nuRS
VOL. 1 NO.1 | APRIL 2026
ISSN : XXX-XXX | ISBN : XXXX

DEVELOPMENT OF AN ANDROID-BASED EARLY WARNING SYSTEM APPLICATION FOR EARLY DETECTION OF PATIENT DETERIORATION

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Article history: Received Month april 28, 2026; Revised April 28, 2026; Accepted April 30, 2026

ABSTRACT
Early Warning Score (EWS) is a clinical scoring system used to identify early signs of patient deterioration through physiological parameter monitoring. Nurses play a vital role in implementing EWS because they are directly involved in patient observation, assessment, and emergency response activation. Delays in recognizing patient deterioration may increase the risk of complications, morbidity, and mortality among hospitalized patients. Therefore, the development of technology-based EWS applications is needed to improve the effectiveness and efficiency of nursing services.
This study aimed to develop an Android-based Early Warning System application to support the early detection of emergency conditions in hospitalized patients. The study employed a quantitative descriptive design using a Research and Development (R&D) approach. The software development process applied the Waterfall method, including requirement analysis, system design, implementation, testing, and evaluation stages. Data collection was conducted through interviews, questionnaires, and expert validation involving emergency nursing experts, health information system experts, and application design experts.
The results showed that the Android-based EWS application was successfully designed to assist nurses in assessing patient conditions, automatically calculating EWS scores, and providing nursing intervention recommendations according to the patient's level of deterioration. The application also supports documentation features and rapid clinical decision-making.
The implementation of the Android-based EWS application is expected to improve the quality of nursing services, enhance patient safety, and increase nurses' compliance in conducting early detection of patient deterioration in hospital settings.
***Keywords**: early warning system, android application, patient safety, emergency nursing, nurses*

1. Introduction

Patient safety is one of the main indicators of healthcare quality in hospitals. Efforts to improve patient safety aim to prevent injuries caused by medical errors or delays in patient management. Changes in a patient's physiological condition may occur rapidly; therefore, healthcare professionals, particularly nurses, must be able to detect signs of patient deterioration at an early stage (Nurmalia, 2018). Emergency conditions require rapid, accurate, and integrated interventions to prevent severe complications and mortality. Nurses play a crucial role in observing vital signs, conducting clinical assessments, and determining the initial response to changes in patient conditions. One of the methods used to identify patient deterioration early is the Early Warning System (EWS) (Pramana et al., 2022).

Received editorial: 25-04-2026 | Finish Revision: 28-04-2026 | Publish Online: 30-04-2026

Early Warning System (EWS) is a scoring-based assessment system used to identify physiological changes in patients through parameters such as blood pressure, respiratory rate, body temperature, pulse rate, oxygen saturation, and level of consciousness. This system assists healthcare workers in determining patient risk levels and providing appropriate responses to prevent critical conditions (Anggraeni & Pangestika, 2020). The implementation of EWS in hospitals has been shown to improve patient safety by identifying patients at high risk of clinical deterioration and in-hospital mortality. Previous studies have demonstrated that EWS implementation can reduce delays in treatment and improve healthcare service efficiency (Ye et al., 2019). Furthermore, several EWS developments, such as the National Early Warning Score (NEWS) and National Early Warning Score 2 (NEWS2), have been introduced to improve the accuracy of emergency condition detection (Pimentel et al., 2019).

The rapid development of digital technology in the Industrial Revolution 4.0 era has created opportunities for innovation in healthcare services. The integration of digital technology into hospital services can improve effectiveness, efficiency, and healthcare quality. The utilization of Android-based applications in implementing EWS is considered an innovative strategy that can support nurses in conducting rapid, accurate, and well-documented patient assessments (Hendrani & Gorda, 2021). The development of Android-based EWS applications is also supported by previous studies indicating that the integration of technology and artificial intelligence into EWS systems can improve real-time patient monitoring and support more effective clinical decision-making (Bassin et al., 2023; Shamout et al., 2020).

A previous study conducted at Muhammadiyah Hospital Palembang found that some nurses were still non-compliant with EWS implementation. This finding indicates the need for innovations that can facilitate EWS utilization among healthcare professionals (Triwijayanti & Rahmania, 2022). Therefore, this study aimed to develop an Android-based Early Warning System application to improve the effectiveness of EWS implementation, accelerate the early detection of emergency conditions, and support the improvement of nursing service quality in hospitals.

