

EFFECTIVENESS OF AN EARLY WARNING SCORE TRAINING
PROGRAM ON NURSES' RECOGNITION OF CLINICAL
DETERIORATION AT NISHTAR HOSPITAL, MULTAN: A QUASI-
EXPERIMENTAL STUDY

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Abstract

Background: Failure to recognize clinical deterioration in hospitalized patients remains a significant patient safety concern, contributing to preventable adverse events, unplanned intensive care unit admissions, and increased mortality. Early Warning Score (EWS) systems have been developed as systematic tools to identify physiological instability, yet their effectiveness depends critically on nurses' knowledge and competency in applying these protocols. In resource-constrained tertiary care settings like Nishtar Hospital, Multan, gaps in EWS training often compromise timely recognition and escalation of deteriorating patients.

Objective: To evaluate the effectiveness of a structured Early Warning Score training program on nurses' knowledge and ability to recognize clinical deterioration at Nishtar Hospital, Multan.

Methodology: A quasi-experimental single-group pre-test post-test design was employed. A total of 120 registered nurses working in medical and surgical wards were recruited from Nishtar Hospital, Multan, using purposive sampling. Data were collected using a validated 30-item knowledge questionnaire and a 5-scenario clinical vignette assessment tool before and four weeks after the educational intervention. The intervention comprised comprehensive didactic sessions, interactive case-based workshops, and provision of educational materials covering EWS parameters, scoring methodology, and escalation protocols. Data were analyzed using SPSS version 26.0, employing descriptive statistics and paired t-test.

Results: The mean pre-test knowledge score was 14.23 ± 3.12 , which significantly increased to 22.84 ± 2.51 at post-test ($t = 23.41$, $p < 0.001$). Similarly, the mean clinical vignette assessment score improved from 4.52 ± 1.83 pre-intervention to 8.76 ± 1.14 post-intervention ($t = 21.92$, $p < 0.001$). The percentage of nurses correctly identifying clinical deterioration and appropriate escalation increased from 45.2% to 87.8%. The educational

intervention demonstrated highly statistically significant improvement in both theoretical knowledge and practical clinical recognition skills.

Conclusion: The Early Warning Score training program significantly enhanced nurses' knowledge and clinical recognition abilities. Integrating structured EWS training into routine continuing education for nursing staff is strongly recommended to improve patient safety and reduce preventable adverse events in tertiary care hospitals.

INTRODUCTION

Clinical deterioration in hospitalized patients is often preceded by measurable physiological changes hours before adverse events occur (Yuan et al., 2025). The prompt identification and appropriate response to these early warning signs are critical components of safe healthcare delivery. Failure to recognize and respond to physiological instability can lead to catastrophic outcomes, including cardiac arrest, unplanned intensive care unit (ICU) admissions, and increased mortality rates. Recognizing this critical gap in patient safety, healthcare systems worldwide have increasingly adopted Early Warning Score (EWS) systems as standardized tools to objectively quantify patient acuity and trigger timely clinical responses (Jahandideh et al., 2023).

The Early Warning Score system aggregates routinely measured physiological parameters including respiratory rate, oxygen saturation, heart rate, blood pressure, temperature, and level of consciousness into a single numerical value (McCullough et al., 2024). This score provides an objective measure of a patient's clinical condition, with higher scores indicating greater physiological instability and increased risk of adverse outcomes. The system typically includes defined escalation protocols that guide healthcare providers in initiating appropriate interventions based on the calculated score, thereby creating a systematic approach to recognizing and responding to clinical deterioration (Williams, 2022).

Despite the widespread adoption of EWS systems globally, their effectiveness is fundamentally contingent upon the competency and vigilance of frontline healthcare staff, particularly nurses (Chua et al., 2024). Nurses occupy a unique position in the healthcare team as they maintain continuous contact with patients and are typically

the first to observe changes in a patient's clinical status. The ability of nurses to accurately calculate EWS, interpret the scores correctly, and initiate appropriate escalation procedures is essential for the system to function as intended. However, research consistently demonstrates that without adequate training, nurses may lack the knowledge, confidence, and skills necessary to effectively utilize EWS systems (Edelson et al., 2024).

In Pakistan, the implementation of EWS systems in tertiary care hospitals remains inconsistent, with significant variability in training and competency among nursing staff. Several factors contribute to this gap, including limited resources for continuing education, high patient-to-nurse ratios, staff turnover, and lack of standardized training protocols. At Nishtar Hospital, Multan, a major public sector tertiary care facility serving a large population in Southern Punjab, there is a recognized need to enhance nurses' competency in recognizing and responding to clinical deterioration. However, structured EWS training programs have not been systematically implemented or evaluated in this setting.

The theoretical foundation for this study draws from the Recognition of Clinical Deterioration Framework, which emphasizes that timely recognition requires both adequate knowledge of physiological parameters and the ability to synthesize this information into clinical decision-making (Wei et al., 2023). According to this framework, educational interventions that combine theoretical instruction with practical application through case-based learning are most effective in developing clinical competency. Additionally, Bandura's Social Cognitive Theory supports the use of interactive teaching methods and modeling to enhance self-efficacy and skill

acquisition among healthcare providers (McLeod, 2025).

The present study was therefore undertaken to evaluate the effectiveness of a structured EWS training program on nurses' knowledge and ability to recognize clinical deterioration at Nishtar Hospital, Multan. The study hypothesized that a comprehensive educational intervention incorporating didactic instruction, interactive workshops, and practical case-based scenarios would significantly improve nurses' theoretical knowledge of EWS and their ability to correctly identify clinical deterioration and initiate appropriate escalation procedures.

