relevant personnel receive timely alerts when critical cases are detected, supporting more efficient emergency response coordination. Meanwhile, the spatial dashboard provides visualisation of case distribution and response delay patterns, making it easier for decision-makers to prioritise interventions in high-risk areas. The integration of village maps, healthcare facility references, and emergency SOPs also shows that MONITA is not merely a digitisation of procedures, but is adaptive to the local context, increasing the relevance and effectiveness of implementation in the field. This is in line with research conducted by (Liu & Wang, 2021) to design and build mobile health systems that can improve maternal health services based on these features

When compared to similar systems abroad, many platforms only focus on one aspect, such as risk detection or emergency notifications, but rarely combine clinical screening, location tracking, response coordination, and monitoring dashboards in a single, easy-to-operate platform. According to (Liu & Wang, 2021; Oguntunde et al., 2018), transportation difficulties have repeatedly been highlighted as one of the main challenges limiting the use of pregnancy care in rural areas. According to UNICEF and Commission Nigeria (in Okonofua et al., 2023), in Nigeria, the population has widespread mobile phone usage, with 89.1% of the population using mobile technology devices, but there has been no evaluation of the use of mobile technology devices to improve maternal health services.

MONITA is available in Indonesia, particularly in Tanah Laut Regency, and stands out because it combines all four of these features. It is designed so that midwives and cadres with minimal technological experience can use it, and it is adapted to local data to support evidence-based decision-making. However, MONITA has limitations. Current testing is only on a limited scale

(alpha test) and has not been tested on a large population, so its effectiveness in reducing maternal and infant mortality rates needs further evaluation through field studies or long-term pilots. In addition, the use of GPS and real-time notifications may face technical obstacles such as weak signals or high battery consumption, while adoption by cadres or families depends on digital literacy and the availability of Android devices.

Overall, MONITA shows great potential as an innovative solution that integrates risk screening, field coordination, and spatial monitoring into a single platform. With further testing, ongoing training, and integration of local policies, this application could become an effective implementation model for accelerating maternal-neonatal emergency response and improving maternal and infant health outcomes in resource-limited areas.

CONCLUSION

The MONITA application shows significant potential as an Android-based digital platform for monitoring maternal and neonatal emergency response in Tanah Laut Regency. This system enables early detection of risks of complications for mothers and babies, strengthens field response coordination through GPS and automatic notification features, and provides a spatial dashboard for real-time monitoring. The integration of local data and emergency SOPs ensures that the application is adaptable to the regional context, supporting midwives, cadres, and families in making quick decisions. The implementation of MONITA is expected to accelerate emergency response, improve the effectiveness of coordination between health workers, and contribute to reducing the Maternal Mortality Rate and Neonatal Mortality Rate in areas with limited access and resources.

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