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Effect of Digital Safety Huddles on Patient Safety Culture in Hospital Settings: A Systematic Review

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Abstract

Patient safety culture is a fundamental component of healthcare quality and plays an important role in preventing adverse events and improving clinical outcomes. Safety huddles have been widely implemented to enhance communication, teamwork, and early risk identification among healthcare professionals. With the increasing adoption of digital technologies in healthcare, digital safety huddles have emerged as a promising approach to support real-time information sharing and multidisciplinary collaboration. However, evidence regarding their contribution to patient safety culture remains limited. This study aimed to identify, evaluate, and synthesize evidence on the effect of digital safety huddle implementation on patient safety culture in hospital settings. A Systematic Literature Review (SLR) was conducted following the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 guidelines. Literature searches were performed in PubMed, Scopus, and CINAHL for studies published between 2021 and 2025. A total of 309 articles were identified, and after screening and eligibility assessment, 19 studies met the inclusion criteria and were included in the narrative synthesis. The reviewed studies demonstrated that safety huddle interventions, particularly those supported by digital technology, positively influenced several dimensions of patient safety culture, including safety climate, interprofessional collaboration, open communication, organisational learning, and reduction of adverse events. Effective implementation was associated with leadership support, consistency of practice, multidisciplinary participation, and adaptation to local organizational contexts. Digital safety huddles have the potential to strengthen patient safety culture in hospitals by improving communication, teamwork, and organizational learning. Nevertheless, further randomized controlled trials comparing digital and conventional safety huddles are required to provide stronger evidence regarding their long-term effectiveness and impact on patient outcomes.

Keywords: Digital Safety Huddle, Patient Safety Culture, Systematic Review, Interprofessional Collaboration, Patient Safety

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1. Introduction

Patient safety is a fundamental pillar of high-quality healthcare and has become a global priority for healthcare systems and international organizations. Over the past two decades, hospitals have introduced numerous patient safety initiatives, including incident reporting systems, accreditation standards, clinical governance programs, standardized safety protocols, and multidisciplinary teamwork interventions. Nevertheless, preventable adverse events remain a significant challenge in healthcare delivery worldwide. Medication errors, patient falls, and healthcare-associated infections continue to compromise patient outcomes despite ongoing improvement efforts. A systematic study conducted by (Alabdullah & Karwowski, 2024) confirming that building a robust patient safety culture is a global public health goal, and the study found that teamwork and organizational learning are the dominant forces, while non-punitive responses to errors and staffing inadequacies are still weaknesses found across continents. This condition suggests that there is still a huge gap that needs to be addressed, not only through individual training, but through systemic transformations in the way clinical teams communicate and collaborate (Aldawood et al., 2020).

One of the strategies that is increasingly being applied to strengthen Patient Safety Culture is Safety Huddle, which is a brief inter-disciplinary meeting that is carried out in a structured and routine manner to identify and respond to safety risks proactively. A systematic review published in BMJ Open Quality by (Finn et al., 2024) who analysed 42 studies found that interventions based on Safety Culture In hospitals provide tangible benefits for staff, including increased job

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satisfaction, reduced emotional fatigue, and improved working conditions, with the strongest effects found in interventions that have longer time scales, strong institutional support, and comprehensive theory-based designs. Systematic review by (Rowan et al., 2022) who analyzed 12 studies found that all showed a positive impact of Huddle on teamwork and job satisfaction, despite the evidence Work Engagement It is still very limited.

The development of digital technology in recent years has opened up new opportunities in the implementation of Safety Huddle. Digital platform integration enables the collection and distribution of safety data in a timely manner real-time, which transcends limitations Huddle conventional ones that still rely on face-to-face discussions and manual notes. Research results (Lai et al., 2023) that uses design Pretest-Posttest in 109 medical team members in Taiwan found significant improvements in teamwork climate, safety climate, job satisfaction, perception of management, and working conditions after the intervention Huddle implemented. These findings reinforce the assumption that the format Huddle structured, when combined with technological support, has the potential to produce greater and measurable impact. Research (McCain et al., 2023) that used pre-post intervention design showed that the implementation of Huddle daily interdisciplinary can improve reporting Near-miss, patient satisfaction in terms of teamwork, as well as perceptions of communication and psychological safety among staff.

Despite the benefits Safety Huddle In general, it has been widely documented, studies that specifically focus on the digital version, namely Digital Safety Huddle, is still very minimal and has not been comprehensively synthesized. Previous studies have primarily focused on reporting the effectiveness of Safety Huddles through specific outcomes, such as improved communication, enhanced teamwork, or reduced adverse events. However, the available evidence remains fragmented, as individual studies have addressed only isolated aspects of patient safety culture without integrating the organizational factors that influence the successful implementation of Digital Safety Huddles. Consequently, there is still gap how the interaction between digital technology, leadership, interprofessional collaboration, organizational learning, organizational readiness, and implementation consistency collectively shapes patient safety culture in hospital settings..

The novelty of this study lies in its attempt to systematically synthesize scientific evidence focusing on digital safety huddle as a technology-based intervention, and evaluate its impact specifically on the dimensions of patient safety culture in hospitals. Based on this background, the formulation of this research problem is: what is the effect of the implementation of digital safety huddle on patient safety culture in the hospital environment based on the synthesis of available scientific evidence? The purpose of this study is to identify, evaluate, and synthesize evidence from various studies on the impact of digital safety huddle on patient safety culture in hospital facilities through a systematic review approach.

