Factors affecting the recurrence of medical errors in hospitals and the preventive strategies: a scoping review

Negar Aghighi [1], Aidin Aryankhesal [2]*, Pouran Raeissi [3]

1. PhD candidate in Health Services Management, Department of Health Services Management, School of Health Management and Information Sciences, Iran University of Medical Sciences, Tehran, Iran.
2. Professor, Department of Health Services Management, School of Health Management and Information Sciences, Iran University of Medical Science, Tehran, Iran.
3. Professor, Department of Health Services Management, School of Health Management and Information Sciences, Iran University of Medical Sciences, Tehran, Iran.

Abstract

Due to the high value of human life, the occurrence of even one error that leads to death or complications is of great consequence and requires serious attention. Although significant efforts have been made to ensure patient safety, serious medical errors continue to exist. This study aimed to identify the factors associated with the recurrence of medical errors and strategies to prevent them through a scoping review.

Data were gathered through a scoping review of PubMed, Embase, Scopus, and Cochrane Library databases during August 2020. Articles related to factors influencing the recurrence of errors despite the available information, as well as articles related to measures taken worldwide to prevent them, were included in study. Overall, 32 articles were selected out of the 3422 primary papers. Two main categories of factors were identified as influential in error recurrence: human factors (fatigue, stress, inadequate knowledge) and environmental and organizational factors (ineffective management, distractions, poor teamwork).

The six effective strategies for preventing error recurrence included the use of electronic systems, attention to human behaviors, proper workplace management, workplace culture, training, and teamwork.

It was concluded that using a combination of methods related to health management, psychology, behavioral sciences and electronic systems can be effective in preventing the recurrence of errors.

Keywords: *Medical errors; Medical mistakes; Patient safety; Hospitals.*

*Corresponding Author

Aidin Aryankhesal
Address: No. 6, Rashid Yasemi St., Vali-e Asr Ave., Tehran, Iran.
Postal Code: 19967138831
Tel: (+98) 21 88 77 20 86
Email: aryankhesal.a@iums.ac.ir

Introduction

Medical errors are unavoidable occurrences in health systems that can adversely affect patient safety (1). Years after the American Institute of Medicine's prominent report, "To Err Is Human" (2), which addressed the importance of medical errors for the first time, there are still serious concerns about patient safety (3).

Patient safety is a fundamental right that must be guaranteed when visiting or hospitalizing patients. It is rather significant to investigate the possible causes and preventive measures for medical errors. In addition, medical error prevention can help to reduce adverse after-effects such as permanent disability, complications and death (4). Clinicians have the moral obligation to maximize benefits and minimize harm while providing treatments or services to patients. Clinicians also have an ethical responsibility not to inflict harm on patients intentionally or through carelessness (5). Preventing medical errors requires the establishment and management of value-based ethical environments. Such environments describe ethical policies that focus on employee's commitment to values and norms related to practices (6).

As reported by the Institute of Medicine, an estimated 44000 - 98000 deaths in the USA every year are attributed to medical errors (2). Patient safety and quality of care are seriously affected by medical errors in hospitals. The epidemiology of medical error injuries remains a pressing global issue. In the United States, a recent report reviewing previous studies ranked unpleasant occurrences, especially medical errors, as the third leading cause of death (7). In particular, up to 1.1% of hospital admissions have resulted in deaths due to medical errors. In 2013, more than 400,000 deaths were caused by medical errors (8). In the UK, 101 medication errors occur per 1,000 drug prescription cases (9), and it is also estimated that drug errors cause 12,000 deaths per year according to the National Health Service (NHS) (10). The number of reported events increased from 135,356 between October and December 2005 to 508,409 during the same period in 2017 (11).