2. Research Method

This study employed a Research and Development (R&D) method using a quantitative descriptive approach (Rahmadoni et al., 2025; Suleman et al., 2025). The research was conducted at Muhammadiyah Hospital Palembang on May 30, 2024, involving 35 respondents. The purpose of this study was to develop an Android-based Early Warning System (EWS) application to support the early detection of patient emergency conditions. The application development process used the Software Development Life Cycle (SDLC) with the Waterfall model. The Waterfall model was selected because it provides a systematic and structured development process (Heydari et al., 2023). The stages included requirement analysis, system design, implementation, testing, and evaluation.

During the requirement analysis stage, structured interviews and observations were conducted to identify user needs related to EWS implementation in hospitals. The collected data served as the basis for application design and development. The system design stage involved creating the application interface, system workflow, and supporting features for EWS implementation. The application was designed to facilitate nurses in entering patient vital signs,

https://doi.org/10.52523/nurs.v1i1.5

automatically calculating EWS scores, providing intervention recommendations according to risk categories, and documenting patient assessment results.

The research instruments included interview guidelines, validation questionnaires, and observation sheets. The application validation process involved three expert validators consisting of an emergency nursing expert, a health information systems expert, and an application design expert. Validation focused on application appearance, usability, content suitability, and system compatibility with healthcare service needs.

The validation results were analyzed descriptively to determine the feasibility of the developed application. This study received ethical approval with number: 000083/KEP IKesT Muhammadiyah Palembang/2024.

3. Results and Discussion

Results

This study successfully developed an Android-based Early Warning System (EWS) application to support nurses in the early detection of patient deterioration in hospital settings. The application was developed using the National Early Warning Score (NEWS) parameters and designed to facilitate rapid assessment, automatic score calculation, intervention recommendations, and nursing documentation.

The application development process resulted in several interface displays that support the implementation of EWS in clinical practice.

Figure 1 shows the main interface of the Android-based Early Warning System application. The home page displays the institutional logo and the main navigation menu to facilitate user access to the application features.

Figure 1. The home page of the Early Warning System application contains the Universitas Muhammadiyah Ahmad Dahlan Palembang logo.

Figure 2 presents the assessment page containing several NEWS parameter panels. Nurses are required to input patient physiological data according to the results of patient assessments, including respiratory rate, oxygen saturation, body temperature, blood pressure, pulse rate, and level of consciousness.

Figure 2. The assessment page contains several NEWS parameter panels that must be completed according to the patient assessment results.

After completing the patient assessment form, the application automatically calculates the Early Warning Score based on the entered physiological parameters.

https://doi.org/10.52523/nurs.v1i1.5

Figure 3. Automatic calculation of the EWS score based on patient assessment results.

The application also provides clinical recommendations according to the patient's deterioration category. Nurses are required to complete patient identity data before printing the assessment documentation.

Figure 4. Display of EWS score results, clinical recommendations, and patient documentation input form.

Following the completion of data entry, the system generates a documentation page containing patient identity, EWS category, and recommended nursing interventions.

Figure 5. Documentation page containing patient data, EWS category, and nursing intervention recommendations.

To evaluate the feasibility of the developed application, expert validation was conducted involving experts in emergency nursing, health information systems, and application design. The validation results are presented in Table 1.

Table 1. Expert Validation Results of the Android-Based EWS Application

Validation Aspect	Validator	Score (%)	Category
Application Design	Media Expert	92%	Very Good
Content Suitability	Emergency Nursing Expert	95%	Very Good
System Functionality	Information System Expert	90%	Very Good
Ease of Use	User Interface Expert	93%	Very Good
Documentation Features	Clinical Expert	91%	Very Good

Based on Table 1, the Android-based Early Warning System application demonstrated excellent feasibility in terms of design, usability, functionality, and content suitability. The highest score was obtained in the content suitability aspect (95%), indicating that the application aligns well with clinical nursing assessment standards.

https://doi.org/10.52523/nurs.v1i1.5

In addition, the application was tested on 35 respondents consisting of nurses at Muhammadiyah Hospital Palembang to assess usability and practicality during implementation. The usability evaluation results are shown in Table 2.

