The Impact of Wearable Technology on Patient Monitoring and Clinical Decision-Making in Emergency Rooms

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Introduction

Emergency rooms function in high-pressure settings that require rapid assessment, ongoing monitoring, and prompt intervention in order to improve patient outcomes. Emergency healthcare systems worldwide continue to face overcrowding, staffing shortages, and delayed recognition of patient deterioration. Wearable technologies such as biosensors, smart monitors, and wireless physiological tracking devices have emerged as instruments that could enhance emergency care by enabling continuous real-time monitoring of vital signs and improving communication between providers.

The evidence base for these devices is developing but uneven. A systematic review and meta-analysis of randomized controlled trials examining continuous vital sign monitoring on general hospital wards found that the technology is feasible at scale, while noting that demonstrated effects on hard clinical outcomes remain limited and variable across trials (Bowles et al., 2024). A narrative review of continuous monitoring in postoperative ward care reached a similar conclusion, identifying promise in earlier detection of physiological deterioration alongside unresolved questions about alarm burden and workflow integration (Khanna et al., 2025).

Emergency medicine specifically has less evidence than ward-based care. Alotaibi et al. (2026) published a protocol for a scoping review of wearable technology in emergency care, and the existence of that protocol is itself an indication that the literature has not yet been synthesized for this setting. Preliminary work reported by Tambini et al. (2026) suggests that emergency medical services personnel recognize a role for wearables in patient management during mass casualty incidents, though that finding comes from a conference abstract rather than a full study.

This gap is the opening for the present research. There is limited empirical data on the effectiveness of wearable technology specifically in emergency rooms, and limited understanding of how clinicians there judge its value in practice. This mixed methods study investigates both the measurable clinical outcomes associated with wearable implementation and the experiences of the emergency personnel who use these devices.

Statement of the Problem

Emergency rooms often experience delays in patient monitoring because of overcrowding, staffing shortages, and reliance on intermittent manual vital sign checks. These conditions raise the risk of missed indicators of patient decline, delayed intervention, and unfavorable outcomes. Wearable monitoring devices offer continuous surveillance and real-time data collection, yet their value in improving emergency room outcomes and supporting clinical decision-making has not been well established in this setting (Alotaibi et al., 2026).

A second problem concerns the people using the devices. Comparatively little is known about the attitudes, acceptance, and practical experiences of healthcare professionals with wearable technology in emergency care. Implementation research on continuous monitoring has repeatedly identified alarm burden, device reliability, and integration into existing workflow as barriers that determine whether a technology succeeds in practice (Khanna et al., 2025). Without understanding both clinical results and provider experience, healthcare organizations may struggle to incorporate wearable technologies into emergency care procedures successfully.

Purpose of the Study

This mixed methods study investigates how wearable technology affects patient monitoring, emergency response effectiveness, and clinical decision-making in emergency department settings. The quantitative strand assesses patient care outcomes associated with

wearable technology deployment. The qualitative strand examines healthcare professionals' experiences, attitudes, and difficulties regarding wearable device use in emergency care.

The study further asks whether wearable technology supports better communication between emergency medical teams, greater workflow efficiency, and earlier detection of patient deterioration. By combining quantitative outcome data with qualitative insight from clinicians, the study aims to produce a fuller understanding of how these technologies affect emergency room operations, patient safety, and quality of care than either strand could produce alone. The results may help healthcare organizations develop evidence-based implementation strategies for wearable technology in emergency settings.

Quantitative Research Questions

1. To what extent does the use of wearable technology change the time between onset of physiological deterioration and clinical response in the emergency room?
2. To what extent does wearable technology change the frequency and accuracy of vital sign monitoring for emergency room patients?
3. Is there a statistically significant difference in patient outcomes, including hospital admission rate, length of stay, and adverse event rate, before and after wearable technology implementation?