Over the years, the World Health Organization (WHO) has developed patient safety guidelines to prevent medical malpractice, including Preventing Patient Fall , patient identification, hand hygiene, and safe surgery (12). The Joint Patient Safety Group has introduced several patient safety goals

to help healthcare providers create a safer environment for patients as well as themselves (13). However, despite these efforts, the rate of medical errors leading to disability and significant mortality is high (14). Moreover, we still encounter errors that have detailed guidelines dedicated to them and should not keep recurring. While emphasizing the enormous burden of harm to patients seeking treatment, the World Health Organization has stated that over the past 15 years, global efforts to reduce harm to patients have not been effective despite pioneering work in some healthcare centers (15, 12).

Recurrence of errors in this study refers to errors that 1) have been discovered once in the study environment, 2) are caused by factors that have been analyzed and for which specific preventive guidelines exist, and 3) continue to occur in spite of training and sensitization (Figure 1).

It appears that the measures currently being taken to reduce medical errors are not sufficiently coherent and need to be reviewed to prevent the recurrence of errors that occur frequently. Given the widespread efforts that have been made to prevent medical errors worldwide, the high frequency of errors has led to the hypothesis that there may be factors other than those currently known. Therefore, a scoping review was needed to identify the factors that have been considered at the international level in the field of error recurrence. This study aimed to identify international actions regarding factors related to the recurrence and prevention of medical errors in hospitals and to identify any existing knowledge gaps.

Figure 1. Concept of recurring errors in comparison to other types of errors
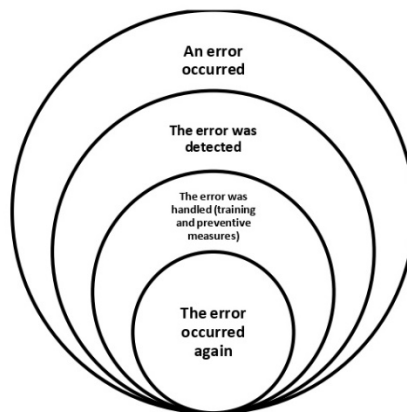
Methods

A scoping review was conducted based on the framework outlined by Arksey and O'Malley's method. The purpose of a scoping review is to summarize "a range of evidence to convey the breadth and depth of a field". (16).

1) Identifying the Research Question

This study addresses two main questions: 1) What factors can play a role in the recurrence of errors besides the ones already known to prevent error recurrence, and 2) What measures have been taken worldwide to prevent the recurrence of errors.

2) Identifying Relevant Studies

To select related studies, the following keywords were used in PubMed, Embase, Scopus, and Cochrane Library databases without time limit. The database research was done in August 2020, and the search strategy is shown in table 1.

Table 1: Search Strategy

("Medical Mistakes"[tiab] OR (Errors[tiab] AND Medical[tiab]) OR (Error[tiab] AND Medical[tiab]) OR "Medical Error"[tiab] OR "Medical Mistake"[tiab] OR "Wrong-Procedure Errors"[tiab] OR "Wrong Procedure Errors"[tiab] OR "Wrong-Procedure Error"[tiab] OR "Wrong-Site Surgery"[tiab] OR "Wrong-Site Surgery"[tiab] OR "Wrong-Site Surgeries"[tiab] OR "Surgical Errors"[tiab] OR "Surgical Error"[tiab] OR "Wrong-Patient Surgery"[tiab] OR "Wrong Patient Surgery"[tiab] OR "Wrong-Patient Surgeries"[tiab] OR "Never Event"[tiab] OR "Never Events"[tiab] OR "medication error"[tiab] OR "medication errors"[tiab] OR "near miss"[tiab] OR "patient fall"[tiab] OR "wrong medicine"[tiab] OR "learning from error"[tiab] OR "root cause analysis"[tiab]) AND (repeat[tiab] OR repetition[tiab] OR occurrence[tiab] OR "re-occurrence"[tiab])

A manual search was also performed to identify additional relevant studies. In September 2020, in line with our scoping review methodology, we conducted a second comprehensive database search to confirm and complement the results of the first literature search. We developed our search string based on a primary set of relevant records identified in the first search. Variations of the search string were then tested against a second set of relevant records.

