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Beyond the Alerts: Nurses' Experiences of Alert Fatigue and Clinical Decision-Making in a Saudi Tertiary Hospital - A Qualitative Study

Hessah O. Alenazi[1], Ibrahim S. Alsulayyih[2], Ahmed N. Altamimi[3]

Tertiary Hospital

Abstract

Background: Electronic clinical decision support systems are increasingly integrated into nursing practice to enhance patient safety and clinical decision-making. However, frequent and repetitive electronic alerts may contribute to alert fatigue, potentially affecting nurses' responsiveness, clinical judgment, and workflow efficiency.

Objective: To explore nurses' experiences of electronic clinical alert fatigue and its perceived influence on clinical decision-making in a tertiary hospital in Riyadh, Saudi Arabia.

Methods: A qualitative descriptive study was designed for the period 2023–2024 at a tertiary hospital in Riyadh, Saudi Arabia. Purposive sampling was used to target 24 registered nurses from medical, surgical, and intensive care units. Data were to be collected through individual semi-structured interviews and analyzed using Braun and Clarke's six-phase thematic analysis. Institutional Review Board approval was obtained.

Results: A provisional analytical framework identified five candidate themes: (1) alert overload and reduced responsiveness, (2) balancing technology with clinical judgment, (3) workflow disruption and competing priorities, (4) adaptive responses to electronic alerts, and (5) opportunities for improving alert systems.

Conclusion: Understanding nurses' experiences of electronic clinical alerts may inform the development of more clinically relevant, user-centered decision support systems. Greater collaboration between nursing professionals and health informatics specialists may improve alert usability, workflow integration, and clinical decision-making.

Keywords: Alert fatigue; Nursing; Clinical decision support systems; Electronic health records; Clinical decision-making; Qualitative research; Saudi Arabia.

1. Introduction

The increasing integration of electronic health records (EHRs) and clinical decision support systems (CDSSs) into healthcare delivery has transformed how healthcare professionals access information, identify clinical risks, and make patient-care decisions. These systems are designed to support clinical judgment by providing timely alerts, reminders, and recommendations related to medication safety, patient deterioration, and evidence-based clinical practices. When appropriately designed and integrated into clinical workflows, electronic decision support can improve the availability of relevant clinical

information and facilitate safer decision-making. However, the effectiveness of these technologies depends not only on their technical capabilities but also on how healthcare professionals perceive, interpret, and respond to the information they generate (1,2).

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Despite their potential benefits, excessive or poorly targeted clinical alerts may contribute to alert fatigue, a phenomenon in which repeated exposure to electronic notifications increases cognitive burden and may reduce clinicians' responsiveness to subsequent warnings. Alert fatigue can arise when notifications are repetitive, clinically irrelevant, poorly timed, or disruptive to routine clinical activities. A systematic review by van der Sijs et al. reported that 49%–96% of computerized medication-safety alerts were overridden in the studies examined, although many overrides were clinically justified. Importantly, these findings largely concerned prescribing clinicians and should not be interpreted as nursing-specific override rates (3). Ancker et al. further demonstrated that alert acceptance decreased as the number of alerts and repeated reminders increased, suggesting that alert frequency, complexity, and informational value influence clinicians' responses to decision-support notifications (4).

PubMed+1

For nurses, electronic alerts are increasingly relevant to the continuous assessment, monitoring, and management of hospitalized patients. Nurses must integrate electronic notifications with bedside observations, clinical knowledge, patient conditions, and competing care priorities. However, the relationship between digital alerts and nursing judgment is complex. In a qualitative study involving 227 bedside nurses, Braun et al. identified concerns regarding delayed or inaccurate early warning alerts, workflow interruptions, unclear recommended actions, and the perceived undervaluing of nurses' clinical expertise (5). Similarly, a qualitative study by Seeburger et al. demonstrated that emergency nurses recognized the potential value of EHR-based behavioral notifications while also identifying implementation difficulties and concerns about their implications for patient care (6). These findings emphasize that the clinical usefulness of electronic alerts depends on more than the accuracy of the technology; it also requires consideration of nurses' experiences, professional judgment, and everyday clinical workflows.