Qualitative Research Questions

4. How do emergency room clinicians describe the value of wearable technology in patient care?
5. What difficulties do clinicians encounter when incorporating wearable technology into emergency department workflow?
6. How do clinicians describe the influence of wearable data on their clinical judgment?

Mixed Methods Research Question

How do quantitative patient outcome data and qualitative clinician experiences converge or diverge in explaining the success of wearable technology implementation in emergency department settings?

Significance of the Study

This study contributes to the growing body of research on digital health technologies in emergency medicine. Its findings may demonstrate whether wearable technology improves patient monitoring, shortens emergency response times, and supports better clinical judgment in emergency care environments.

The study is significant for three audiences in particular. Emergency room administrators seeking to improve workflow efficiency and patient safety would gain outcome data tied to a specific technology. Healthcare organizations considering wearable implementation would gain insight into the barriers that determine whether such a rollout succeeds. Clinicians interested in technology-assisted patient monitoring would gain an account of how colleagues actually use these devices in practice.

The mixed methods structure is what gives the study its particular contribution. Existing research on continuous monitoring has tended to report either outcomes or implementation experience rather than both, which makes it difficult to determine whether a null or modest outcome finding reflects the limits of the technology or the conditions of its adoption (Bowles et al., 2024). By collecting both strands in the same setting, this study is positioned to distinguish those explanations.

Research Design

This study uses a convergent parallel mixed methods design, in which quantitative and qualitative data are collected during the same period, analyzed separately, and merged at the interpretation stage (Creswell & Plano Clark, 2018). The design is appropriate because the research question requires two different kinds of evidence that neither strand can supply alone: measurable change in patient outcomes, and clinician accounts of why the technology did or did not work in practice. A comparable structure has been adopted in recent continuous-monitoring trials that pair outcome measurement with stakeholder interviews (Syan et al., 2025).

Quantitative Strand

The quantitative strand uses a quasi-experimental pre-test and post-test design comparing patient outcomes before and after the introduction of wearable monitoring in participating emergency departments. Participants are adult emergency room patients monitored using wearable devices. Records for approximately 200 patients in each period will be drawn from hospital data systems, a target chosen to provide adequate power for detecting moderate differences in response time while remaining feasible within one study year.

Outcome variables are drawn from existing hospital records rather than new instruments: time from first recorded physiological deterioration to clinical response, frequency of documented vital sign monitoring, emergency department length of stay, adverse event rate, hospital admission rate, and 30-day readmission rate. Analysis will use descriptive statistics to summarize each variable, paired-sample t tests to compare pre-implementation and post-implementation periods, analysis of variance to compare across participating sites, and multiple regression to examine whether the association between wearable use and response time persists after adjusting for patient acuity and department census.

Qualitative Strand

The qualitative strand uses a phenomenological approach to examine clinicians' lived experience of using wearable technology in the emergency room. Participants will include emergency department nurses, physicians, emergency medical technicians, and nurse supervisors with direct experience using or overseeing these devices, recruited through purposive sampling for variation in role and years of experience.

Data will be collected through semi-structured individual interviews of 45 to 60 minutes, supplemented by the researcher's structured observation notes recorded during clinical shifts. Limiting collection to these two sources rather than adding focus groups keeps the design feasible within the time constraints of emergency practice and avoids duplicating the same accounts in a second format. An initial sample of 15 to 18 clinicians is planned, with recruitment continuing until successive interviews produce no new codes. Interviews will be audio recorded with consent, transcribed verbatim, and de-identified.

Transcripts and observation notes will be analyzed using reflexive thematic analysis following the six phases described by Braun and Clarke (2006), with inductive coding drawn from the data rather than applied from a prior framework. Trustworthiness will be supported through member checking, peer debriefing, an audit trail of coding decisions, and a reflexivity journal documenting the researcher's own position as a practitioner in emergency care.

Integration of Data

The two strands will be merged at the interpretation stage using a joint display, a table that arrays quantitative results alongside the qualitative themes that bear on the same question so that convergence and divergence become visible (Creswell & Plano Clark, 2018). For example, a measured reduction in response time would be placed beside clinician accounts of how alerts

changed their monitoring behavior; an absence of measured change would be placed beside accounts of alarm fatigue or workflow obstacles.