To validate the accuracy of the selection process, all authors screened the same 32 publications, discussed the results, and amended the screening and data extraction conducted before the beginning of the screening. Disagreements on study selection and data extraction were resolved through consensus and discussion among the authors.

3) Study Selection

Articles were included if they 1) dealt with the factors affecting the recurrence of the error, 2) presented strategies to prevent the recurrence of the error, or 3) were based on research conducted in hospital settings. The initially included papers were excluded if they 1) had been conducted in rehabilitation units and primary care centers, 2) only reported the incidence of errors, or 3) lacked a full text. Due to the need for a comprehensive study, the type of article or study method did not affect the selection of articles. Finally, 32 articles with the desired characteristics were selected out of the 3422 initially retrieved papers. The final inclusion of studies was achieved by consensus among the authors (Figure 2).
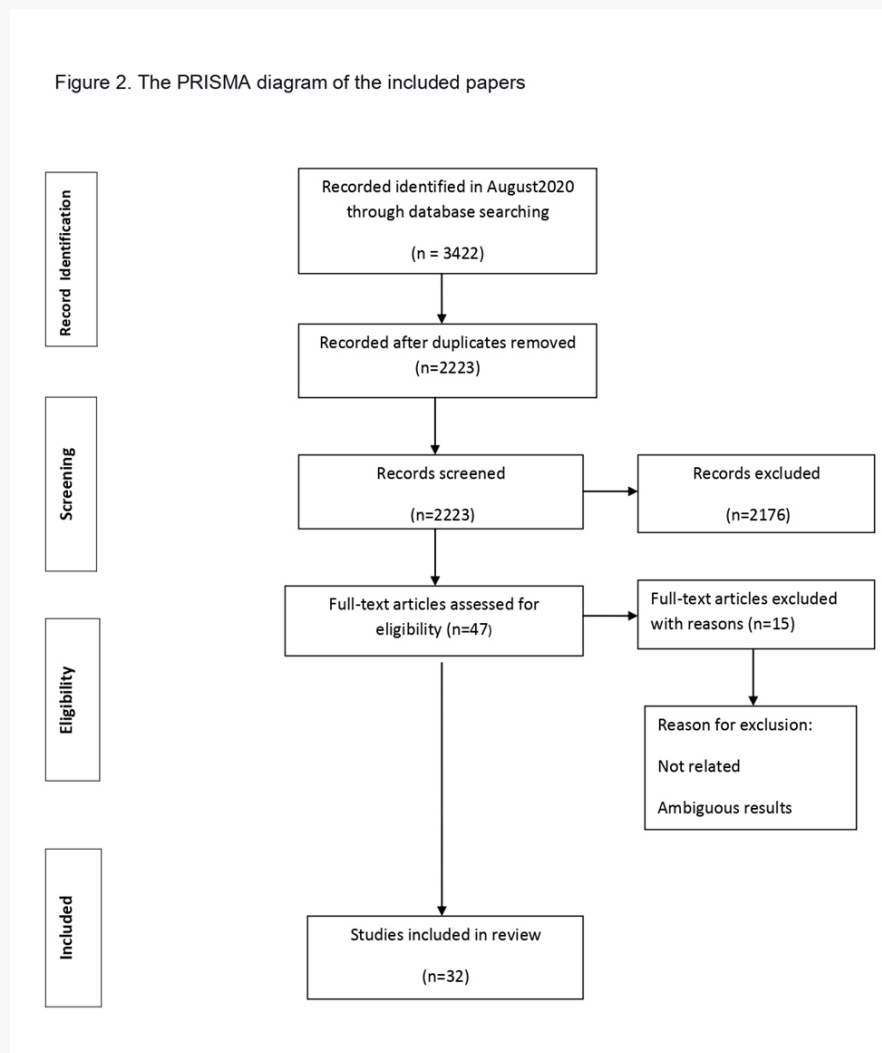