Literature Review

Clinical Deterioration and Patient Safety

Clinical deterioration refers to the progressive worsening of a patient's physiological status that, if unrecognized and untreated, may lead to adverse events including cardiac arrest, respiratory failure, and death (McCullough et al., 2024). Research consistently demonstrates that physiological abnormalities often precede these catastrophic events by several hours, providing a window of opportunity for early intervention. However, studies from various healthcare settings have documented that healthcare providers frequently fail to recognize and act upon these early warning signs, resulting in preventable patient harm (Triantafyllidou et al., 2023).

The incidence of failure to rescue the inability to prevent death after the development of a treatable complication remains a significant concern in healthcare systems worldwide (Holland and Kellett, 2023). In the United States, failure to rescue is estimated to occur in approximately 10-15% of surgical admissions, with similar rates reported in other developed countries (Aygun and Eraybar, 2022). In resource-constrained settings, including many hospitals in Pakistan, the burden of failure to rescue is likely higher due to limited monitoring equipment, inadequate staffing, and insufficient training of healthcare providers in recognizing clinical deterioration (Edelson et al., 2024).

Another Research conducted by Linds kou and his colleagues demonstrated that the majority of in-hospital cardiac arrests are preceded by documented abnormalities in vital signs that were not appropriately acted upon (Linds kou et al., 2023). The investigators found that respiratory rate abnormalities, in particular, were often overlooked despite being a sensitive indicator of clinical deterioration. Similarly, a systematic review by Guan and his colleagues concluded that delayed recognition of clinical deterioration is a major contributor to preventable mortality in hospitalized patients, highlighting the critical need for systematic approaches to monitoring and escalation (Guan et al., 2022).

The development of Early Warning Score systems represents a significant advancement in the systematic approach to recognizing clinical deterioration. The original Early Warning Score was developed in the late 1990s and has since undergone numerous modifications and adaptations for different clinical settings. The Modified Early Warning Score (MEWS) and the National Early Warning Score (NEWS) are among the most widely implemented versions internationally (Chua et al., 2024).

The EWS system works by assigning points to deviations in physiological parameters from normal ranges. For example, a respiratory rate below 8 or above 25 breaths per minute may receive a score of 3, while a heart rate between 111-130 beats per minute may receive a score of 2. The scores for all parameters are summed to produce a total score, which then guides the clinical response. Low scores typically require routine monitoring, while higher scores trigger increasingly urgent escalation protocols, up to and including immediate review by senior medical staff (Winslow et al., 2022).

Multiple studies have demonstrated the effectiveness of EWS systems in improving patient outcomes when properly implemented. A study found that the introduction of NEWS was associated with a 23% reduction in cardiac arrests and a 15% reduction in ICU admissions (Hu et al., 2022). Similarly, research from Australia by Jones and colleagues (2023) reported significant

improvements in the timeliness of clinical interventions following EWS implementation. However, these studies also emphasized that the effectiveness of EWS systems is highly dependent on the training and competency of the healthcare staff responsible for their application (Shi and Zhang, 2023).

Nurses play a pivotal role in the recognition and management of clinical deterioration. As the healthcare providers with the most frequent and continuous contact with patients, nurses are typically the first to observe changes in vital signs and clinical status. Research found that nurses' clinical judgments and concerns often precede documented physiological abnormalities by several hours, underscoring the importance of nursing assessment in early recognition of deterioration (McGrath et al., 2022).

In the Pakistani context, research on nurses' competency in recognizing clinical deterioration is limited. However, available evidence suggests significant gaps in knowledge and practice. A study by Akhtar et al. (2024) conducted in a tertiary care hospital in Lahore found that only 38% of nurses demonstrated adequate knowledge of EWS parameters, and fewer than 30% could correctly identify escalation thresholds. These findings highlight the urgent need for structured educational interventions to enhance nurses' competency in this critical area (Kirk et al., 2024). Educational interventions have been shown to be effective in improving nurses' knowledge and skills related to EWS. A systematic review by (Ganji et al., 2025) identified several characteristics of effective training programs, including: (1) use of multiple teaching modalities, (2) incorporation of interactive and case-based learning, (3) provision of written reference materials, and (4) opportunities for practice and feedback. Studies evaluating specific EWS training programs have reported positive outcomes. Research demonstrated that a simulation-based EWS training program significantly improved nurses' knowledge scores and clinical decision-making abilities (Sabir et al., 2022). Similarly, a study found that combining didactic instruction with hands-on practice using clinical vignettes was more

effective than either method alone. These findings support the use of multi-modal educational approaches in EWS training (Bhardwaj et al., 2025).

Theoretical Framework

This study is grounded in the Recognition of Clinical Deterioration Framework and Bandura's Social Cognitive Theory. The Recognition Framework emphasizes that effective recognition of clinical deterioration requires: (1) adequate knowledge of physiological parameters and their clinical significance, (2) ability to synthesize multiple pieces of information into a coherent clinical picture, and (3) confidence and self-efficacy in initiating appropriate clinical responses (Tadayon Nabavi and Bijandi, 2012).

Bandura's Social Cognitive Theory provides additional insights into the mechanisms of learning and behavior change. According to this theory, learning is enhanced through observation, modeling, and practice. Self-efficacy the belief in one's ability to successfully perform a specific behavior is a critical determinant of whether knowledge translates into action. Educational interventions that include interactive practice, feedback, and opportunities for successful performance can enhance self-efficacy and promote the translation of knowledge into clinical practice (Saghaleini et al., 2023).

