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Research article

Human Error and Near Misses in Hospital Occupational Safety: A Root Cause Analysis Using HFACS Framework

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ABSTRACT

Background: Occupational health and safety (OHS) at hospitals is at high risk of near-miss events and human error, both of which have an influence on healthcare workers' safety and service quality. Although many hospitals have technical SOPs, problems still occur because the underlying reasons are rarely properly investigated. The Human Factors Analysis and Classification System (HFACS) framework can assist uncover the underlying causes of accidents, however its implementation in Indonesian hospitals is limited.
Methods: This study used a qualitative case study methodology and a root cause analysis technique based on HFACS. Data were gathered over a six-month period by reviewing near-miss occurrence reports and conducting in-depth interviews with seven key informants at Patut Patuh Patju Hospital in West Lombok. Thematic analysis was carried out using NVivo, with data triangulation and member verification.
Results: A total of 27 near-miss occurrences were discovered, with root cause patterns spanning all four levels of HFACS: risky acts, preconditions for unsafe acts, insufficient supervision, and organizational impacts. SOP breaches, weariness from heavy workloads, inadequate supervision, and an incident reporting culture that did not yet support the program were among the most significant issues.
Conclusion: The deployment of HFACS successfully maps the interactions that produce OHS events at all levels in hospitals. These findings highlight the need of transforming the workplace safety culture into a non-punitive learning culture, which is supported by active supervision, continuing training, and work management rules that are more sensitive to tiredness concerns.

I. Introduction

Occupational Health and Safety (OHS) in the hospital environment presents its own problems due to the complexity of health services and interdisciplinary relationships (Andriany & Tiarapuspa, 2023). High-risk scenarios arise from a variety of causes in hospitals, including the use of modern medical equipment, the presence of critical patients, and the need to provide prompt and appropriate care. Potential work accidents, such as physical injury, biological exposure, and psychological stress, must be handled carefully to provide a safe work environment (Musyawir & Sidik, 2022; Jaya *et al*., 2021; Hairunisa, 2022).

Human error has long been known to be a significant contributor to work accidents in various industries, including healthcare, in the context of occupational safety and health (K3). Human error can be caused by a variety of circumstances, including excessive workload, burnout, improper communication, and inadequate management systems. Surprisingly, despite the continuous improvement of technology and processes, human error remains the main cause of various occupational safety accidents (Albeshri *et al*., 2024; Katiyar, 2024; Karahan *et al*., 2023).

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Near miss is a key indication in recognizing potential danger because it is an event that almost causes an incident but is successfully stopped before it occurs (Smit & Peddle, 2025; Alahmad *et al*., 2024). Near Miss reporting is critical in a hospital setting because it provides the data needed to improve patient safety and develop a proactive risk management approach. Unfortunately, near-misses are often not reported by health workers, due to various cultural, psychological, and procedural constraints (Lee, 2021; Braiki *et al*., 2024; Feng *et al*., 2022).

Systematic shortcomings in documenting and assessing near-misses often result in lost opportunities for sustainable improvement. However, international organizations such as the WHO and the ILO emphasize the importance of reporting incidents, including near-misses, as the cornerstone of a solid workplace safety culture. In other words, failing to deal with near-disaster means leaving potential harm unchecked in the future (Hasanspahić *et al*., 2020; Zhou *et al*., 2019).

In reality, the root cause analysis of hospital accidents is often limited to technical or procedural issues. However, the causes of accidents are often multi-level, affecting not only individuals but also managers, policies, and even entire businesses. This is where the human factor analysis paradigm comes into play, which allows us to examine the situation holistically (Stallard *et al*., 2023; Paulino *et al*., 2021; Au *et al*., 2020).

The Human Factors Analysis and Classification System (HFACS) is one technique that has been shown to be beneficial in a number of high-risk sectors (Fa *et al*., 2021). This framework was initially established to study accidents in the military aviation business, but as research evolved, HFACS became useful for use in other sectors such as mining, manufacturing, and even health care. HFACS aids in mapping the causes of accidents, ranging from individual behavior to organizational shortcomings (Wang *et al*., 2020; Joe-Asare *et al*., 2020; Coraddu *et al*., 2020).

HFACS use in hospitals remains modest, particularly in underdeveloped nations. The bulk of research investigate medical occurrences or clinical mistakes, but the potential for using HFACS in an OHS context—to comprehend human error in non-clinical workers and supporting work processes—is immense (Peerally *et al*., 2022). The usage of HFACS is thought to allow for a more in-depth and methodical exploration of the fundamental causes of issues (Liou *et al*., 2022; Luo *et al*., 2022).