Figure 2. The PRISMA diagram of the included papers

Figure 2. The PRISMA diagram of the included papers

4) Charting the Data

Two authors jointly developed a data charting form to determine which variables to extract. The authors independently charted the data, discussed the results, and continuously updated the data-charting form in an iterative process. Two authors independently charted data from each eligible article. Any disagreement was resolved through discussion between the two authors or further adjudication by a third author. Critical appraisal of the included studies and meta-analysis across studies were not undertaken due to methodological heterogeneity. Data extraction was conducted based on the JBI Reviewer's Manual (17), including authors' names, year of publication, country of origin, aims of the study, overview of methods, and the results such as factors affecting the recurrence of medical errors, and those related to strategies for prevention of their recurrence.

5) Collating, Summarizing and Reporting the Results

At this stage, a peer check was performed and each researcher checked the codes and validated the data. The findings were categorized, summarized and reported in such a way that all articles related to similar categories were put together and, after careful study, placed in related categories. Lastly, the reports were provided.

This study was registered under the number IR.IUMS.REC.1399.774 and is available in the research system of Iran University of Medical Sciences (https://research.iums.ac.ir /), but for external access, permission must be obtained from Iran University of Medical Sciences.

Results

Thirty-two articles were selected without time limitation in August 2020. The majority were from the US (n = 13) and Australia (n = 3). Other countries with less than three studies included the UK, Austria, Spain, Iran, Portugal, Germany, Italy, Japan, Denmark, France, South Korea, Israel and Thailand. A vast majority of the studies used cross-sectional analyses (n = 11) and review studies (n = 11) (Table 2).

Table 2. Summary of findings of selected articles

Authors, Publication Year	Country	Aim of the Study	Method	Results
Flynn, E.A. 1999 (18)	US	Investigating the relationship between interruptions and distribution of errors	Cross-sectional study	1. Pharmacists who were more distracted had higher error rates than those who were less distracted. 2. Distraction has a significant effect on distribution of errors
De Carvalho, M. 2002 (19)	Portugal	Investigating medical errors, predisposing factors and prevention in the neonatal ward	Literature review and bibliographic review in Medline	1. Environmental factors, physical factors and physiological factors contribute to errors. 2. Using technology such as electronic order entry (CPOE) and barcodes can prevent errors. 3. Automatic detection of side effects is useful in error prevention
Meinberg, E.G. 2003 (20)	US	Determining the incidence of wrong-site surgery	Cross-sectional study	Using the sign your site campaign caused a 45% reduction in wrong-site surgery in the United States, and almost everyone takes steps to prevent this type of medical error.
Bates, D. 2004 (4)	US	Identifying solutions to prevent medication errors	Cross-sectional study	Some measures for prevention: 1) Including training on medication errors in the university curriculum 2) Focusing on improving secure systems 3) Utilizing modern technology 4) Using clinical pharmacists 5) Creating innovative safety plans
Berman, A. 2004 (21)	US	Identifying ways to reduce the look-alike and sound-alike errors	Literature review	The most common cause of medication errors is human factors such as dysfunction, lack of knowledge, errors in preparation and calculation, and slips and loss of memory.
Meaney, M.E. 2004 (22)	Germany	Filling the gap about the organizational ethics committees and their impact on patient safety	Descriptive research	1. Ethics committees can be effective in achieving a safety culture. 2. Patient safety culture depends on the teamwork culture. 3. Patient safety culture should include internal and psychological factors and daily behaviors related to patient safety,

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Table 2. Summary of findings of selected articles (continued)