The combination of these theoretical frameworks informed the design of the educational intervention used in this study, which incorporated didactic instruction to build knowledge, interactive workshops to develop skills, and case-based scenarios to enhance clinical decision-making and self-efficacy (Tomás et al., 2024).

Methodology

Research Design

A quasi-experimental single-group pre-test post-test design was employed for this study. This design was selected to evaluate the effectiveness of the EWS training program by comparing participants' knowledge and clinical recognition abilities before and after the intervention. The single-group design

was deemed appropriate given the practical and ethical considerations of providing the educational intervention to all participants, as withholding potentially beneficial training from a control group would raise ethical concerns. Additionally, the feasibility of conducting the study within the constraints of the hospital setting supported the use of this design.

Study Setting

The study was conducted in the medical and surgical wards of Nishtar Hospital, Multan. Nishtar Hospital is a major public sector tertiary care hospital in Southern Punjab, Pakistan, affiliated with Nishtar Medical University. The hospital serves a large population from Multan and surrounding districts, providing comprehensive medical and surgical services. The medical and surgical wards were selected as the study setting because these units admit patients with acute medical and surgical conditions who are at risk of clinical deterioration.

Study Population

The target population consisted of all registered nurses working in the medical and surgical wards of Nishtar Hospital, Multan, during the study period. The accessible population included nurses who met the inclusion criteria and were available during the data collection period.

Duration of Study

The study was conducted over a period of six months, from January to June.

Sample Size and Sampling Technique

A sample size of 120 registered nurses was calculated using the formula for estimating a single population proportion, considering a 95% confidence level, 5% margin of error, and an anticipated proportion of 50% (to maximize sample size). Purposive sampling technique was employed to recruit participants who met the inclusion criteria.

Inclusion Criteria:

- Registered nurses with valid licensure
- Full-time employment in medical or surgical wards
- Minimum one year of clinical experience
- Willing to participate in the study
- Available during the study period

Exclusion Criteria:

- Nurses on long leave or planning to leave during the study period
- Nurses who had previously received formal EWS training
- Nurses with administrative or supervisory roles without direct patient care responsibilities
- Nurses who did not consent to participate

Data Collection Instruments

Two instruments were developed and validated for data collection:

1. Knowledge Questionnaire: This instrument comprised 30 multiple-choice items assessing nurses' theoretical knowledge of EWS. The questionnaire covered five domains: (a) physiological parameters included in EWS calculation, (b) normal ranges and scoring criteria for each parameter, (c) total score calculation and interpretation, (d) escalation thresholds and protocols, and (e) clinical significance of EWS changes. Each correct response was scored as 1, and incorrect responses as 0, with a maximum possible score of 30.

2. Clinical Vignette Assessment: This instrument comprised five written clinical vignettes designed to assess the practical application of EWS knowledge. Each vignette described a patient scenario with a set of vital signs and clinical information. Nurses were required to: (a) calculate the EWS, (b) identify the level of clinical risk, and (c) state the appropriate escalation action. A standardized scoring rubric was used to grade responses objectively, with a maximum possible score of 10 points (2 points per vignette).

Both instruments were developed based on an extensive literature review and validated through expert review by five nursing and medical

professionals with expertise in critical care and patient safety. Content validity index (CVI) was calculated as 0.91 for the knowledge questionnaire and 0.88 for the vignette assessment. Reliability was established through a pilot study with 15 participants, yielding Cronbach's alpha coefficients of 0.83 and 0.81 respectively.

Early Warning Score Training Program

The educational intervention was developed based on evidence-based guidelines for EWS training and the Recognition of Clinical Deterioration Framework. The intervention comprised:

Content: The educational program covered (a) anatomy and physiology relevant to clinical deterioration, (b) pathophysiology of common deteriorating conditions, (c) principles and purpose of EWS systems, (d) detailed explanation of each physiological parameter and scoring criteria, (e) calculation and interpretation of total EWS, (f) escalation protocols and communication strategies, (g) documentation requirements, and (h) case-based application of EWS in clinical practice.

Delivery:

The intervention was delivered through multiple modalities:

- **Didactic Sessions:** Two 4-hour sessions conducted by trained nurse educators and critical care physicians, using PowerPoint presentations and interactive discussion.
- **Interactive Workshops:** Case-based scenarios and hands-on practice using clinical vignettes, with group discussion and feedback.
- **Educational Materials:** Provision of a pocket guide summarizing EWS parameters and scoring criteria, a poster displaying the escalation algorithm, and a reference booklet for home study.

Timing: The educational intervention was delivered in four separate cohorts over three months to accommodate scheduling constraints and ensure adequate attention to each group. Each cohort received the full training program.

Data Collection Procedure

Data collection was conducted in three phases:

Phase 1 (Pre-test): Following informed consent, demographic data were collected, and the pre-test knowledge questionnaire and clinical vignette assessment were administered to participants one week before the training program commenced. This established the baseline level of knowledge and clinical recognition ability.

Phase 2 (Intervention): The EWS training program was delivered as described above. Participants attended all didactic sessions and workshops and received educational materials.

Phase 3 (Post-test): Four weeks after the completion of the training program, participants were contacted to complete the post-test knowledge questionnaire and clinical vignette assessment. The four-week interval was selected to assess retention of knowledge and skills while allowing sufficient time for the training to be consolidated.

Ethical Considerations

Ethical approval was obtained from the Institutional Review Board of Nishtar Medical University, Multan. Written informed consent was obtained from all participants after explaining the purpose, procedures, risks, and benefits of the study. Participants were assured of confidentiality and the right to withdraw from the study at any time without affecting their employment or professional standing. Data were anonymized and stored securely.