2. Literature Review

Patient safety is widely acknowledged by the Institute of Medicine (IOM) as a fundamental element of healthcare systems, highlighting its essential role in enhancing overall care quality. The IOM strongly emphasizes the development of a safety-focused culture within healthcare organizations to improve both patient safety and the standard of care delivered. Protecting patients from harm remains one of the most important priorities in healthcare practice (Hemmelgarn et al., 2022). Patient safety culture is a key determinant of how effectively hospitals can manage and minimize risks to patients. It reflects the organization’s ability to support safe practices and prevent harm during care delivery. Nurses and other healthcare professionals play a crucial role in maintaining patient safety, as they provide continuous and direct care to patients and are often the first to identify potential risks (Kamemam et al., 2022).

Patient safety incidents (PSIs) were reported to occur with notable frequency, including medication errors (30.4%), wound infections (23.3%), infusion reactions (24.7%), pressure ulcers (21.3%), and patient falls (18.7%) at least once per month. Healthcare professionals demonstrated relatively satisfactory mean scores in areas such as response to adverse events (3.40), teamwork (4.18), handoffs and information exchange (3.88), and communication openness (3.84). Among these factors, teamwork, effective handoffs and information exchange, and open communication were identified as significant predictors of responses to PSIs, explaining 28.3% of the variance. Overall, the findings highlight that strengthening teamwork, improving communication during handoffs, and fostering openness are essential strategies for enhancing responses to patient safety incidents. Developing a supportive culture that encourages learning from errors can improve patient outcomes, while targeted training programs for healthcare professionals can further strengthen safety competencies. Ultimately, patient safety should be viewed as a continuous process that requires

sustained commitment from all stakeholders to achieve meaningful and lasting improvements in healthcare quality (Poku et al., 2023).

A strong safety culture is associated with improved communication, increased incident reporting, reduced medical errors, and better patient outcomes. Despite its importance, many hospital settings continue to face challenges such as hierarchical communication structures, workload pressure, and fragmented information systems, which can hinder the development of an effective safety culture (Kaya et al., 2023).

In response to these challenges, safety huddles have been introduced as a structured communication strategy aimed at improving teamwork and situational awareness among healthcare professionals. Safety huddles are typically short, focused meetings conducted regularly to discuss patient risks, operational concerns, and safety issues. These meetings encourage multidisciplinary collaboration and allow staff to proactively identify and address potential safety threats before they escalate into adverse events (Tuyishime et al., 2024).

Traditionally, safety huddles are conducted face-to-face, often during shift changes or specific clinical intervals. Evidence from various hospital settings suggests that these conventional huddles can improve communication, enhance team coordination, and support early detection of patient safety risks. However, their effectiveness may be limited by time constraints, staffing shortages, and inconsistent participation, particularly in busy or resource-limited healthcare environments (Adapa et al., 2022).

With the advancement of health information technology, digital safety huddles have emerged as an innovative approach to overcoming the limitations of traditional methods. Digital safety huddles utilize electronic platforms such as dashboards, mobile applications, and video conferencing tools to facilitate real-time communication and data sharing among healthcare teams. This approach enables more flexible participation, broader dissemination of safety information, and improved integration with electronic health records (Ibrahim et al., 2024).

3. Methods

3.1. Research Design

This study uses the Systematic Literature Review (SLR) as the main design. This method was chosen because it is able to produce a comprehensive and structured synthesis of evidence from a wide range of relevant studies, as well as minimize bias through the application of strict and reproducible protocols. All stages of reporting refer to the guidelines Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2020 which consists of 27 items Checklist along with a four-phase flowchart, including identification, screening, feasibility assessment, and inclusion (Page et al., 2021). The PRISMA 2020 framework was chosen because it is an internationally recognized reporting standard and is specifically designed to ensure transparency and completeness of the systematic review process in health research.

3.2. Literature Search Strategy

Literature searches were conducted systematically on four highly reputable electronic databases, namely PubMed, Scopus, and CINAHL. All searches were carried out in the period from 2021-2025. Keywords were combined using the Boolean operators "AND" and "OR" with the following terms: "digital safety huddle", "patient safety culture", "safety huddle intervention", "hospital setting", "huddle patient safety", and "patient safety improvement". The search was limited to English-language articles published between 2021 and 2025 to ensure the relevance and up-to-date of the evidence used.

3.3. Inclusion and Exclusion Criteria

The inclusion criteria set in this study include: articles published in the range of 2021 to 2025, in English, are primary research or systematic reviews, are conducted at the hospital setting, and specifically discuss the application Safety Huddle in the context of improvement Patient Safety Culture. The application of standardized inclusion and exclusion criteria is an important component of a systematic review to ensure that the included studies are truly appropriate and able to answer the established research questions. The exclusion criteria include articles that are not available in the version Full text, articles in the form of opinions or editorials without empirical data, studies that were not conducted

in hospital settings, and articles that did not discuss Safety Huddle or Patient Safety Culture directly after an in-depth assessment of the content of the article.

3.4. Article Selection and Quality Assessment

The article selection process is carried out through four stages according to the PRISMA flow. At the identification stage, 309 articles were obtained from all databases. After the removal of duplicates and irrelevant articles before screening (n = 102), there were 207 articles left that were then filtered by title and abstract. A total of 96 articles were excluded at this stage for not meeting the inclusion criteria, leaving 111 articles. Of the 111 articles, 56 articles could not be obtained for the full text, leaving 55 articles that entered the feasibility assessment stage. At this stage, 36 articles were issued with details of 26 articles because they did not discuss Digital Safety Huddle specifically and 10 articles because the study design was not suitable, so the total number of final articles included in the review amounted to 19 articles. Methodological quality assessment was conducted independently by two reviewers using the Critical Appraisal Skills Programme (CASP) checklist appropriate to each study design. The appraisal evaluated key methodological domains, including clarity of research objectives, appropriateness of study design, participant selection, data collection methods, risk of bias, ethical considerations, rigor of data analysis, and the validity of the reported findings (Shaheen et al., 2023). Each study was classified as high quality (meeting ≥80% of applicable CASP criteria), moderate quality (60–79%), or low quality (<60%).