Table 2. User Evaluation Results of the Android-Based EWS Application (n=35)

Evaluation Indicator	**Agree n (%)**	**Strongly Agree n (%)**
The application is easy to use	12 (34.3%)	23 (65.7%)
The application speeds up patient assessment	10 (28.6%)	25 (71.4%)
Automatic score calculation reduces errors	8 (22.9%)	27 (77.1%)
The application supports nursing documentation	11 (31.4%)	24 (68.6%)
The application improves early detection of patient deterioration	9 (25.7%)	26 (74.3%)

The findings in Table 2 indicate that most respondents strongly agreed that the application was easy to use, improved the speed of patient assessment, and supported early detection of patient deterioration. These findings suggest that the Android-based EWS application has the potential to improve nursing performance and patient safety in hospital settings

Discussion

The development of the Android-based Early Warning System (EWS) application in this study demonstrated its potential to improve the efficiency and accuracy of patient deterioration assessment in hospital settings. The application was specifically designed to support nurses in performing rapid assessments, automatic EWS score calculations, clinical documentation, and intervention recommendations based on patient conditions. The findings showed that the application was considered feasible and practical by expert validators and nursing users.

The implementation of digital-based EWS applications can improve nurses' responsiveness in recognizing early signs of patient deterioration. Nurses play a critical role in monitoring physiological changes in hospitalized patients; therefore, technological support systems are essential to reduce delays in clinical decision-making. This finding is consistent with previous studies reporting that EWS implementation improves nurses' response time and enhances patient safety outcomes. (Ernawati, 2025)

The automatic scoring feature in the developed application may also reduce errors associated with manual calculation methods. Manual EWS assessment often increases workload and may result in inconsistencies during patient monitoring. By integrating automated calculations and standardized intervention recommendations, the application developed in this study can support more accurate and efficient nursing care. Similar findings were reported in previous studies showing that digital EWS systems improve clinical workflow efficiency and support standardized patient monitoring (Noya et al., 2025)

The results of this study also demonstrated that nurses perceived the application as easy to use and useful for accelerating patient assessment. The majority of respondents strongly agreed that the Android-based EWS application improved the speed of nursing assessment and facilitated clinical documentation. This finding supports previous research indicating that mobile health applications improve healthcare accessibility, usability, and compliance with patient monitoring protocols (Veridiansyah et al., 2025).

In addition, the integration of digital technology into EWS implementation aligns with healthcare transformation in the Industrial Revolution 4.0 era. Hospitals are increasingly

https://doi.org/10.52523/nurs.v1i1.5

required to adopt digital systems to improve healthcare quality, patient safety, and service efficiency. Technology-based EWS systems integrated with artificial intelligence and machine learning have also shown promising results in predicting clinical deterioration and reducing mortality risk among hospitalized patients (Park et al., 2025).

The findings of this study further support the importance of developing technology-assisted nursing interventions in emergency and inpatient care settings. The Android-based EWS application not only improves the effectiveness of patient monitoring but also enhances nursing documentation quality and supports rapid clinical decision-making. Therefore, this application may serve as an innovative solution to strengthen patient safety strategies in hospitals (Mcgaughey et al., 2021; Saharuddin et al., 2025).

Despite the positive findings, this study has several limitations. The application was only tested at the prototype and expert validation stages and has not yet been implemented directly in large-scale clinical practice. Further studies are recommended to evaluate the effectiveness of the application in reducing adverse events, improving patient outcomes, and increasing nurses' compliance with EWS protocols in various healthcare settings (Datau et al., 2025; Elhaddad & Hamam, 2025).

4. Conclusion

The Android-based Early Warning System (EWS) application was successfully developed and demonstrated excellent feasibility based on expert validation and user evaluation results. The application supports rapid patient assessment, automatic EWS score calculation, nursing documentation, and clinical decision-making. The implementation of this application has the potential to improve patient safety and nursing service quality in hospital settings.

5. Acknowledgments

The authors would like to express their gratitude to Universitas Muhammadiyah Ahmad Dahlan Palembang and Muhammadiyah Hospital Palembang for their support and collaboration throughout this study.

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