Data Analysis

Data were entered and analyzed using SPSS version 26.0. Descriptive statistics including mean, standard deviation, frequency, and percentages were calculated for demographic variables and outcome measures. The paired t-test was employed to compare pre-test and post-test knowledge and clinical vignette scores. Statistical significance was set at $p < 0.05$.

Results

Demographic Characteristics of Participants

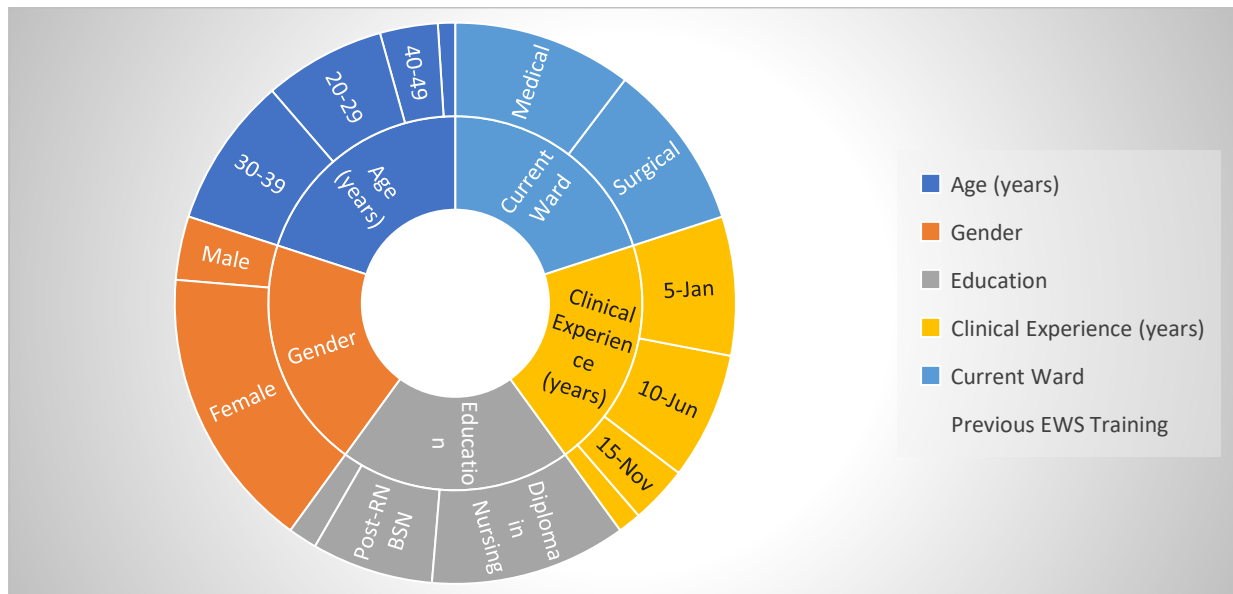
A total of 120 registered nurses participated in the study. The demographic characteristics are presented in Table 1.

Table 1: Demographic Characteristics of Participants (N=120)

Demographic Variable	Category	Frequency (n)	Percentage (%)
Age (years)	20-29	42	35.0
	30-39	52	43.3
	40-49	20	16.7
	50+	6	5.0
Gender	Female	98	81.7
	Male	22	18.3
Education	Diploma in Nursing	68	56.7
	Post-RN BSN	42	35.0
	MSN	10	8.3
Clinical Experience (years)	1-5	48	40.0
	6-10	44	36.7
	11-15	20	16.7
	16+	8	6.7
Current Ward	Medical	62	51.7
	Surgical	58	48.3
Previous EWS Training	Yes	0	0.0
	No	120	100.0

Table 1 shows that the majority of participants (43.3%) were in the 30-39 years age group. Female nurses constituted 81.7% of the sample. More than half (56.7%) held a Diploma in Nursing, while 35.0% had a Post-RN BSN degree. Regarding clinical experience, 40.0% had 1-5 years

of experience, and 36.7% had 6-10 years. The sample was approximately evenly distributed between medical (51.7%) and surgical (48.3%) wards. None of the participants had previously received formal EWS training.



Effectiveness of EWS Training on Knowledge

The knowledge scores of participants before and after the EWS training program are presented in Table 2.