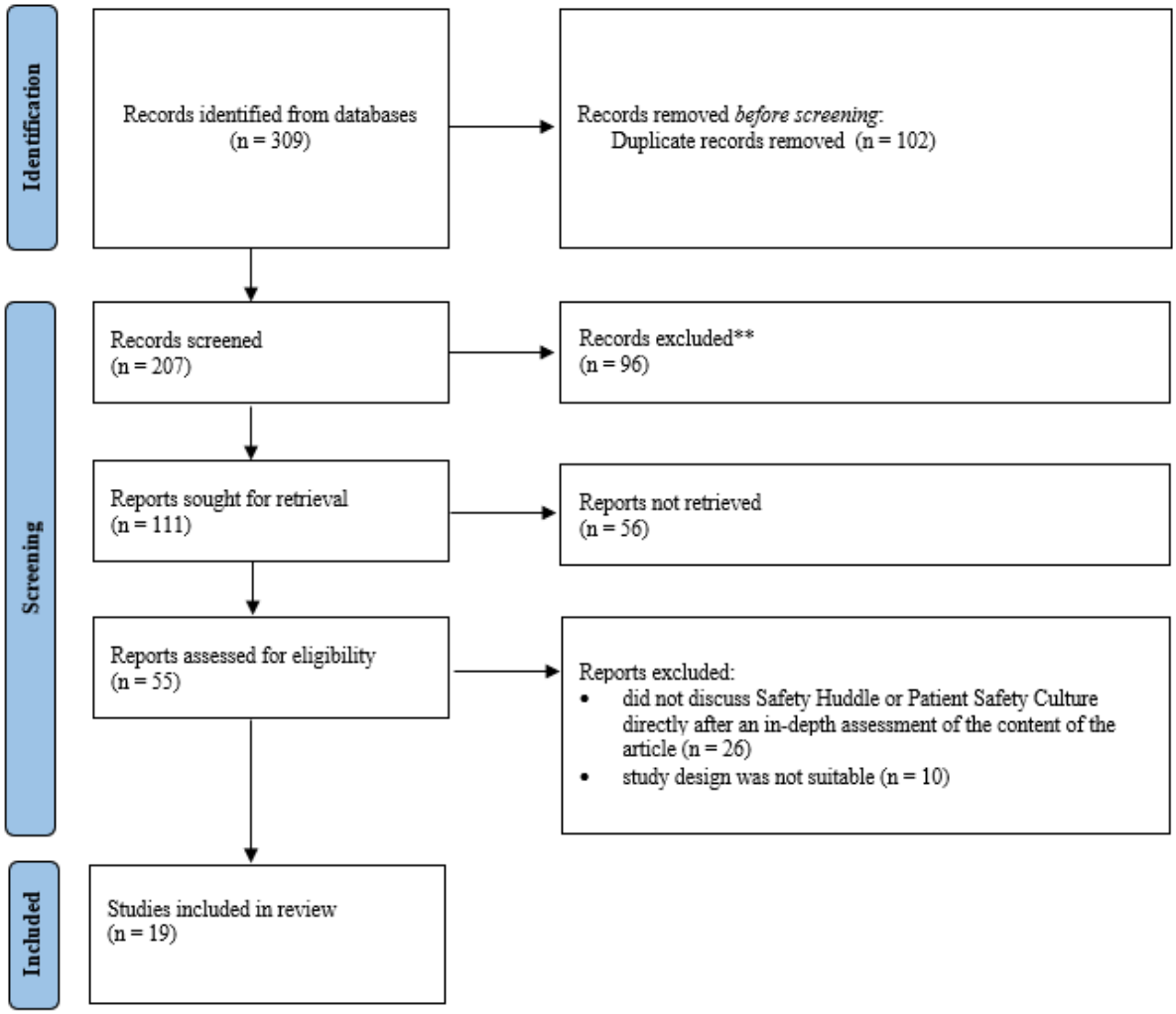


Figure 1. Article Selection Flowchart Based on the PRISMA Protocol

3.5. Data Extraction and Synthesis

Data extraction was carried out independently by two researchers on all articles that passed the selection. The extracted data included author name, year of publication, research objective, study design, population, type of digital safety huddle intervention, patient safety culture measurement instrument, and key findings. If there is a difference in judgment between the two researchers, consensus is reached through discussion and if necessary involves a third researcher as a mediator. Given the fairly high heterogeneity of design and measurement between studies, the synthesis was conducted narratively without quantitative meta-analysis. The article selection process was conducted in accordance with the PRISMA 2020 guidelines, beginning with the identification of records from multiple databases, followed by screening, eligibility assessment, and final inclusion of studies. A total of 19 studies met the predefined inclusion criteria and were included in the final synthesis. The entire article selection process is visualized in Figure 1, which illustrates the flow of study identification, screening, exclusion, and inclusion stages throughout the review process.