Authors, Publication Year	Country	Aim of the Study	Method	Results
Deans, C. 2005 (23)	Australia	Identifying and describing the incidence, type and causes of medication errors	Cross-sectional study	With regard to reasons for recurring errors: 1. Handwriting illegibility and misreading 2. Stress and fatigue have been reported 3. Interruptions and distractions 4. Lack of knowledge
Ziv, A. 2005 (24)	Israel	Investigating the effect of simulation-based medical education (SBME) on the occurrence of medical errors	Literature review	1. The main feature of SBME is its unique approach to making mistakes (and learning from them). 2. Accountability should be a key.
Jirapaet, V. 2006 (25)	Thailand	Describing the barriers that nurses face when providing nursing services	Qualitative descriptive methodology	Factors associated with error recurrence are: 1) Insufficient knowledge of patient safety in neonatal wards 2) Inadequate staffing 3) Multitude of tasks 4) Poor team communication
Hovor, C. 2007 (26)	US	Evaluating medication errors using the Bayesian Causal Network Model	Literature review	The Bayesian Causal Network Model identifies behavioral and systemic factors that may increase the risk of drug misuse, misdiagnosis and missed doses, as well as drug interactions and drug errors.
Hakimzada, A.F. 2008 (27)	US	Examining the nature of errors and their consequences for patient safety	Qualitative grounded theory	1. Some causes of medical errors are stress in the workplace, heavy workload, and the tendency to adopt shortcuts. 2. While in some cases technological solutions can improve the situation, they can sometimes lead to more errors, or automate errors in the system.

Table 2. Summary of findings of selected articles (continued)

Authors, Publication Year	Country	Aim of the Study	Method	Results
Brandão, P. 2011 (14)	Portugal	Providing solutions to reduce side effects by identifying and eliminating the root causes of errors	Descriptive research	1. Accumulation data on errors alone does not help much to improve the system and reduce errors. 2. Learning from errors can be facilitated by using mathematical-logical operators. 3. The electronic system of the Eindhoven Classification Model can be sutable.
Agrawal, A. 2012 (28)	US	Learning from Root Cause Analysis	Descriptive research Root Cause Analysis	Some Reasons for repeating an error include: 1) Failure to provide instructions to stakeholders in time (despite the existence of related guidelines for some years) 2) Lack of official supervision over the implementation of safety protocols 3) Poor teamwork between doctors and nurses
Charpiat, B. 2012 (15)	France	Investigating the data on the nature and frequency of medication errors	Review based on searching PubMed and CAT-INIST databases	1. Electronic methods did not prevent drug errors and led to new types of errors. 2. The possibility of providing duplicate prescriptions can cause errors. 3. There are defects in human-machine communication.
Frith, K.H. 2012 (29)	US	Investigating the relationship between nursing staff and the incidence of medication errors	Cross-sectional study .	1. Increasing the number of RN hours and decreasing or eliminating LPN hours can be a strategy to reduce medication errors. 2. Nursing staff is an important human resource to keep patients safe from medication errors
Steyrer, J. 2013 (30)	Austria	Investigating the effect of production pressure and workload on patient safety	Prospective, observational, cross-sectional study	1. No significant relationship was observed between safety tools and error rate. 2. Safety atmosphere affects the error rate. 3. Heavy workload has a devastating effect on patient safety.

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Table 2. Summary of findings of selected articles (continued)

Authors, Publication Year	Country	Aim of the Study	Method	Results
Barrington, M.J. 2015 (31)	Australia	Identifying preventive strategies in wrong-site anesthetic blocks	Literature review and MEDLINE search strategies	Prevention strategies for local anesthesia in the wrong place include: 1) Individual and systemic accountability 2) Paying attention to time-out 3) Continuous audits 4) Markings in action positions 5) Using valid checklists 6) Using strong documentation 7) Improving team communication
Fraser, S.G. 2015 (32)	UK	Describing the reasons for the occurrence of wrong-site procedure errors and ways to prevent them	Descriptive research	Some prevention strategies include: 1) Using campaigns to encourage action marking 2) Establishing the pre-operation approval process 3) Enforcing patient participation in marking the operation site 4) Establishing time out immediately before starting the operation 5) Using electronic systems such as barcoding
Stein, J.E. 2015 (33)	US	Introducing human factors science and its applicability to teamwork	Descriptive research	1. Classifying human factors and describing unsafe behaviors and actions are some tools to understand the nature of errors. 2. Human behaviors must be known.
Chiarini, M. 2017 (3)	Italy	Evaluating the effect of knowledge and attitude of nursing students on failure	Cross-sectional study	1. The culture of error is important in medicine. 2. Patient safety culture and prevention of medical errors should be included in the university education of medical personnel.
Hartford-Beynon, J. 2017 (35)	UK	Identifying wrong-site blocks and reducing their occurrence	An audit of regional anesthetics and compliance with SB4YB	1. Training campaigns such as the SB4YB campaign must be encouraged. 2. WHO involvement in patient safety issues increases compliance in achieving the goals of preventing error recurrence.