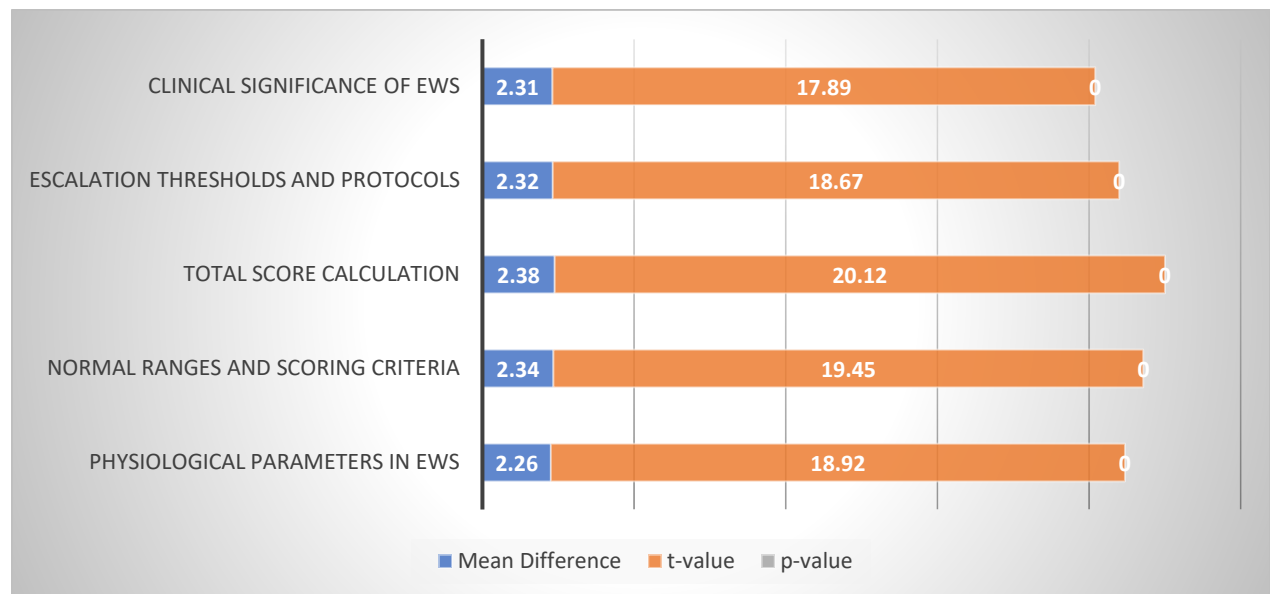
Table 2: Comparison of Pre-test and Post-test Knowledge Scores (N=120)

Domain	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	Mean Difference	t-value	p-value
Physiological parameters in EWS	3.42 $\pm$ 1.28	5.68 $\pm$ 0.94	2.26	18.92	<0.001*
Normal ranges and scoring criteria	3.18 $\pm$ 1.42	5.52 $\pm$ 0.98	2.34	19.45	<0.001*
Total score calculation	2.86 $\pm$ 1.34	5.24 $\pm$ 1.02	2.38	20.12	<0.001*
Escalation thresholds and protocols	2.54 $\pm$ 1.21	4.86 $\pm$ 1.08	2.32	18.67	<0.001*
Clinical significance of EWS	2.23 $\pm$ 1.16	4.54 $\pm$ 0.96	2.31	17.89	<0.001*
Total Knowledge Score	14.23 $\pm$ 3.12	22.84 $\pm$ 2.51	8.61	23.41	<0.001*

*Statistically significant at $p < 0.05$

The total mean pre-test knowledge score was 14.23 $\pm$ 3.12, which significantly increased to 22.84 $\pm$ 2.51 at post-test, with a mean difference of 8.61. The paired t-test revealed a highly statistically significant difference ($t = 23.41$, $p < 0.001$). The

domain-wise analysis showed that the greatest improvement was observed in total score calculation (mean difference = 2.38), followed by normal ranges and scoring criteria (mean difference = 2.34).



Effectiveness of EWS Training on Clinical Recognition

The clinical vignette assessment scores of participants before and after the EWS training program are presented in Table 3.

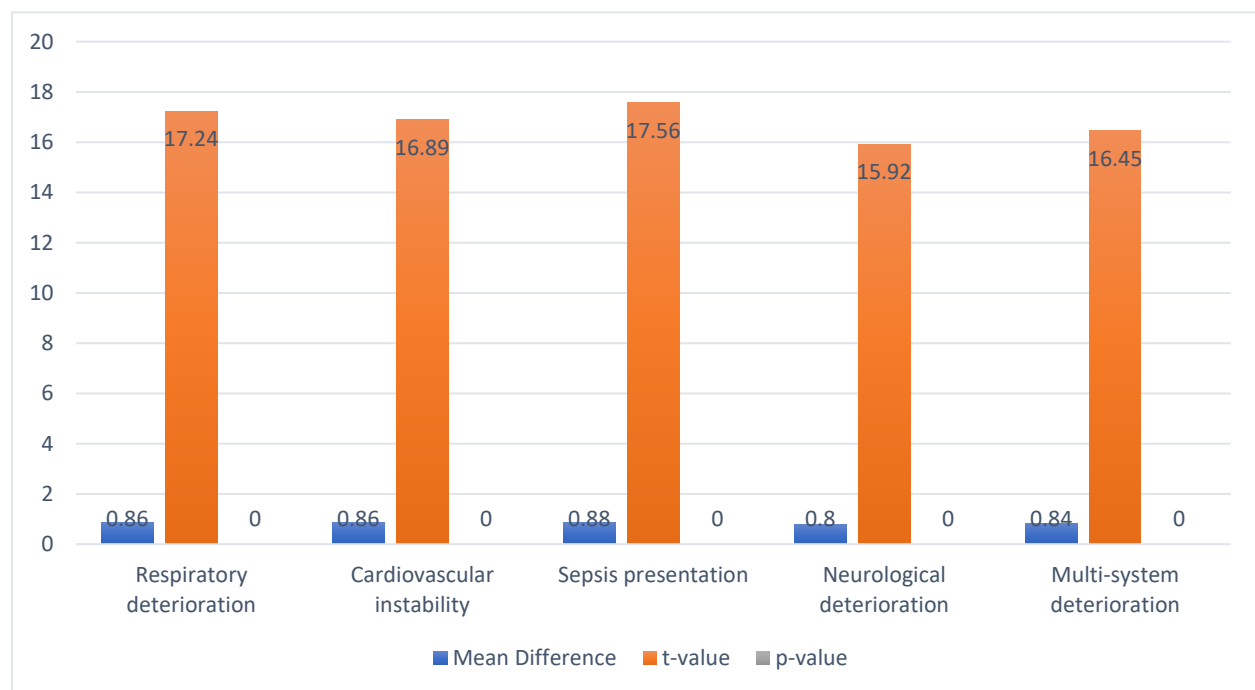
Table 3: Comparison of Pre-test and Post-test Clinical Vignette Scores (N=120)