4. Result and Discussion

4.1. Results

The article selection process in this systematic review resulted in 19 studies that met all predefined inclusion criteria. As presented in Table 1, the included studies originated from various countries and employed diverse research designs, including quasi-experimental, cross-sectional, mixed-methods, randomized controlled trials, and conceptual review approaches. All studies focused on topics directly related to the implementation of safety huddles and patient safety culture in hospital settings, with publication years ranging from 2021 to 2025. The geographical distribution of the studies encompassed East Asia, the Middle East, North America, Europe, Africa, and South America, providing a broad and representative global perspective on the phenomenon under investigation. Overall, the synthesized evidence suggests that safety huddle interventions, including those supported by digital technologies, have considerable potential to strengthen multiple dimensions of patient safety culture in hospitals. A detailed summary of the characteristics and key findings of the included studies is presented in Table 1.

Table 1. Synthesis of Systematic Review Articles

Yes	Author & Year	Title	Design	Population/Setting	Key Findings
1	(Albaalharith & A'Aqoulah, 2023)	Level of Patient Safety Culture Awareness Among Healthcare Workers	Quantitative descriptive cross-sectional	204 health workers, 3 hospitals in Riyadh, Saudi Arabia	Low patient safety culture awareness (average score 2.24/5); recommended implementation of safety huddle and leadership walkarounds
2	(Amarneh & Al Nobani, 2022)	The Influence of Physician-Nurse Collaboration on Patient Safety Culture	Descriptive cross-sectional	Nurses and doctors in 4 hospitals in Jordan	Doctor-nurse collaboration was positively correlated significantly with all dimensions of patient safety culture ($p < 0.01$)
3	(Anders, 2025)	Global Perspectives on Patient Safety: The Central Role of Nursing Management	Narrative review	37 Global Empirical Studies	Transformational leadership, adequate staffing, and a positive safety culture are strongly associated with reduced errors and improved well-being of healthcare workers

Yes	Author & Year	Title	Design	Population/Setting	Key Findings
4	(Chau, 2024)	Enhancing Safety Culture in Radiology	Thematic overview	Department of radiology	Safety huddles, leadership walkarounds, and multidisciplinary rounds have been proven to facilitate open communication and transparency as the foundation of a sustainable safety culture
5	(Lai et al., 2023)	Impacts of Huddle Intervention on Patient Safety Culture	Pretest-posttest one group	109 medical team members, internal medicine ward in Taiwan	Significant improvements in teamwork climate, safety climate, job satisfaction, management perception, and working conditions (all $p < 0.001$)
6	(Fekadu et al., 2025)	Patient Safety Culture in Resource-Limited Healthcare Settings	Cross-sectional multisenter	582 health professionals in Eastern Ethiopian public hospitals	Overall safety culture positive score of 47%; ICU scores lower; Barriers include the absence of an incident reporting system and a culture of blame
7	(Ghoul et al., 2025)	Safety Huddle in Healthcare Settings: A Concept Analysis	Concept analysis (Rodgers & Knafl)	32 studies, CINAHL, Medline, PubMed (2013–2025)	The five core attributes of the safety huddle: structured communication, interdisciplinary collaboration, time-bound design, proactive risk prediction, and contextual adaptability
8	(Guo et al., 2022)	Protocol for a Stepped Wedge Cluster Randomized QI Project	Randomized stepped-wedge cluster protocol	4 academic hospitals, Canada	Study design to evaluate the impact of medical safety huddle on adverse events and patient safety culture in physicians
9	(Guo et al., 2025)	Impact of Medical Safety Huddles on Patient Safety	Stepped-wedge cluster randomized trial	Physicians in oncology, surgery, and rehabilitation programs, 4 academic hospitals	Adverse events decreased by 12% post-intervention (RR: 0.88; $p = 0.016$); odds of adverse events were 17% lower (OR: 0.83; $p < 0.001$); patient safety score increased from 2.3 to 2.8
10	(Hadi et al., 2025)	Nurses' Perspectives on Patient Safety Culture in NICUs	Qualitative descriptive phenomenology	15 NICU nurses in Riyadh, Saudi Arabia	Communication, teamwork, positive leadership improve safety; staff shortages

Yes	Author & Year	Title	Design	Population/Setting	Key Findings
					and workloads negatively; Daily Huddle is recommended as a practical intervention
11	(Lamming et al., 2021)	Fidelity and Impact of PSH on Teamwork and Safety Culture (HUSH)	Multi-method developmental evaluation	5 hospitals, 92 wards, 3 NHS Trusts in England	PSH proved feasible to improve teamwork and safety culture; 26/27 survey questions showed positive changes; Fidelity needs adjustments
12	(Lee et al., 2023)	A Safety Huddle Intervention in In-Patient Surgical Units	Mixed-methods, a pre-post group	89 staff nurses, 4 surgical units, South Korean tertiary hospitals	Significant improvement in 6/9 outcomes; huddle encourages hierarchical alignment and encourages nurses to speak openly; leadership is key
13	(Lin et al., 2022)	The Effectiveness of Multidisciplinary Team Huddles	Descriptive QI studies	74-bed general medical ward in Taiwan	81 issues identified and resolved; 92.9% of staff said huddle helped achieve governance goals, reduce errors, and improve teamwork
14	(Abdelaliem & Alsenany, 2022)	Factors Affecting Patient Safety Culture from Nurses' Perspectives	Descriptive cross-sectional	146 nurses, one hospital in Egypt	Patient safety culture perception is high (score 159.94 ± 7.864); multidimensional interventions at various levels of the organization are necessary for sustainability
15	(Nwosu et al., 2022)	Patient Safety Culture in the Operating Room	Cross-sectional	122 frontline operating room staff, Nigeria	The average composite score was 47%; only the dimension of teamwork shows strength; non-punitive response to mistakes and communication openness is weakest
16	(Murray, 2024)	The Role of High Reliability Organization Foundational Practices	Literature review	Veterans Health Administration (VHA) Facility, United States	4 HRO foundational practices have been proven to support safety culture; Safety huddle is included in the foundation of safety-based communication
17	(Sullivan et al., 2024)	A Mixed Methods Study Exploring PSC at Four VHA Hospitals	Mixed methods	Staff of 4 VHA hospitals	PSC survey data differed significantly between hospitals (12/20 items);