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Within Saudi Arabia, healthcare digitalization has increased the importance of understanding how electronic systems interact with clinical practice. Previous studies have examined healthcare professionals' experiences with electronic medical records, particularly their usability, perceived performance, and associated challenges. AlQahtani et al. reported that 50% of 212 nurses surveyed at a tertiary eye hospital in Riyadh experienced EHR-related stress, with difficulties in information retrieval, documentation correction, and coordination between departments contributing to this burden (7). Similarly, a national multicenter study involving 2,684 healthcare professionals identified variation in perceptions of electronic medical record performance and satisfaction (8). More recently, Alrasheeday et al. found generally positive attitudes toward EHR use among nurses in Saudi Arabia, while identifying differences associated with professional and technological characteristics (9). Although these studies provide insight into the adoption and usability of electronic healthcare systems, they do not specifically explain how nurses experience frequent clinical alerts or how such notifications interact with clinical decision-making in tertiary hospital settings.

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Understanding alert fatigue from the nursing perspective is particularly important in tertiary hospitals, where patients frequently require complex care, continuous monitoring, and timely clinical decisions. Nurses may encounter competing demands that require them to distinguish urgent notifications from less relevant information while maintaining patient safety and efficient care delivery. However, the reasons underlying nurses' responses to electronic alerts cannot be fully understood through alert frequency, override rates, or system-performance measures alone. Qualitative exploration can provide deeper insight into how nurses interpret notifications, determine their clinical relevance, reconcile them with bedside assessments, and respond to potential conflicts between electronic recommendations and professional judgment. Such understanding may also help identify organizational and system-design factors that influence alert responsiveness.

Therefore, this study aims to explore nurses' experiences of electronic clinical alert fatigue and its perceived influence on clinical decision-making in a tertiary hospital in Riyadh, Saudi Arabia. Specifically, the study seeks to understand how nurses perceive and prioritize clinical alerts, the factors influencing their responses to these notifications, and the challenges they encounter when integrating electronic decision support into routine patient care. By examining these experiences, the study may provide context-specific evidence to inform more clinically relevant alert systems, support nursing decision-making, and guide improvements in digital healthcare practices.

2. Methods

2.1. Study Design

A qualitative descriptive study was conducted between 2023 and 2024 at a tertiary hospital in Riyadh, Saudi Arabia, to explore nurses' experiences of electronic clinical alert fatigue and its perceived influence on clinical decision-making. A qualitative descriptive approach was selected to obtain an in-depth understanding of nurses' perceptions, experiences, and responses to electronic clinical alerts within routine clinical practice (10). Individual semi-structured interviews were used to explore how nurses interpreted and prioritized electronic alerts and integrated these notifications into their clinical judgment. The study was designed in accordance with the Consolidated Criteria for Reporting Qualitative Research (COREQ) guidelines (11).

2.2. Study Setting and Participants

The study was conducted at a tertiary hospital in Riyadh, Saudi Arabia, during 2023–2024. The hospital utilized electronic health records (EHRs) and clinical decision support systems to facilitate patient documentation, medication management, and clinical decision-making.

A purposive sampling strategy was adopted, with a target sample of 24 registered nurses (n = 24). This sample size was considered appropriate as an initial recruitment target for obtaining detailed accounts from nurses with diverse clinical experiences, while allowing sample adequacy to be assessed according to information power (12).

Participants were selected from different clinical departments, including medical, surgical, and intensive care units, to capture variation in clinical workload and exposure to electronic alerts. Eligible participants were registered nurses with at least six months of clinical experience who had routinely used electronic

clinical alert systems for at least three months. Nurses working exclusively in administrative positions or without direct experience using electronic clinical alerts were excluded.

The final number of nurses interviewed was [insert actual enrolled sample size].

2.3. Participant Recruitment

Eligible nurses were recruited using purposive sampling to ensure representation across clinical specialties, nursing experience levels, and work shifts. Potential participants were approached through departmental communication channels and provided with an information sheet describing the study objectives, interview procedures, confidentiality measures, and voluntary nature of participation.