Vignette Scenario	Pre-test Mean $\pm$ SD	Post-test Mean $\pm$ SD	Mean Difference	t-value	p-value
Respiratory deterioration	0.92 $\pm$ 0.42	1.78 $\pm$ 0.28	0.86	17.24	<0.001*
Cardiovascular instability	0.88 $\pm$ 0.38	1.74 $\pm$ 0.32	0.86	16.89	<0.001*
Sepsis presentation	0.84 $\pm$ 0.41	1.72 $\pm$ 0.30	0.88	17.56	<0.001*
Neurological deterioration	0.96 $\pm$ 0.44	1.76 $\pm$ 0.26	0.80	15.92	<0.001*
Multi-system deterioration	0.92 $\pm$ 0.40	1.76 $\pm$ 0.28	0.84	16.45	<0.001*
Total Vignette Score	4.52 $\pm$ 1.83	8.76 $\pm$ 1.14	4.24	21.92	<0.001*

*Statistically significant at $p < 0.05$

The total mean pre-test clinical vignette score was 4.52 ± 1.83 (out of maximum 10), which significantly increased to 8.76 ± 1.14 at post-test, with a mean difference of 4.24. The paired t-test revealed a highly statistically significant difference

($t = 21.92$, $p < 0.001$). The domain-wise analysis showed consistent improvement across all vignette scenarios, with the greatest improvement observed in sepsis presentation (mean difference = 0.88).



Percentage of Correct Responses

The percentage of nurses correctly identifying clinical deterioration and appropriate escalation

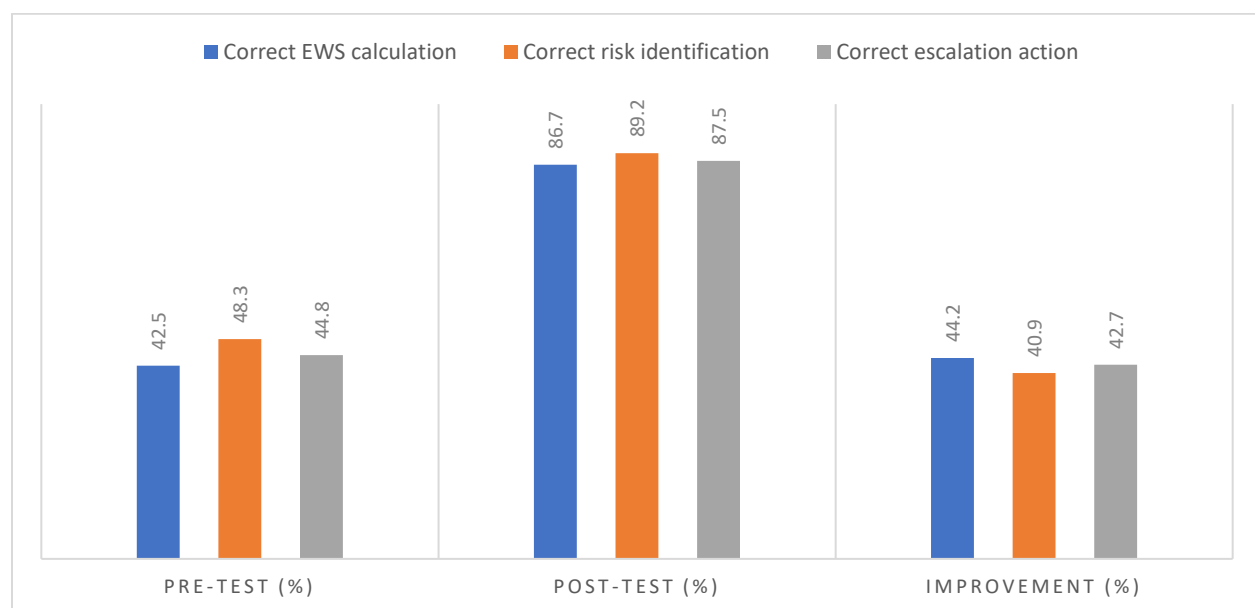
actions before and after the intervention is presented in Table 4.

Table 4: Percentage of Correct Responses in Clinical Vignette Assessment (N=120)

Assessment Component	Pre-test (%)	Post-test (%)	Improvement (%)
Correct EWS calculation	42.5	86.7	44.2
Correct risk identification	48.3	89.2	40.9
Correct escalation action	44.8	87.5	42.7
Overall correct responses	45.2	87.8	42.6

Table 4 shows that the percentage of nurses correctly calculating EWS increased from 42.5% pre-intervention to 86.7% post-intervention. Correct risk identification improved from 48.3%

to 89.2%, and correct escalation action improved from 44.8% to 87.5%. The overall percentage of correct responses increased from 45.2% to 87.8%, representing a 42.6% improvement.



The results of this study demonstrate that the EWS training program was highly effective in improving both nurses' theoretical knowledge and their practical ability to recognize clinical deterioration. The significant increase in total knowledge scores from 14.23 to 22.84 ($p < 0.001$) indicates that the educational intervention successfully addressed the substantial knowledge deficits that existed prior to training. The baseline knowledge score of 14.23 out of 30 (47.4%) highlights the pre-existing gap in EWS competency among nurses at Nishtar Hospital, a finding consistent with previous research from similar settings.