Yes	Author & Year	Title	Design	Population/Setting	Key Findings
					qualitative data support 80% of PSC survey items; Need more research
18	(Wahl et al., 2022)	Experience of Learning from Everyday Work in Daily Safety Huddles	Multi-method	Staff of the Neonatal Care Unit, a regional hospital in Sweden	The Safety-II model on the huddle encourages learning from things that go well; an open climate and the involvement of all professions are crucial
19	(Wazqar & Attallah, 2024)	Patient Safety Culture Predictors and Outcomes for Oncology Nursing	Cross-sectional correlation	101 oncology nurses, 2 tertiary hospitals Saudi Arabia	The PSC rate is lower than expected; management support, experience in the unit, and openness of communication are the strongest predictors of PSC

4.2. Discussion

4.2.1. Overview of Patient Safety Culture Conditions in Hospitals

The findings of a large number of studies synthesized in this review consistently indicate that the condition of the patient safety culture in various hospital settings around the world is still below the expected standard. Low safety culture scores are found not only in developing countries, but also in countries with relatively advanced health systems. (Albaalharith & A'aqoulah, 2023) reported that patient safety culture awareness among healthcare workers at three hospitals in Riyadh, Saudi Arabia, was relatively low with an average score of only 2.24 out of a scale of 5, although the organizational learning and continuous improvement dimensions were rated slightly higher than the other dimensions. Similar findings were also reported by (Wazqar &Attallah, 2024) who examined oncology nurses in two tertiary hospitals in Saudi Arabia, where the overall level of patient safety culture was lower than expected, with communication openness, experience in the unit, and management support identified as the strongest predictors.

Conditions are not much different in the African region. (Fekadu et al., 2025) reported that the overall safety culture positive score in Eastern Ethiopian public hospitals was only 47%, with intensive care units receiving lower ratings than other clinical units. The main barriers identified include the absence of an adequate incident reporting system, limited resources, ineffective communication, and a strong culture of blame that is a barrier for health workers to report wrongdoing openly. (Nwosu et al., 2022) also found that the safety culture in the operating room of a hospital in Nigeria was relatively weak, with an average composite score of 47% and only the teamwork dimension showing strength, while non-punitive response to mistakes and open communication being the weakest dimensions. Collectively, these findings demonstrate that deficiencies in patient safety culture are a widespread and systemic issue, with recurring challenges related to communication, non-punitive error reporting, staffing adequacy, and organizational support regardless of differences in healthcare system development (Abdelaliem & Alsenany, 2022).

4.2.2. The Effect of Safety Huddle on the Dimension of Patient Safety Culture

The essence of this research question is the extent to which the implementation of safety huddle, especially those that utilize digital support, has a real influence on various dimensions of patient safety culture in hospitals. Evidence from the various studies synthesized showed results that were generally positive, although with variations in magnitude and dimensions being most affected.

The study of (Lai et al., 2023) provides the most detailed quantitative evidence in this review. Using a pretest-posttest design on 109 members of the medical team in the internal medicine ward of a medical center in Taiwan, the study found a statistically significant improvement across all dimensions of the Safety Attitudes Questionnaire (SAQ) post-

intervention huddle. Teamwork climate increased from 76.49 to 83.26 ($p < 0.001$), safety climate from 75.07 to 82.63 ($p < 0.001$), job satisfaction from 73.67 to 83.39 ($p < 0.001$), perception of management from 77.87 to 84.86 ($p < 0.001$), and working conditions from 78.96 to 86.18 ($p < 0.001$). These findings show not only positive effects on clinical dimensions such as safety climate, but also on non-clinical dimensions such as job satisfaction, which hints at a much broader impact than just procedural improvements.

Similar findings were reported by (Lee et al., 2023) who examined the effects of a 12-week safety huddle intervention in four surgical units at a tertiary hospital in South Korea. Using a mixed-methods design, the study found significant improvements in 6 of the 9 outcomes measured, including dimensions of organizational learning, situation monitoring, mutual support, and a speaking-up climate at the unit level. Qualitatively, nurses reported that huddles helped flatten existing hierarchies and encouraged them to be more courageous in raising concerns related to patient safety. Leadership is cited as a crucial factor in creating the foundation of a collaborative safety culture through daily huddles. These findings are in line with (Anders, 2025) view that transformational leadership is the most consistent component related to improving safety culture and reducing clinical errors across various global settings.

Lamming et al., (2021) evaluated the Huddle Up for Safer Healthcare (HUSH) project which included 5 hospitals, 92 wards, and 3 NHS Trusts in the UK. Although this study was conducted in a conventional huddle context, its relevance remains high because it highlights the dimensions that are most responsive to the intervention. The analysis showed positive changes on 26 of the 27 question items of the Teamwork and Safety Climate (TSC) survey, with the largest changes found in dimensions related to teamwork and mutual safety awareness. The study also found that huddles held consistently create a "fear-free space" that allows health workers to discuss safety issues more openly. The establishment of this safe psychological space is a fundamental prerequisite for the formation of an authentic and sustainable safety culture, as also underlined by (Ghoul et al., 2025) who identify psychological safety as one of the main antecedents of an effective safety huddle.