Research of near-misses in Indonesian hospitals is still quite scarce. Fear of punishments, administrative hurdles, and a lack of managerial support continue to impede Indonesia's incident reporting culture (Dhamanti *et al*., 2022). The combination of the HFACS technique with a focus on near-misses is likely to create chances for enhancing the OHS system by revealing risk areas that are frequently missed (Feng *et al*., 2022). Moreover, this study is intended to contribute to the worldwide literature by addressing unique difficulties encountered by developing-country hospitals, such as limited human resources, high patient loads, and evolving OHS legislation (Aram *et al*., 2022). As a result, the findings of this study have the potential to aid in the development of OHS improvement measures in hospitals in other countries with comparable situations (Nurunnabi *et al*., 2024).

As a result, this study was developed to investigate human error and near-miss trends in hospitals utilizing the HFACS framework as a systematic method. The findings of this study, which investigate underlying causes at several levels, are intended to give practical advice for hospital management in establishing more comprehensive occupational risk prevention strategies.

Beyond meeting academic needs, this study is expected to promote a shift in hospital occupational safety culture by raising awareness of the importance of near-miss reporting, collaborative learning, and strengthening human factors-based risk management systems. This collaboration is critical to realizing the goal of safer, more productive, and sustainable hospitals.

II. METHODS

Design and samples

This study used a qualitative case study methodology and the Human Factors Analysis and Classification System (HFACS) framework to conduct root cause analysis (RCA). This strategy allowed researchers to perform in-depth investigations of human error and near misses in the context of occupational health and safety (OHS) in hospitals. The study was place at Patut Patuh Patju Regional Hospital in West Lombok. The research ran from January to July 2025 to allow for proper data gathering, triangulation, and validation.

The research sample consists of two types. (1) Incident reports, which are papers that record near misses and work occurrences that happened over the past six months, were received from the hospital's Occupational Safety and Health (K3) unit. (2) Key informants include front-line health professionals, K3 officers, and leaders of work units who are directly involved in safety event reporting, investigation, or management. Informant selection was done with the intention of gathering rich and relevant data till data saturation (theoretical saturation).

Research instrument and data collection

The key instruments used in this study were: (1) a document review checklist designed to extract essential variables from incident and near-miss reports, such as event type, location, individuals involved, immediate cause, and recorded remedial action. (2) A semi-structured interview guide based on the HFACS framework, with four major levels: dangerous acts, preconditions, unsafe supervision, and organizational impacts.

Data gathering took place in two stages: (1) Conduct a retrospective assessment of the hospital's incident reporting database to identify and categorize near-miss occurrences and workplace problems. (2) In-depth interviews with 15-20 key informants to elicit narratives, context, and perceptions that cannot be captured just through records.

All interviews were audio recorded with the informants' permission and transcribed verbatim for analysis.

Data analysis

The data was analyzed using a deductive-inductive technique. (1) Incident reports were categorized and classified using the HFACS taxonomy to uncover human error pathways and latent variables at the organisational level. (2) Thematic analysis was then used on interview transcripts to identify themes, patterns, and explanatory factors that support or expand the documentary results.

The analysis's validity and trustworthiness were strengthened by triangulation of documentary material and interview findings. Two researchers worked independently to code and construct themes, which were then confirmed by peer debriefing.

Research Process

The research procedure was carried out systematically across four phases:

Phase 1: Preparation

Obtaining formal clearance from hospital administration and ethical approval from the research ethics committee. Creating and verifying research tools with expert evaluation.

Phase 2: Data Collection

Collected and anonymized incident reports. Interviews with important informants should be scheduled and conducted in a private and transparent atmosphere.

Phase 3: Analysis.

Coding, categorizing, and mapping event data to the HFACS framework. Results are cross-validated using thematic coding of interview narratives.

Phase 4: Interpreting and Reporting

Synthesizing results to uncover fundamental causes, making practical suggestions for hospital administration, and creating a policy brief based on the study's findings.

Ethical consideration

This study has received ethical approval from Bima International University's Ethics Committee (MFH No. 016/UNBIM.4/PN.01.00/2025). Prior to the interview, all informants provided written informed permission, ensuring voluntary participation, secrecy of identity, and the ability to withdraw at any moment without consequence. To safeguard individual and institutional identities, all data were handled anonymously. To ensure the research's integrity, results were reported in aggregate form.