Written informed consent was obtained before interviews. Participants were informed that participation was voluntary and that declining or withdrawing would not affect their employment or professional evaluation.

2.4. Data Collection

Data were collected through individual semi-structured interviews conducted in Arabic or English according to participants' preferences. An interview guide was developed based on the study objectives and relevant literature addressing electronic clinical decision support, alert fatigue, and nursing workflow.

The interviews explored nurses' experiences with electronic clinical alerts, perceived alert frequency and relevance, responses to repeated notifications, and the influence of electronic alerts on clinical prioritization and decision-making. Participants were also encouraged to describe situations in which electronic alerts supported or conflicted with their clinical judgment.

Additional probing questions explored factors such as patient acuity, workload, workflow interruptions, and system usability. With participants' consent, interviews were audio-recorded, transcribed verbatim, and de-identified before analysis.

2.5. Data Analysis

Data were analyzed using Braun and Clarke's six-phase thematic analysis framework (13). First, interview transcripts were reviewed repeatedly to achieve familiarity with the data. Second, meaningful statements related to electronic alert experiences and clinical decision-making were identified and assigned initial codes.

Third, related codes were grouped into preliminary themes reflecting patterns across participants' accounts. Fourth, these themes were reviewed against the original transcripts to ensure coherence and consistency. Fifth, themes were refined, defined, and named according to their central meanings. Finally, the themes were organized into an interpretive narrative supported by representative participant quotations.

The nursing and health informatics researchers contributed their respective clinical and technical perspectives to the interpretation of the findings. Differences in interpretation were discussed, and reflexive notes were maintained to document analytical decisions.

2.6. Trustworthiness

The trustworthiness of the study was addressed through attention to credibility, dependability, confirmability, and transferability. Purposive sampling across clinical departments was intended to capture varied nursing experiences. Researchers maintained reflexive notes to identify potential assumptions and document analytical decisions.

Regular discussions between researchers supported critical examination of emerging themes. An analytical record of coding decisions and theme development was maintained to enhance transparency. Descriptions of the study setting and participant characteristics, together with representative quotations, were used to support interpretation and assessment of transferability.

2.7. Ethical Considerations

Ethical approval was granted by the Institutional Review Board (IRB) of the participating tertiary hospital in Riyadh, Saudi Arabia, before commencement of the study.

All participants provided informed consent before participation. Confidentiality was maintained through the assignment of unique participant identification codes, and personally identifiable information was removed from the interview transcripts. Research data were stored securely and were accessible only to authorized members of the research team. Participation was entirely voluntary, and participants were informed of their right to withdraw in accordance with the approved research protocol.

3. Results

3.1. Participant Characteristics

The study targeted 24 registered nurses working in medical, surgical, and intensive care units at a tertiary hospital in Riyadh, Saudi Arabia, during 2023–2024. The final number of participants and their demographic characteristics will be reported following verification of the recruitment records.

3.2. Thematic Findings

The following illustrative analysis is organized into five overarching themes and ten subthemes describing potential dimensions of nurses' experiences with electronic clinical alerts and their perceived influence on clinical decision-making.

Table 2. Illustrative Themes and Subthemes

Themes	Subthemes
1. Alert overload and reduced responsiveness	1.1. Repetitive and excessive notifications; 1.2. Desensitization to clinical warnings
2. Balancing technology with clinical judgment	2.1. Trusting bedside assessment over electronic recommendations; 2.2. Professional accountability
3. Workflow disruption and competing priorities	3.1. Interruptions during patient care; 3.2. Workload and time pressure
4. Adaptive responses to electronic alerts	4.1. Selective prioritization; 4.2. Workarounds and informal strategies
5. Opportunities for improving alert systems	5.1. Clinical relevance and alert customization; 5.2. Nursing participation in system development

Theme 1: Alert Overload and Reduced Responsiveness

This illustrative theme concerns how frequent and repetitive electronic notifications may affect nurses' attention and responsiveness. It distinguishes the experience of receiving numerous notifications from the potential development of reduced sensitivity to alerts over time.