4.2.3. The Impact of Digital Safety Huddle on Reducing Adverse Events

One of the most concrete measures of the success of safety huddle interventions is the reduction of adverse events experienced by patients. (Ghoul et al., 2025) presented the strongest evidence in this regard through a stepped-wedge cluster randomized trial conducted in four academic hospitals in Canada. The study involved oncology, surgery, and rehabilitation programs, with a review of medical records in 912 randomly selected patients. The results showed that the rate of adverse events per 1.000 patient days in the post-intervention phase was 12% lower than in the pre-intervention phase (RR: 0.88; 95% CI: 0.80–0.98; $p = 0.016$), and the odds of adverse events occurring after huddle implementation were 17% lower (OR: 0.83; 95% CI: 0.80–0.87; $p < 0.001$). At the same time, the overall average patient safety score increased significantly from 2.3 to 2.8 ($p = 0.010$), and the organisational learning dimension also increased significantly. This study is one of the highest levels of evidence in the literature that directly links the structured medical safety huddle format to a reduction in adverse events verified through a blinded medical record audit.

The protocol that preceded the study, (Ghoul et al., 2025) explained that medical safety huddles are specifically designed to engage physicians in proactive discussions about safety concerns specific to their profession. This approach is important because previous studies have consistently shown that doctors are the most difficult group to engage in regular huddle activities. By providing a platform that is tailored to the needs and work rhythm of doctors, this format has succeeded in bridging the participation gap that has been an obstacle in the implementation of multidisciplinary safety huddle. The fact that this more structured and context-specific format is able to result in a measurable reduction in adverse events provides a strong argument for the further development of a digital safety huddle that can automatically adjust content and formasts based on the risk profile of the unit and the preferences of each profession.

Lin et al., (2022) provide a slightly different but still relevant perspective. In a quality improvement study in a 74-bed general medical ward in Taiwan, a multidisciplinary huddle team successfully identified and resolved 81 safety issues during the implementation period, with 82.7% of them in the category of quick hits resolved within 24 to 48 hours. A total of 92.9% of staff stated that huddles help accelerate the achievement of governance goals, reduce clinical errors and near-misses, and improve teamwork. This ability to quickly identify and resolve issues is one of the most potential advantages to be enhanced through the digitization of huddle processes, where digital platforms can facilitate real-time issue tracking, data-driven prioritization, and automated follow-up monitoring (Murray et al., 2024).

The integration of digital technology in the implementation of safety huddles also opens up a new dimension in terms of standardization and reproducibility of interventions across units and health facilities. One of the fundamental limitations of conventional huddles is the high variability in the format, duration, and content delivered, making it very

difficult to compare the effectiveness between sites. The structured digital safety huddle platform allows for uniform agenda, automatic dashboard-based data distribution, and periodically auditable documentation of each session's outputs. This ability directly supports the improvement of implementation fidelity which in the study of (Lamming et al., 2021) proved to be one of the strongest predictors of huddle effectiveness. Furthermore, the accessibility of historical data through digital platforms allows clinical teams to track incident trends over time, identify recurring risk patterns, and dynamically adjust huddle focus based on the unit's actual risk profile. This is in line with the principle of continuous quality improvement which is the main foundation of the High Reliability Organization (HRO) approach. Thus, digitalization is not just a shift in the medium of communication, but a fundamental transformation in the way clinical teams access, process, and respond to safety information collectively and evidence-based in their daily work routines (Guo et al., 2025; Murray et al., 2024).

4.2.4. The Role of Leadership and Managerial Support in Safety Huddle Effectiveness

The findings of the various studies synthesized in this review consistently show that leadership support is one of the most important determining factors in the successful implementation of the safety huddle and the formation of a strong patient safety culture. (Murray et al., 2024) describe four High Reliability Organization (HRO) foundational practices implemented across Veterans Health Administration (VHA) facilities in the United States, where the safety huddle is an integral component of a safety-based communication system that is fully supported by leadership at all levels. This study confirms that the effective and sustainable implementation of HRO foundational practices requires real commitment from organizational leadership, not just written policies.

Anders, (2025) reinforces this argument through a review of the global narrative that includes 37 empirical studies. Evidence consistently shows that transformational leadership styles, positive manager expectations, organizational learning, constructive feedback, effective communication, and positive perceptions of safety are interrelated components in forming a strong patient safety culture. Leadership not only influences the safety climate directly, but also shapes the norms of behavior and values embraced by all team members in responding to risky situations. In the context of digital safety huddle, the role of leadership is becoming increasingly important as leaders need to actively encourage engagement in digital platforms and ensure that the information generated is truly acted upon.

Sullivan et al., (2024) found significant variation in patient safety culture among the four VHA hospitals studied, where 12 of the 20 PSC survey items showed statistically significant differences. Qualitative data show that the manifestation of these different patient safety cultures is closely related to the extent to which HRO implementation is lived and practiced by leaders in each facility. These findings confirm that a culture of safety is not something that can be built solely through policy or technology, but rather must be brought to life through consistent and authentic leadership practices. (Chau, 2024) also emphasizes that radiology managers play an instrumental role in implementing and maintaining effective safety practices, with the safety huddle being one of the key practices that facilitate open communication and transparency.