III. RESULT

Near Miss Overview

According to an examination of incident data, 27 near-miss occurrences involving occupational safety were registered in the hospital over the six-month research period. These accidents were classified into three categories: 37% exposure to hazardous chemicals, 33% slips and falls, and 30% damage or malfunction of medical equipment. The majority of the near-misses happened during the night shift and in intensive care units including the Emergency Department (ER) and Intensive Care Unit (ICU).

Root Causes Based on the HFACS Framework

The analysis using the HFACS (Human Factors Analysis and Classification System) framework identified the factors that cause near miss and human error covering the four levels of categories, namely:

Table 1. HFACS Framework Analysis Results

Level HFACS	Tema Utama	Interview Quotes
Unsafe Acts	Non-compliance with procedures, pruning of SOP measures	"*Sometimes we miss rechecking the safety lock in case of an emergency*." (Nurse, ICU)
Preconditions for Unsafe Acts	Work fatigue, lack of manpower, miscommunication between units	"*If you keep it for 16 hours, the focus is no longer full, especially if the room is full of patients*." (Doctor)
Unsafe Supervision	Lack of ongoing training, weak supervision	"*New tools come a lot, but there's rarely any formal training*." (Medical Equipment Technician)
Organizational Influences	Limited resources, weak safety culture	"*If a small incident is reported, I am afraid of being scolded by my superiors. So sometimes it's left out*." (Cleaner)

Thematic Map of Root Causes (NVivo Output)

The thematic map in Figure 1 depicts the link between the primary theme, subthemes, and important quotations using the HFACS framework. This graphic is the result of coding and theme analysis with NVivo 12 Plus. According to the theme analysis, the most common triggers for risky behavior are time pressure, an excessive workload, and unclear lines of supervision. Several respondents also underlined that near-miss reporting remained low owing to fear of administrative consequences and the belief that small incidences do not require official reporting

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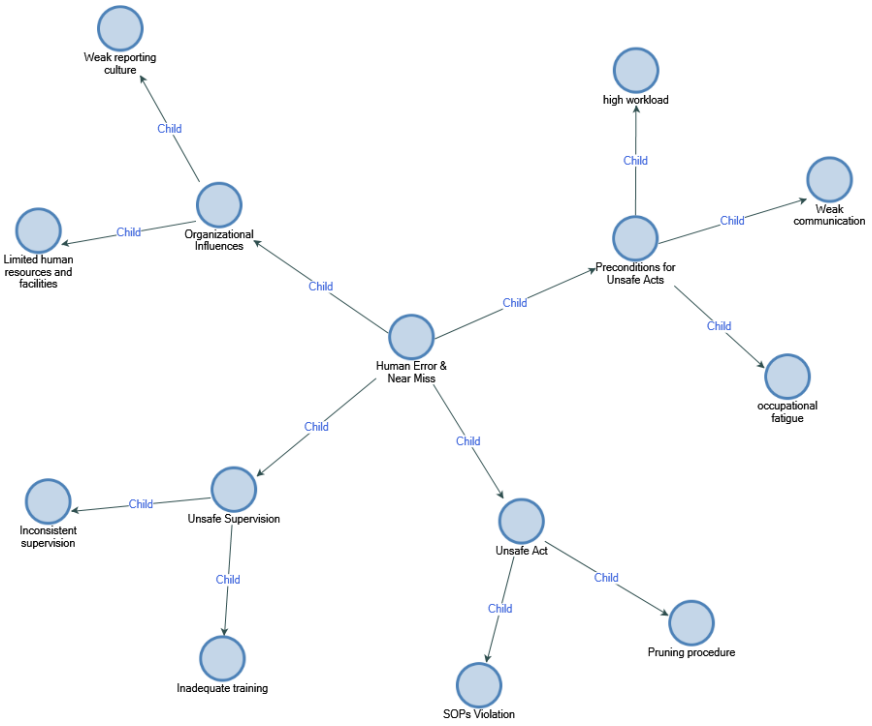

Figure 1. Thematic Map of Human Error and Near Miss Root Causes Based on HFACS Framework (NVivo Output)

IV. DISCUSSION

The study's findings show that near-miss and human error patterns in hospital occupational safety have complicated and multilayered core causes. Using the HFACS paradigm, the study demonstrates that accidents are not exclusively caused by individual field errors, but are also intimately tied to pre-existing dangerous activities, poor monitoring, and a lack of organizational influence over occupational safety culture.

