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FORMULATION OF RECOMMENDATIONS FOR REDUCING *MEDICATION ERROR INCIDENTS* WITH *THE HUMAN FACTOR ANALYSIS AND CLASSIFICATION SYSTEM* (HFACS) APPROACH AT HOSPITAL "X" IN 2024

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A B S T R A C T

Background. Medication errors often occur in health services so that a systematic analysis tool is needed to reduce them. Objective. Formulate recommendations for reducing the incidence of medication errors using the HFACS approach at Hospital "X". Method. This study is a qualitative study with purposive sampling of health workers involved in medication error incidents. The analysis used the HFACS questionnaire that has been adapted into Indonesian. Results. Factors causing medication errors at the prescribing, transcribing, administration, and dispensing stages include unsafe actions, unsafe action requirements, unsafe supervision, and organizational influences. Recommendations include strengthening input (competent human resources, adequate facilities), processes (evaluation of procedures and workflows), and output (routine incident communication). Conclusion. Implementation of HFACS-based recommendations can improve the quality and safety of patients at Hospital "X" .

INTRODUCTION

Medication errors are a significant problem in healthcare with a wide impact on patients and healthcare institutions. According to WHO (2023), medication errors account for 25% of patient safety incidents, with incidence rates ranging from 2% to 14% in hospitals in the United States and 7% in the United Kingdom (Williams, 2007). In Indonesia, data from the National Patient Safety Reporting and Learning System (SP2KPN) shows that 35% of patient safety incidents are medication errors (Handoko et al., 2023).

Medication errors can occur at all stages of the medication lifecycle: prescribing, transcribing, dispensing, and administration. Causes include active human error and latent factors such as unsafe work environments, lack of training, and lack of standard protocols (Egberts, 2014; WHO, 2020). Consequences include patient harm, increased costs, and reputational harm to the institution.

The Human Factor Analysis and Classification System (HFACS) approach allows for systematic analysis of the causes of medication errors by identifying causal factors at four taxonomic levels: unsafe acts, unsafe act requirements, unsafe supervision, and organizational influences (Chapel & Wiegman, 2001). This model has been adapted in a variety of sectors including healthcare.

Previous research at Hospital "X" showed 65 medication error incidents in the period 2021–2023, with the majority caused by active human error. Although investigations using Root Cause Analysis (RCA) have been conducted, there has been no comprehensive analysis using HFACS.

This study aims to formulate HFACS-based recommendations to reduce the incidence of medication errors at Hospital "X". These recommendations are expected to be the basis for improving the quality of service and patient safety.

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RESEARCH METHODS

Research Location and Design

This study uses a qualitative method with an exploratory approach to analyze the occurrence of medication errors at Hospital "X" using the Human Factor Analysis and Classification System (HFACS). This study aims to identify the causes of medication errors at various stages of the medication process and formulate prevention recommendations

.Location and time of research

The study was conducted at Hospital "X" during the period January to June 2024.

Population and Sample

The study population was all health workers involved in medication error incidents at Hospital "X". The sample was selected using a purposive sampling technique, namely health workers who were directly involved in eleven medication error incidents that occurred in the period 2021–2023. Informants consisted of doctors, pharmacists, nurses, and midwives.

Data Collection Method

In-Depth Interview: Conducted with healthcare workers involved in the medication error incident to understand the context and causal factors from their perspective. Focus Group Discussion (FGD): FGD involving the patient safety team, hospital management, and healthcare workers to validate initial findings and formulate HFACS-based recommendations. Documentation: Secondary data analysis from patient safety incident reports and previous investigation documents.

Research Instruments

HFACS Questionnaire: Using the HFACS questionnaire that has been adapted into Indonesian. This instrument identifies the causes of medication errors at four taxonomic levels: unsafe acts, unsafe act requirements, unsafe supervision, and organizational influences. Interview and FGD Guide: Developed based on the HFACS framework to explore causal factors and preventive recommendations

Data Analysis

Thematic Analysis: Qualitative data from interviews and FGDs were analyzed thematically to identify key patterns related to the causes of medication errors. Root Cause Analysis (RCA): Used to identify the root cause of each incident based on report and interview data. HFACS Analysis: RCA results were classified according to the HFACS taxonomy to link active and latent errors. Triangulation was performed by comparing interview, FGD, and documentation results to increase the validity of the findings.