Subtheme 1.1: Repetitive and Excessive Notifications

In this example, nurses described encountering recurring notifications during routine documentation and clinical activities. Repeated alerts concerning previously reviewed patient information were perceived as particularly disruptive. Participants differentiated between clinically useful notifications and messages that added little new information.

"Sometimes the system keeps showing the same warning even after I have already reviewed the patient's condition. It becomes frustrating because I have to acknowledge the message repeatedly while trying to complete my work."
— Illustrative participant P03

Subtheme 1.2: Desensitization to Clinical Warnings

The illustrative accounts suggest that repeated exposure to alerts may contribute to habitual acknowledgment of notifications. Although nurses recognized the importance of electronic warnings, frequent low-priority alerts could make it more difficult to maintain attention to potentially important information.

"At the beginning, I used to read every alert carefully. After some time, when you see so many similar messages, you start expecting them to be routine. My concern is that one day an important warning could appear among them."
— Illustrative participant P08

Theme 2: Balancing Technology With Clinical Judgment

This illustrative theme explores the relationship between electronic recommendations and nurses' professional judgment. It emphasizes how clinical experience, bedside observations, and knowledge of individual patients may influence responses to automated alerts.

Subtheme 2.1: Trusting Bedside Assessment Over Electronic Recommendations

In these hypothetical accounts, nurses viewed electronic alerts as supporting rather than replacing clinical assessment. They described situations in which electronic notifications did not fully reflect the patient's current condition, prompting them to rely on direct assessment and additional clinical verification.

"The computer gives us information, but it does not see the patient the way we do. Sometimes an alert appears, but after assessing the patient, I realize the situation is different from what the system suggests."
— Illustrative participant P11

Subtheme 2.2: Professional Accountability

The illustrative responses highlight the importance of nurses maintaining responsibility for their clinical decisions. Electronic alerts were perceived as additional sources of information, while decisions about patient care required professional judgment and consideration of the clinical context.

"I cannot depend only on the electronic warning. If I follow an alert without assessing the patient, I am still responsible for my decision. The system should support my judgment, not make the decision for me."
— Illustrative participant P05

Theme 3: Workflow Disruption and Competing Clinical Priorities

This illustrative theme examines the potential influence of electronic alerts on nursing workflow, particularly during periods of high clinical activity. It explores how alerts may compete with bedside responsibilities and affect nurses' ability to prioritize tasks.

Subtheme 3.1: Interruptions During Patient Care

In the hypothetical accounts, nurses described electronic alerts appearing during medication administration, patient assessment, and clinical documentation. Notifications were perceived as disruptive when they required attention without providing information relevant to the immediate clinical task.

"When I am preparing medications or documenting a patient's condition, several notifications may appear. I have to stop, review them, and then return to what I was doing. Sometimes this interrupts my concentration."
— Illustrative participant P14

Subtheme 3.2: Workload and Time Pressure

The example responses suggest that high patient acuity and competing responsibilities may influence how nurses respond to electronic notifications. During periods of increased workload, participants described prioritizing direct patient needs while assessing which notifications required immediate action.

"During a busy shift, especially when we have unstable patients, it is difficult to give every notification the same attention. You have to decide what is urgent and what can wait because the patient in front of you is the priority."
— Illustrative participant P17

Theme 4: Adaptive Responses to Electronic Alerts

This illustrative theme describes the strategies nurses may develop to manage electronic alerts while maintaining clinical responsibilities. Such adaptations may reflect attempts to balance efficiency and safety, rather than necessarily indicating inappropriate practice.

Subtheme 4.1: Selective Prioritization of Notifications

In this hypothetical analysis, nurses distinguished between alerts according to their perceived urgency, clinical relevance, and potential consequences. Nurses described giving greater attention to notifications associated with immediate patient-safety concerns while evaluating less urgent messages within the clinical context.

"I pay more attention to alerts related to medication allergies or serious patient risks. Other notifications are less urgent, so I review them according to the situation and what the patient needs at that moment."
— Illustrative participant P20

Subtheme 4.2: Workarounds and Informal Strategies

The illustrative accounts describe nurses seeking alternative ways to verify information when electronic notifications were unclear, repeated, or inconsistent with clinical observations. Such strategies included consulting colleagues, reviewing additional clinical information, and contacting appropriate healthcare professionals.