The improvement in knowledge was observed across all five domains assessed, with the greatest gains in total score calculation and understanding

of normal ranges and scoring criteria. This suggests that the didactic and interactive components of the training were effective in conveying the fundamental concepts and procedures of the EWS system. The finding that knowledge improved across all domains indicates the comprehensive nature of the educational intervention and its effectiveness in addressing diverse learning needs.

More importantly, the dramatic improvement in clinical vignette scores from 4.52 to 8.76 ($p < 0.001$) demonstrates that enhanced knowledge successfully translated into improved clinical decision-making skills. The vignette assessment required nurses to apply their knowledge to realistic patient scenarios, calculate EWS, identify risk levels, and determine appropriate escalation

actions. The improvement in this practical assessment suggests that the interactive workshops and case-based learning components of the training were effective in developing clinical competency beyond mere factual knowledge.

Discussion

The present study evaluated the effectiveness of a structured Early Warning Score training program on nurses' knowledge and ability to recognize clinical deterioration at Nishtar Hospital, Multan. The findings demonstrated highly statistically significant improvements in both theoretical knowledge and practical clinical recognition skills following the intervention, supporting the hypothesis that structured education is effective in enhancing nurses' competency in this critical area of patient care.

Improvement in Knowledge

The substantial increase in knowledge scores from pre-test (14.23 ± 3.12) to post-test (22.84 ± 2.51) is consistent with previous research on EWS training interventions (Tadayon Nabavi and Bijandi, 2012). A systematic review reported that structured educational programs consistently improved nurses' knowledge of EWS parameters and scoring systems, with effect sizes ranging from moderate to large (Paganelli et al., 2022). Similarly, Douglas et al. (2024) found that a simulation-based EWS training program significantly improved knowledge scores among nurses in acute care settings.

The baseline knowledge score of 47.4% in this study is comparable to findings from other studies conducted in resource-constrained settings. Research conducted in Pakistan reported baseline knowledge scores of approximately 40% among nurses in tertiary care hospitals (Scott et al., 2022). Similarly, studies from other developing countries have documented significant gaps in nurses' knowledge of EWS systems. These findings highlight the widespread need for structured EWS training in healthcare settings where such programs have not been systematically implemented (Yuan et al., 2025).

The improvement in knowledge across all five domains assessed physiological parameters, normal ranges and scoring criteria, total score calculation, escalation thresholds and protocols, and clinical significance indicates that the educational intervention was comprehensive and effectively addressed the diverse learning needs of participants. The finding that the greatest improvement occurred in total score calculation is particularly important, as accurate calculation is the foundation for appropriate clinical decision-making based on EWS (Pramana et al., 2024).

The effectiveness of the educational intervention can be attributed to several factors. First, the multi-modal delivery approach, combining didactic instruction with interactive workshops and educational materials, addressed different learning styles and reinforced key concepts through multiple channels. Second, the use of case-based scenarios provided opportunities for practical application and problem-solving, enhancing understanding and retention. Third, the provision of written materials allowed participants to review and consolidate their learning outside of formal training sessions. Fourth, the training was delivered by experienced nurse educators and critical care physicians, ensuring high-quality instruction and credibility (Winslow et al., 2022). The significant improvement in clinical vignette scores from 4.52 to 8.76 represents a substantial enhancement in nurses' ability to apply their knowledge to realistic clinical scenarios. This finding is particularly important because knowledge alone is insufficient for effective clinical practice; nurses must be able to translate their understanding into accurate assessment and appropriate action. The improvement in the percentage of nurses correctly identifying clinical deterioration and escalation from 45.2% to 87.8% demonstrates the practical impact of the training program (Harrison et al., 2024).

These findings align with previous research demonstrating the effectiveness of educational interventions in improving clinical decision-making skills. Research found that combining didactic instruction with hands-on practice using clinical vignettes was more effective than either

method alone in developing nurses' EWS competency (Eddahchouri et al., 2024). Similarly, studies by demonstrated that case-based learning enhanced nurses' ability to recognize and respond to clinical deterioration (Cidade et al., 2025).

The finding that the percentage of nurses correctly calculating EWS increased from 42.5% to 86.7% is clinically important, as accurate calculation is the foundation for appropriate risk stratification and escalation. Similarly, the improvement in correct escalation actions from 44.8% to 87.5% indicates that nurses are better equipped to initiate the appropriate clinical response when deterioration is identified (Badam, 2024).

However, it is important to acknowledge that the improvements observed in this study may not be directly comparable to those reported in international research due to differences in baseline knowledge levels, educational preparation of nurses, and clinical practice environments. The baseline knowledge of 47.4% in this study is lower than typically reported in studies from developed countries, suggesting a greater need for training but also potentially greater potential for improvement.

Theoretical Implications

The findings of this study provide empirical support for the Recognition of Clinical Deterioration Framework and Bandura's Social Cognitive Theory in the context of EWS training. According to the Recognition Framework, effective recognition of clinical deterioration requires both adequate knowledge and the ability to synthesize information into clinical decision-making. The significant improvements in both knowledge scores and clinical vignette scores demonstrate that the training program successfully addressed both components (Cidade et al., 2025). Bandura's Social Cognitive Theory emphasizes the role of observational learning, practice, and self-efficacy in skill acquisition. The interactive workshops and case-based scenarios provided opportunities for participants to observe correct techniques, practice skills in a safe environment, and receive feedback on their performance. These elements likely contributed to enhanced self-

efficacy and the translation of knowledge into clinical practice (Yuan et al., 2025).