Research Ethics

This study was conducted in accordance with the principles of research ethics. Prior to data collection, ethical approval was obtained from the Ethics Committee of the Faculty of Public Health, Hasanuddin University . All respondents were given informed consent and explained that participation was voluntary and anonymous. The data collected were used only for research purposes and kept confidential.

RESULTS

Informant Profile

Eleven medication error incidents at Hospital "X" involved 15 health workers, including doctors, pharmacists, nurses, and midwives. Most of the informants had more than 5 years of work experience, but training related to patient safety and medication errors was still limited.

This study analyzed eleven medication error incidents that occurred at Hospital "X" in the last three years. Based on in-depth interviews with doctors, nurses, pharmacists, and midwives involved in the incidents, various causes of medication errors were found which were classified using the Human Factor Analysis and Classification System (HFACS) approach. The results of this analysis provide a comprehensive picture of active and latent errors that influenced the incidents.

Unsafe Actions were the main category of causes of medication errors. Several performance errors were identified, such as the lack of re-verification when administering LASA (Look Alike Sound Alike) medications. A nurse stated,

"We are often in a hurry because of time pressure. When we see similar drug labels, we sometimes take them without double-checking."

In addition, decision-making errors were also found, especially in the selection of drug doses. A doctor said,

"In some cases, we make quick decisions without consulting the pharmacist because of emergency situations, but this increases the risk of errors."

At the **Unsafe Action Requirements level** , physical environmental factors are a significant issue. Several healthcare workers complained about less than ideal working conditions, such as poor lighting and noise disturbances in the pharmacy work area. One pharmacist said,

"When the pharmacy is busy, the work environment becomes very noisy, making it difficult for us to concentrate."

Psychological conditions, such as fatigue due to excessive workload, also play a role. A nurse admitted,

"We are often exhausted after long shifts, and that affects our focus when treating patients."

Unsafe Supervision also contributes to medication error events. Lack of direct supervision from supervisors at the dispensing and administration stages is one of the root causes. One pharmacist said,

"Sometimes there is no one to ensure that all medicines have been prepared according to the prescription, especially in urgent situations."

Evaluation of procedural compliance is also not carried out consistently, so the same mistakes tend to be repeated.

At the **Organizational Influence level** , there was a lack of adequate facility support to support patient safety. The hospital has not provided a special marking system for LASA drugs that can help health workers identify high-risk drugs. In addition, internal policies related to medication errors have not been fully implemented or socialized well to all staff. A unit manager said,

"There are procedures we are supposed to follow, but many staff are not aware of them due to lack of training."

As a result of these findings, HFACS-based recommendations were formulated to improve patient safety at Hospital "X".

In terms of input, hospitals need to provide health workers with adequate numbers and competencies and provide regular training related to medication errors. In addition, facilities such as good lighting in the work area and special marking for LASA drugs must be provided.

In terms of process, medication workflows must be reorganized, with more detailed procedures being developed and compliance evaluations being conducted periodically.

Meanwhile, in the output aspect, routine communication regarding patient safety incidents must be carried out as part of continuous learning. A patient safety manager emphasized,

"We need to share the results of this analysis with the entire staff so they can learn from the mistakes that occurred."

Medication Error Incidence Patterns

Based on incident data from 2021 to 2023, medication errors most often occur at the prescribing and dispensing stages. The prescribing stage accounts for 40% of total incidents, where errors occur due to the use of unclear terms in the prescription. One pharmacist said,

"Recipes are often hastily written with abbreviations that are hard to understand, leaving us to guess what they mean."

At the dispensing stage, 35% of incidents were caused by errors in selecting drugs that were similar in packaging and name. Incidents at the administration stage were also found, mainly due to the lack of patient identification before administering the drug. A nurse explained,

"We often rely on data in information systems without verifying it directly with patients, so there is a risk of giving the wrong medicine."

Root Cause Analysis Based on RCA

Root cause analysis using the Root Cause Analysis (RCA) method shows that most incidents are rooted in active human error. However, latent factors such as lack of patient safety training and inadequate infrastructure also play a significant role. One doctor stated, *"Many of us have never had specific training related to medication errors, so we just learn from experience."*

FGD Results: Identification of Strategic Solutions

Focus Group Discussion (FGD) with patient safety team, health workers, and hospital management resulted in strategic solutions based on HFACS. Participants agreed that transparent and routine incident communication can prevent similar incidents in the future. A patient safety manager suggested,

"We need a non-blaming incident reporting system, so staff are not afraid to report errors."