"If the alert does not make sense, I usually check the patient's information again or ask another nurse or the physician. We cannot ignore the warning, but sometimes we need more information than the system provides."
— Illustrative participant P09

Theme 5: Opportunities for Improving Clinical Alert Systems

This illustrative theme concerns nurses' perspectives on potential improvements to electronic clinical alert systems. The hypothetical responses emphasize the importance of meaningful notifications, effective prioritization, and greater collaboration between clinical staff and health informatics teams.

Subtheme 5.1: Clinical Relevance and Alert Customization

In the example accounts, nurses expressed a preference for electronic alerts that communicated clear, actionable information. Suggested improvements included reducing duplicate notifications, distinguishing high-priority warnings from routine reminders, and making alerts more relevant to patients' clinical conditions.

"I think the system would be better if important alerts were clearly different from routine reminders. We do not need the same warning appearing many times when nothing has changed. The message should

tell us what is important and what action is needed."
— Illustrative participant P22

Subtheme 5.2: Nursing Participation in System Development

The illustrative responses emphasize the potential value of involving bedside nurses in the design, evaluation, and modification of electronic alert systems. Participants described the importance of communicating practical workflow problems to informatics specialists and incorporating nursing feedback into system improvements.

"The people who develop these systems should spend time with nurses and understand what happens during a real shift. Sometimes the system looks good technically, but it does not match how we actually provide care."
— Illustrative participant P24

3.3. Summary of Illustrative Findings

The proposed thematic framework highlights five interconnected dimensions of electronic clinical alert fatigue: excessive notifications, the interaction between electronic recommendations and clinical judgment, workflow disruption, adaptive responses, and opportunities for system improvement.

4. Discussion

4.1. Principal Findings

This study sought to explore nurses' experiences of electronic clinical alert fatigue and its perceived influence on clinical decision-making in a Saudi tertiary hospital. The proposed thematic framework encompasses five interconnected areas: alert overload and reduced responsiveness, balancing electronic recommendations with clinical judgment, workflow disruption, adaptive responses to electronic alerts, and opportunities for system improvement. Together, these themes suggest that alert fatigue should be understood not merely as a consequence of excessive notifications but as a complex interaction between technology design, clinical demands, and professional judgment.

4.2. Alert Overload and Reduced Responsiveness

The potential relationship between repetitive electronic notifications and reduced alert responsiveness is consistent with previous research identifying excessive and low-value alerts as important challenges in clinical decision support. Ancker et al. (4) demonstrated that repeated alerts and increasing alert frequency were associated with reduced alert acceptance among clinicians. Similarly, van der Sijs et al. (3) identified high override rates for medication-related alerts and emphasized that many overrides were clinically justified. These findings highlight the importance of distinguishing unnecessary notifications from alerts that provide meaningful clinical information. Importantly, reduced alert acceptance does not necessarily establish psychological desensitization, nor does acknowledgment or dismissal of an alert automatically indicate unsafe practice. Rather, alert fatigue may reflect difficulties in identifying clinically relevant information within high volumes of electronic notifications.

4.3. Clinical Judgment and Electronic Decision Support

The proposed theme concerning the relationship between electronic alerts and clinical judgment reflects the continuing importance of nurses' professional expertise in technology-supported healthcare. Electronic alerts may provide useful clinical information; however, they cannot independently capture every aspect of a patient's condition or replace direct nursing assessment. Braun et al. (5) similarly reported that bedside nurses sometimes identified clinical deterioration before electronic early warning systems generated notifications and expressed concerns regarding alert accuracy, actionability, and the undervaluing of nursing expertise. These observations suggest that clinical decision support should complement, rather than substitute for, professional judgment. Supporting nurses in interpreting electronic recommendations within the clinical context may therefore be essential for maintaining appropriate responses to alerts.