Points of divergence are treated as findings rather than problems. Where outcome data and clinician experience disagree, the discrepancy itself indicates something about implementation, and this study treats such cases as the most informative results it can produce.

Ethical Considerations

The study will be submitted for institutional review board approval at each participating site before data collection begins. Clinician participants will provide written informed consent. Patient outcome data will be extracted in de-identified form under an approved data use agreement, and no patient will be identifiable in any reported result.

Definitions

- Wearable technology: electronic devices worn on the body that continuously monitor and transmit physiological or health-related data.
- Emergency department: a hospital division that treats urgent medical conditions, trauma, and acute illness.
- Clinical decision-making: the process by which clinicians evaluate patient data and select interventions and treatments.
- Patient monitoring: the ongoing observation and evaluation of a patient's physiological status.
- Mixed methods research: an approach that integrates quantitative and qualitative methods within a single study to answer questions neither could answer alone (Creswell & Plano Clark, 2018).

- Real-time monitoring: the continuous collection and transmission of patient data allowing immediate access to physiological information.
- Joint display: a table or matrix that arrays quantitative and qualitative results together to make convergence and divergence visible (Creswell & Plano Clark, 2018).

Limitations

The sample size and the number of participating hospitals may limit the scope of the findings. Because emergency care settings are distinctive, results may not transfer to non-emergency healthcare environments. Variation in staff technological skill may affect both how the devices are used and what outcomes follow, introducing a source of difference the design cannot fully isolate.

Technical malfunctions or connectivity problems may affect device performance and reliability during the study period. Time pressure in emergency settings may restrict clinician availability for interviews, which could limit the depth of qualitative data collected. The quasi-experimental design also carries a specific threat: because the pre-implementation and post-implementation periods are separated in time, unrelated changes in staffing, patient volume, or protocol could account for differences attributed to the technology.

Finally, existing evidence on continuous monitoring has produced mixed results on hard clinical outcomes (Bowles et al., 2024), so this study may find measurable change in process variables such as monitoring frequency without corresponding change in admission or adverse event rates. That pattern would still be informative, but it should be anticipated rather than treated as a failure of the design.

Delimitations

The study focuses only on emergency care settings and includes only adult patient populations. It examines wearable technology intended for clinical patient monitoring rather than consumer fitness devices. Data collection is restricted to specific hospitals within a defined geographic area in order to keep the study context consistent, and the research is conducted within a fixed time frame to keep it manageable and aligned with the research plan.

Assumptions

The study assumes that participants give truthful and accurate responses in interviews, and that the wearable technology under study is dependable and operates as intended during monitoring. It assumes that emergency department personnel have received the necessary training and are capable of using the devices in clinical practice, and that hospital records and patient outcome data are accurate and complete for analytical purposes.

The study further assumes that participating emergency rooms use broadly comparable patient monitoring practices, which allows more uniform comparison across sites. It also assumes that the convergent design is appropriate, meaning that the quantitative and qualitative strands address the same underlying phenomenon closely enough that merging their results is meaningful (Creswell & Plano Clark, 2018).

Conclusion

Wearable technology has the potential to change emergency healthcare by supporting clinical decision-making, shortening response times, and improving patient monitoring. Current research demonstrates the expanding role of these devices in physiological monitoring and emergency response coordination, while also showing that measured effects on clinical outcomes remain modest and dependent on implementation conditions (Bowles et al., 2024; Khanna et al., 2025; Tambini et al., 2026).

This mixed methods study aims to provide a thorough understanding of both patient outcomes and clinician experience associated with wearable technology in emergency rooms. By collecting both strands in the same setting and merging them through a joint display, the study is designed to show not only whether the technology works but under what conditions it works, which is the question healthcare organizations must answer before adoption.

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