Hadi et al., (2025) provide a rich perspective from the perspective of NICU nurses through a phenomenological study in Saudi Arabia. Thematic analysis of 15 in-depth interviews identified positive leadership as a key facilitator of patient safety, while staff shortages and excessive workload were the biggest obstacles. In practical terms, the study recommends the implementation of daily huddle as a relevant and implementable intervention in the NICU setting, noting that its effectiveness is highly dependent on the quality of supportive leadership and a safe psychological climate. Wahl et al., (2022) also found that in order to make the safety huddle truly function as a vehicle for learning from daily experiences, an open and permissive organizational climate, the involvement of all professions, and stable management conditions, where leaders who understand the underlying Safety-II theory are the key to successful implementation.

4.2.5. Interdisciplinary Collaboration as the Foundation for Safety Huddle Success

The dimension of interdisciplinary collaboration is one of the core attributes of the safety huddle that most consistently appears in the synthesized literature. (Ghoul et al., 2025) identified interdisciplinary collaboration as the second of the five core attributes of the safety huddle, meaning that huddle effectiveness intrinsically depends on the ability of teams of various professions to communicate and coordinate effectively. In digital formats, this dimension presents new challenges as well as opportunities: on the one hand, digital platforms can overcome physical barriers and asynchronous schedules; On the other hand, technology-mediated interactions have the potential to reduce the depth of discussions that usually occur in face-to-face meetings.

Amarneh & Al Nobani., (2022) provide strong empirical evidence that doctor-nurse collaboration is positively correlated significantly with all dimensions of patient safety culture measured ($p < 0.01$). The study, conducted at four

hospitals in Jordan, shows that high-quality interprofessional relationships directly affect perceptions and practices of safety at the unit level, and that building effective collaboration requires support from organizational leaders as well as the development of a blame-free culture. These findings have direct implications for the design of the digital safety huddle: a digital platform designed should be able to facilitate equal multidirectional interaction between different professions, not just provide a one-way communication channel from leaders to staff.

Studies by (Lamming et al., 2021) and (Lee et al., 2023) have also consistently found that successful huddles are those that are able to actively engage all team members, not just specific groups. (Lamming et al., 2021) found that the most effective huddles in the HUSH project were the ones that successfully created a "fear-free space" where all team members felt comfortable voicing their concerns, while (Lee et al., 2023) emphasized that the hierarchical alignment facilitated by huddles was the most powerful mechanism of change in encouraging nurses to speak openly. In the context of the digital safety huddle, features such as anonymity in reporting, standardized notifications, and dashboards that can be accessed by all professions simultaneously can structurally reinforce this collaborative dimension.

The dimension of interdisciplinary collaboration in the digital safety huddle is also closely related to the concept of psychological safety which is increasingly recognized as a fundamental prerequisite for the formation of an authentic incident reporting culture. When team members from different professions feel safe to voice concerns without fear of sanctions or negative judgments, the quality of the information flowing during the huddle becomes much richer and more representative of the actual conditions on the field. (Lee et al., 2023) study explicitly describes how a 12-week huddle intervention was able to encourage previously passive nurses to actively contribute to safety discussions, a behavioral change that reflects an increased sense of psychological security within the team. Digital safety huddle platforms can reinforce this dynamic through semi-anonymous reporting features, transparent feedback notifications, and standardized issue escalation mechanisms that do not rely solely on individual courage. Amarneh and Al Nobani (2022) affirm that a strong foundation of interprofessional collaboration can only be formed if supported by a system that structurally protects each team member from a culture of blame. Therefore, the design of an effective digital safety huddle should not ignore this psychosocial dimension, and should intentionally build features that create a safe space for all professions to participate equally and meaningfully (Ghoul et al., 2025; Wahl et al., 2022).

4.2.6. Factors Influencing the Implementation of Digital Safety Huddle

This systematic review also identifies a number of factors that significantly affect the success or failure of the implementation of the safety huddle, both in conventional and digital formats. A deep understanding of these factors is important for designing more effective implementation strategies in the future.

The first factor is consistency and fidelity of implementation. (Lamming et al., 2021) found that the average fidelity score in the HUSH project was only 4.9 out of 9, indicating that more than half of the elements that should have been in the huddle were not implemented consistently. The most often overlooked element is the use of Statistical Process Control charts and data on historical harms, which are precisely the elements that have the most potential to be provided automatically by digital platforms. This suggests that digitizing the huddle process is not just about convenience, but can structurally improve implementation fidelity by ensuring that relevant information is always available and presented in a standard manner whenever a huddle is executed.

The second factor is the level of participation of health workers (Ghoul et al., 2025) found that the average physician attendance rate in medical safety huddles ranged from 30% to 85% inter-site, a huge variation that reflects the real challenge of engaging physicians consistently. (Wahl et al., 2022) also identified that the involvement of all professions is an important prerequisite for the effectiveness of a Safety-II-oriented safety huddle, but this condition is often difficult to achieve in practice due to differences in schedules, priorities, and professional culture. A well-designed digital safety huddle can overcome some of these barriers by enabling asynchronous participation, automatic summaries for those unable to attend, and transparent participation tracking.

The third factor is the availability of resources and the context of the organization. (Fekadu et al., 2025) found that severe resource constraints in Ethiopian public hospitals constitute a fundamental obstacle to the implementation of incident reporting systems and other safety interventions. In this context, the adoption of digital safety huddles that rely on adequate technological infrastructure has the potential to create a new gap between healthcare facilities in high-income countries and low- and middle-income countries. These findings confirm the importance of designing digital safety huddle solutions that are inclusive, scalable, and adaptable to resource constraints in various contexts.