These findings are consistent with earlier healthcare research, which found that human factors acting within an unsupportive system affect more than 70% of patient and healthcare worker safety events (Nunes *et al*., 2021; Arbianti *et al*., 2023). In the Indonesian context, our data reflect the WHO's (2019) conclusion that hospitals in poor countries are still failing to foster an environment of open, fearless event reporting (Konlan & Shin, 2022).

At the unsafe actions level, the most common results, namely breaches of Standard Operating Procedures (SOPs) and process shortening, show the presence of informal adjustment strategies (workarounds) that frequently develop when healthcare personnel are under severe work pressure. This phenomena was extensively examined in a study on workarounds in European hospitals (Tawiah *et al*., 2025), which emphasised that these activities are not merely human neglect, but rather adaptations to overcome system limitations or heavy workloads (Shoja *et al*., 2020). The precondition for risky behavior, such as job tiredness and poor communication, are consistent with the findings of Zhang *et al*., (2020); Ruiz-Fernández *et al*., (2020); and Peng *et al*., (2021), who discovered that lengthy hours and packed work rotations greatly increase the likelihood of near misses. In this study, informants' narratives reporting workloads of up to 16 hours support the notion that hospital human resource management policies should be reviewed to establish safe work limits in compliance with ILO and WHO recommendations.

Inadequate oversight aspects are represented in findings of limited continuous training and poor field supervision. Recent research Rakhman, (2023; Detha *et al*., (2022); Turyasiima *et al*., (2025); and Alshyyab *et al*., (2021) suggests that active supervisory monitoring is a sign of a robust safety culture. Inconsistent supervision in the hospitals analyzed suggests that training procedures are frequently not followed by continued monitoring. As a result, employees feel obligated to depend on their own experience rather than updated standard processes.

At the organizational level, data on restricted human resources and facilities corroborate the literature that emphasizes the link between latent variables and incident incidence (Jing *et al*., 2019). A poor reporting culture was also discovered: the fear of being criticized for reporting errors or near misses remains. This is similar with the findings of Nwankwo *et al*., (2021) and Priyoasmoro & Djunaidi, (2024), who discovered that a weak reporting culture slows risk identification and limits potential for continuous improvement.

From a methodological standpoint, using the HFACS paradigm in the context of hospital OHS in Indonesia makes an important theoretical contribution. Previous research has mostly focused on the use of HFACS in the aviation sector Niartiningsih & Muis, (2020) and Herwanto *et al*., (2024), mining, and high-risk manufacturing. This study broadens the application of HFACS in the healthcare industry, notably in assessing non-clinical occurrences such as the occupational safety of support people (cleaning staff, technical staff), which are frequently disregarded in studies (Helga, 2020; Syamsuriansyah & Hizriansyah, 2025).

The practical ramifications of these discoveries are evident. First, hospital management must advocate a shift in safety culture from blame to a learning culture focused on systemic improvement. Second, regulations governing personnel and job rotation must take into account safe workloads. Third, supervision and training must be done strategically, with their impact monitored and tied to safety performance assessments.

This study does have drawbacks. The study was done at a single hospital, hence the findings' generalizability must be confirmed by multi-site research. Furthermore, the qualitative technique allows for interpretation bias, however this has been reduced by triangulation and member verification. Incorporating quantitative data from workplace safety surveys or behavioral audits might improve the evidentiary and external validity of the results. Overall, this study highlights the significance of a systems thinking approach in reducing near misses and human error in hospitals. HFACS has been found to assist map risk pathways at different levels, from individual to corporate policy. Implementing suggestions based on this research is likely to assist hospitals in developing a more mature occupational safety culture that is consistent with worldwide standards for occupational safety in the healthcare industry..

V. CONCLUSION

This study indicates that near-miss accidents and human mistakes in hospitals are not exclusively the product of individual carelessness, but rather the interplay of multi-level variables, as described in the HFACS framework. The findings highlight the need to alter the approach to occupational safety from an individual focus to system-based improvements, notably by developing a reporting culture, reducing job tiredness, active supervision, and providing enough organizational support.

These findings are likely to inspire hospitals to conduct HFACS-based incident investigations, foster a non-punitive safety culture, and develop continuing occupational safety training and monitoring programs. These steps will systematically and sustainably reduce possible occupational dangers, resulting in a safer hospital environment for all healthcare professionals.

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VII. CONFLICTS OF INTEREST

No conflict of interest was discovered during the research

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