Health Workers' Perceptions of Patient Safety Culture

Interviews showed that health workers felt that the patient safety culture at Hospital "X" still needed improvement.

Most informants mentioned that incident reports were often considered a form of punishment, not learning. A nurse stated,

"When we report errors, we are worried that we will be blamed, even though we want the situation to be fixed."

Opportunities and Challenges in Implementing Recommendations

Implementation of HFACS-based recommendations at Hospital "X" has great potential to reduce medication error events. However, several challenges were identified, such as limited budget for routine training and resistance to change from some staff. A management member stated,

"We need to reassure staff that the new system is intended to support them, not add to their workload."

Direct Impact on Patients and Hospitals

In addition to financial losses, medication errors also impact patient trust in hospital services. Several patients who experienced incidents expressed their concerns about the safety of services. One patient stated,

"I hope there is a guarantee that mistakes like this will not happen again."

This study shows that the implementation of HFACS-based recommendations can help reduce the incidence of medication errors, improve the quality of service, and strengthen the culture of patient safety at Hospital "X".

DISCUSSION

The results of this study indicate that medication errors in Hospital "X" are a complex problem, involving human factors, work environment, supervision, and organizational policies. Analysis using the HFACS approach provides a systematic framework for identifying root causes, both at the active and latent error levels.

Unsafe Actions as the Main Cause

This study confirms that unsafe acts, such as performance and decision-making errors, are the main causes of medication errors. Errors in the use of LASA drugs and inappropriate dosing indicate a lack of implementation of standard procedures. This finding is in line with Williams' (2007) study which stated that errors in prescribing and administration often occur due to a lack of re-verification.

The Influence of Physical and Psychological Environment on Errors

Unconducive working environments, such as poor lighting and noise disturbances, also affect the ability of health workers to perform their duties. Fatigue due to excessive workload also increases the risk of errors, in accordance with WHO findings (2020) which state that physical and emotional exhaustion are significant factors in medication errors.

Lack of Supervision and Evaluation

Inadequate supervision factor is one of the weaknesses in the hospital management system. The absence of supervisors in monitoring the dispensing and administration process increases the chances of errors. Previous research by Egberts (2014) showed that weak supervision can result in repeated errors.

Organizational Culture That Does Not Support Patient Safety

The organizational culture and policies at Hospital "X" do not fully support patient safety efforts. The lack of routine training and a blaming incident reporting system create barriers to learning from previous incidents. The non-blaming approach proposed by Reason (1997) in the Swiss Cheese Model is very relevant to be implemented at Hospital "X".

Relevance and Implications of Findings

HFACS-based recommendations provide a practical framework for addressing medication errors. At the input level, providing competent human resources and adequate facilities can strengthen the service system. At the process level, structuring workflows and evaluating procedures can improve efficiency and accuracy. While at the output level, routine incident communication can build a learning culture among hospital staff.

Opportunities for Implementing Recommendations

Implementation of recommendations requires commitment from hospital management, including resource allocation and strengthening organizational culture. This study is in line with the findings of Soubra & Karout (2021),

which emphasize the importance of training and communication to improve patient safety. However, challenges such as resistance to change and budget constraints need to be addressed through a collaborative approach involving all stakeholders.

Contribution to Science and Practice

This study not only provides practical solutions to reduce medication errors in Hospital "X", but also enriches the literature on the application of HFACS in the context of health care. HFACS, originally developed for the aviation industry, has proven to be relevant for analyzing patient safety incidents, supporting the development of safer and more efficient service systems.

CONCLUSIONS AND IMPLICATIONS

This study identified that medication errors in Hospital "X" were caused by a combination of active and latent errors, including unsafe acts, unsafe act requirements, inadequate supervision, and organizational influences. Factors such as health worker fatigue, lack of training, unconducive work environment, and suboptimal organizational policies were the root causes of the incidents. The Human Factor Analysis and Classification System (HFACS) approach has proven effective in uncovering root causes and formulating recommendations. Recommendations include strengthening input (competent human resources and adequate facilities), structuring work processes (evaluating compliance with procedures), and routine communication to build a learning culture. Implementation of these recommendations has the potential to improve patient safety and service quality at Hospital "X".

CONFLICT OF INTEREST STATEMENT

The authors declare no conflict of interest related to this research. All data analysis and interpretation were conducted independently and without any influence from internal or external parties that could affect the results of the study. This research is fully supported by a commitment to improve the quality of patient safety at Hospital "X" without any commercial involvement or specific affiliation that could cause bias.

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