The fourth factor is the alignment between the intervention design and the local context. (Ghoul et al., 2025) emphasized that contextual adaptability is one of the core attributes of an effective safety huddle, while (Ghoul et al., 2025)

underlined the importance of adapting the medical safety huddle to the context of local practice at each site. Findings from (Hadi et al., 2025) in the context of Saudi Arabia's NICU also suggest that context-specific intervention recommendations, such as education, training, and daily huddles tailored to the NICU environment, are more effective than a one-size-fits-all approach.

4.2.7. Safety Huddle in the Context of High Reliability Organization and System Safety

To understand the effects of digital safety huddle more fully, it is necessary to place it within a broader framework, namely the concept of High Reliability Organization (HRO) and system-based safety approaches. Murray et al. (2024) describe four HRO foundation practices that have been implemented across VHA facilities, which include leadership committed to safety, team reliability development, effective communication, and learning from safety incidents. Within this framework, the safety huddle serves as an operational mechanism that integrates the four foundations in the daily work routine. The digitization of huddles has the potential to strengthen each of these foundations: technology can ensure the presence of virtual leadership, provide tools for team development, standardize communication, and facilitate continuous data-driven learning.

(Wahl et al., 2022) introduced a more nuanced dimension through the application of the Safety-II principle in the daily safety huddle in neonatal care units in Sweden. In contrast to the Safety-I approach which focuses on learning from mistakes, the Safety-II approach emphasizes the importance of learning from situations where work is going well. In the Safety-II-oriented huddle, staff are encouraged to share successful daily work experiences, rather than just reporting incidents or near-misses. Although the study found that changes in patient safety culture measurements were relatively small, qualitative findings showed that the majority of respondents were positive towards this approach and identified various supporting factors that could strengthen its effectiveness. The integration of the Safety-II perspective in the digital safety huddle platform opens up new opportunities to build a more holistic learning culture, which is not only reactive to failure but also proactive in identifying and pursuing the conditions that allow work to run well.

In a more specific context, (Chau, 2024) shows that the implementation of safety huddles in radiology departments, along with other practices such as leadership walkarounds, quality learning boards, and multidisciplinary rounds, form a mutually reinforcing safety ecosystem. None of these practices work in isolation; rather, its effectiveness depends on coherent integration in a broader security strategy. This has important implications for the development of the digital safety huddle: an effective digital platform must be able to integrate with other systems such as electronic medical records, incident reporting systems, and quality dashboards, thus forming a comprehensive digital safety infrastructure.

4.2.8. Implications for Nursing Practice and Hospital Policy

The synthesis of all the studies examined in this review has significant and multidimensional implications for nursing practice, hospital management, and health system policy more broadly. From the perspective of nursing practice, (Lee et al., 2023) and (Lamming et al., 2021) both found that nurses were the group most responsive to safety huddle interventions and who benefited the most. The hierarchical alignment facilitated by the huddle directly empowers nurses to talk openly about safety concerns, which is a fundamental component of an effective safety culture. In the context of the digital safety huddle, these opportunities can be further amplified through anonymous reporting features, clear escalation pathways, and feedback systems that ensure that nurses' voices are truly heard and acted upon by management.

From a hospital management perspective, the findings from (Sullivan et al., 2024) and (Anders, 2025) confirm that investment in safety-focused leadership development is a prerequisite for the success of any intervention, including the digital safety huddle. Without authentic leadership commitments, no matter how sophisticated technology will not be able to meaningfully change organizational culture. (Abdelaliem & Alsenany, 2022) recommend the implementation of multidimensional interventions that span various levels of the organization to build and maintain a high patient safety culture, a recommendation that implicitly supports the integration of the digital safety huddle in a more comprehensive safety strategy.

From a policy perspective, the findings of (Fekadu et al., 2025) on the challenges faced in resource-constrained contexts remind policymakers that technology adoption must be preceded by strengthening foundations such as a functional incident reporting system, a sanction-free culture, and adequate staffing. (Amarneh & Al Nobani, 2022) also suggest that strengthening safety culture be paired with specific clinical intervention packages to maximize their impact on patient outcomes. Healthcare organizations need to prioritize the development of strong interprofessional collaboration and a culture without sanctions as the foundation for the continuous improvement of patient safety culture, a condition that can be facilitated and strengthened through an inclusive and data-driven digital safety huddle design.

5. Conclusion

This systematic review comprehensively examined the effect of digital safety huddle implementation on patient safety culture in hospital settings through the synthesis of 19 relevant studies. The findings indicate that safety huddle interventions, particularly those supported by structured processes and digital technologies, have a consistently positive influence on several dimensions of patient safety culture. These include improvements in safety climate, teamwork, open communication, organizational learning, incident reporting, and reductions in adverse events. These dimensions are interrelated and mutually reinforcing, contributing to the development of a stronger and more sustainable culture of safety within healthcare organizations. The effectiveness of digital safety huddles is influenced by several organizational and contextual factors, including leadership commitment, consistency of implementation, multidisciplinary participation, resource availability, staff engagement, and the adaptation of intervention strategies to local needs. Strong managerial support, clear communication, and active involvement from healthcare professionals are essential to ensure successful implementation and long-term sustainability. Digital platforms also facilitate timely information sharing, promote collaborative decision-making, and support continuous quality improvement initiatives. Despite these promising findings, variations in study designs, outcome measures, and intervention characteristics limit the generalizability of the evidence. Furthermore, studies specifically evaluating digital safety huddles remain scarce. Future research should prioritize well-designed randomized controlled trials comparing digital and conventional safety huddles to provide stronger evidence and support evidence-based recommendations for policymakers and healthcare practitioners seeking to optimize patient safety strategies in the era of digital transformation. The findings of this review may serve as a foundation for developing more effective and technology-enabled patient safety interventions in hospitals.

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