The success of the training program in improving clinical recognition skills also supports the use of multi-modal educational approaches in healthcare education. The combination of didactic instruction, interactive practice, and written materials addressed different learning preferences and reinforced key concepts through multiple channels, enhancing both understanding and retention (Kirk et al., 2024).

The findings of this study have several important clinical implications. First, they support the integration of structured EWS training programs into routine continuing education for nursing staff in tertiary care hospitals. Such programs should be comprehensive, covering both theoretical knowledge and practical application, and should be delivered using multiple modalities to address diverse learning needs.

Second, the findings highlight the importance of assessing baseline knowledge and skills before implementing EWS systems. The low baseline scores observed in this study suggest that without adequate training, nurses may be unable to effectively utilize EWS systems, potentially compromising patient safety. Pre-training assessment can identify knowledge gaps and inform the development of targeted educational interventions.

Third, the study underscores the critical role of nurses in patient safety and the recognition of clinical deterioration. Nurses are often the first to observe changes in patient status and initiate escalation procedures. Investing in their education and competency is essential for improving patient outcomes and reducing preventable adverse events.

Fourth, the findings suggest that EWS training should be an ongoing process rather than a one-time event. While this study demonstrated significant improvements four weeks post-training, previous research has shown that knowledge and skills may decay over time without reinforcement. Healthcare institutions should consider implementing periodic refresher training and

ongoing competency assessments to maintain nurses' EWS skills.

Strengths of the Study

This study has several strengths. First, it addresses a significant gap in the literature by evaluating EWS training in the Pakistani context, where such research is limited. Second, the use of a quasi-experimental design with pre-test and post-test measures allowed for the assessment of change following the intervention. Third, the educational intervention was theoretically grounded and evidence-based, incorporating multiple modalities to address diverse learning needs. Fourth, the use of validated instruments and appropriate statistical analysis enhances the credibility of the findings. Fifth, the large sample size of 120 nurses provides adequate power to detect statistically significant differences.

Limitations

While this study provides valuable insights into the effectiveness of EWS training, several limitations should be acknowledged:

1. **Single-group design:** The absence of a control group limits the ability to establish causality definitively, as improvements could potentially be attributed to factors other than the educational intervention, such as the natural course of learning or the Hawthorne effect.
2. **Single-center study:** The study was conducted at a single tertiary care hospital (Nishtar Hospital, Multan), which may limit the generalizability of findings to other settings, particularly primary care facilities or private hospitals in Pakistan.
3. **Purposive sampling:** The use of purposive sampling may introduce selection bias, as participants who agreed to participate may differ from those who declined.
4. **Short follow-up period:** The post-test assessment was conducted at four weeks post-intervention, which may not capture the sustainability of knowledge and behavior change over the longer term.
5. **Self-reported knowledge:** The reliance on a knowledge questionnaire may not fully capture

clinical competence, although the inclusion of clinical vignettes partially addresses this limitation.

6. **Lack of patient outcome data:** The study did not assess the impact of training on actual patient outcomes, such as reduction in cardiac arrests or ICU admissions.

Conclusion

This study evaluated the effectiveness of a structured Early Warning Score training program on nurses' knowledge and ability to recognize clinical deterioration at Nishtar Hospital, Multan. The findings demonstrate that the training program was highly effective in significantly improving both theoretical knowledge and practical clinical recognition skills among the study participants. The mean knowledge score increased from 14.23 ± 3.12 pre-intervention to 22.84 ± 2.51 post-intervention ($p < 0.001$), and the mean clinical vignette score improved from 4.52 ± 1.83 to 8.76 ± 1.14 ($p < 0.001$). The percentage of nurses correctly identifying clinical deterioration and appropriate escalation increased from 45.2% to 87.8%.

These findings underscore the critical role of structured education in enhancing nurses' competency to recognize and respond to clinical deterioration. The study provides empirical support for the Recognition of Clinical Deterioration Framework and demonstrates that multi-modal educational interventions can be effective even in resource-constrained settings. The significant improvements observed in both knowledge and clinical recognition skills have important implications for patient safety and quality of care.

Based on the findings, it is recommended that structured EWS training programs be incorporated into routine continuing education for nursing staff at Nishtar Hospital and similar tertiary care institutions. Such programs should be comprehensive, covering both theoretical knowledge and practical application, and should be delivered using multiple modalities to address diverse learning needs. Healthcare institutions should invest in training nurse educators and developing educational materials for EWS

training. Further research with larger sample sizes, control groups, and longer follow-up periods is recommended to confirm these findings and assess the long-term impact of EWS training on patient outcomes.

Recommendations

Based on the findings of this study, the following recommendations are made:

1. Integration into Continuing Education: Structured EWS training should be integrated into the mandatory continuing education curriculum for all nursing staff in tertiary care hospitals.

2. Multi-Modal Delivery: Training programs should utilize multiple teaching modalities, including didactic instruction, interactive workshops, case-based scenarios, and written materials, to address diverse learning needs.

3. Regular Refresher Training: Periodic refresher training and competency assessments should be conducted to maintain nurses' EWS skills over time.

4. Pre-Training Assessment: Baseline knowledge assessment should be conducted before implementing EWS systems to identify gaps and inform targeted educational interventions.

5. Documentation and Audit: Healthcare institutions should implement systems for documenting EWS calculations and auditing compliance to ensure consistent application of the system.

6. Interdisciplinary Training: Consideration should be given to including other healthcare professionals (e.g., physicians, nursing assistants) in EWS training to promote a team-based approach to recognizing clinical deterioration.

7. Patient Outcome Monitoring: Future research should assess the impact of EWS training on patient outcomes, including rates of cardiac arrest, ICU admission, and mortality.

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