4.4. Workflow Disruption and Competing Clinical Priorities

The proposed findings also highlight the potential relationship between electronic notifications, nursing workload, and clinical workflow interruptions. In tertiary care environments, nurses must manage competing responsibilities, including medication administration, patient assessment, documentation, and responses to changes in patient condition. Notifications that interrupt these activities without providing actionable information may increase cognitive burden and interfere with workflow efficiency. This interpretation is supported by Braun et al. (5), who identified workflow interruptions as a concern among nurses using electronic early warning systems. In Saudi Arabia, AlQahtani et al. (7) reported EHR-related stress among nurses, including difficulties associated with documentation and information retrieval. These studies suggest that the clinical value of alerts depends partly on their timing, relevance, and integration into existing nursing activities.

4.5. Adaptive Responses and Alert Prioritization

The proposed theme of adaptive responses suggests that nurses may develop strategies to prioritize electronic notifications according to perceived urgency, patient condition, and clinical responsibilities. Such behaviors should not automatically be interpreted as noncompliance or unsafe practice. Previous research has shown that alert overrides may occur for clinically appropriate reasons, particularly when notifications are irrelevant or insufficiently specific (3). Therefore, understanding the reasoning behind alert acknowledgment, postponement, or dismissal may be more informative than evaluating response frequency alone. Qualitative investigation may help distinguish appropriate clinical prioritization from potentially unsafe responses associated with poorly designed notification systems. These distinctions are particularly important when developing interventions intended to improve alert responsiveness without unnecessarily increasing nursing workload.

4.6. Implications for Clinical Practice and Health Informatics

The proposed findings indicate several potential directions for improving electronic clinical alert systems. First, healthcare organizations should evaluate notification relevance, duplication, timing, and actionability to reduce unnecessary interruptions while preserving clinically important warnings. Second, alert systems should support appropriate prioritization through clear presentation of clinical urgency and recommended actions. Third, bedside nurses should be involved in system development, evaluation, and optimization to ensure that electronic notifications reflect actual clinical workflows.

These recommendations are consistent with Bates et al. (1), who emphasized the importance of delivering appropriate clinical decision support at the right time and within the clinician's workflow. They also align

with Saudi research highlighting the importance of addressing system-related barriers and involving nurses in decisions concerning electronic healthcare technologies (8,9). Collaboration between nursing departments, health informatics specialists, and hospital leadership may therefore provide an effective approach to improving alert usability and supporting clinical decision-making.

4.7. Strengths and Limitations

The qualitative descriptive approach offers an opportunity to explore clinical alert fatigue through the perspectives of nurses directly involved in patient care. Recruitment across different clinical departments could provide variation in experiences and help identify contextual factors affecting electronic alert use. Additionally, collaboration between nursing and health informatics researchers could strengthen interpretation by incorporating clinical and technological perspectives.

Nevertheless, several limitations should be considered. Conducting the study in a single tertiary hospital may limit the transferability of the findings to institutions with different electronic systems, organizational practices, or clinical workflows. Interview-based findings are also subject to recall and social desirability biases, particularly when participants discuss potentially sensitive practices involving alert acknowledgment or dismissal. Furthermore, qualitative interviews cannot establish the frequency of inappropriate alert responses or demonstrate a causal relationship between alert fatigue and patient-safety outcomes.

4.8. Future Research

Future studies could combine qualitative interviews with electronic alert logs, workflow observations, and measures of alert responsiveness to examine the relationship between perceived alert burden and actual clinical behavior. Comparative studies across different nursing specialties and hospital settings may also identify variations in alert-management practices. Additionally, intervention studies evaluating clinically prioritized notifications, reduced alert duplication, and nurse-informed system redesign could provide evidence regarding strategies for improving alert usability and patient safety.

5. Conclusion

Electronic clinical alerts represent an important component of contemporary nursing practice; however, their effectiveness depends on their relevance, usability, and integration into clinical workflows. The proposed thematic framework highlights the importance of understanding alert fatigue in relation to nurses' clinical judgment, workload, prioritization strategies, and experiences with electronic decision-support systems. Improving alert design and strengthening collaboration between nurses and health informatics professionals may help support more efficient clinical decision-making and safer patient care.

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