Table 2. Summary of findings of selected articles (continued)

Authors, Publication Year	Country	Aim of the Study	Method	Results
Hwang, J.I. 2017 (36)	South Korea	Addressing the importance of systems thinking in nurses and its relationship with the recurrence of medical errors	Cross-sectional study	1. The ability to think systemically plays a role in reducing and reporting medical errors. 2. The skill of systemic thinking has a role in improving the quality and safety of patient care. 3. Nurses' competence to think systemically should contribute to patient safety.
Babaei, M. 2018 (37)	Iran	Evaluating the relationship between personality-related factors and problem-solving ability, and medical errors	Questionnaire case control study	1. People who made fewer medical errors scored significantly higher on the three factors of extroversion, conscientiousness and agreement. 2. People who made more medical errors scored higher on neuroticism. 3. People who made no medical errors scored higher on the three problem-solving scales.
Vrklevski, L.P. 2018 (38)	Australia	Evaluating the impact of RCA (Root Cause Analysis) on improving patient outcomes.	Literature review	1. Physicians' rate of adopting the RCA recommendations is low. 2. There is weak evidence that the implementation of RCA recommendations leads to safer patient care. 3. The RCA often makes recommendations that replicate existing policies
Abbasi, F. 2019 (39)	Iran	Determining the correlation between workplace culture and learning from errors	Descriptive-analytical study	1. There was a positive correlation between workplace culture and learning from error. 2. There was an inverse relationship between workplace culture and occurrence of medication errors.
Tigard, D.W. 2019 (40)	Germany	Trying to prove the importance of responsibility in medical errors instead of preventing blame	Descriptive research	1. It is necessary to resist moving away from the concepts related to blame. The position of blaming should be maintained in order to increase accountability.

Table 2. Summary of findings of selected articles (continued)

Authors, Publication Year	Country	Aim of the Study	Method	Results
Bowden, V. 2019 (13)	US	Describing nurse-specific present at the time of a patient fall	Retrospective cohort study	1. Increasing the number of nurses reduces the risk of patient fall. 2. Nurses' level of experience and work experience affects the rate of patient fall. In other words, the more experienced the nurse is, the less likely the patient is to fall.
Lee, Y.J. 2019 (41)	South Korea	Investigating the effect of nurse-nurse and nurse-physician relationship	Cross-sectional questionnaire survey	Optimal collaboration between physician and nurse is effective in reducing medical errors.
Honno, K. 2020 (42)	Japan	Investigating the relationship between depression and near miss among ELST emergency technicians	Cross-sectional study	1. Stress and depression were the main risk factors for medical errors. 2. Proper management of the work environment can lead to the provision of safe services.
Koleva, S.I. 2020 (43)	US	Exploring some common factors contributing to never events in surgery	Literature review	Some Factors associated with error recurrence include: 1) Weak communication 2) Fatigue 3) Lack of specialized personnel 4) Operating room interruptions 5) Number of surgical cases 6) Issues related to employees 7) Working hours 8) Fatigue
Latzke, M. 2020 (44)	Austria	Examining the effect of safety climate and team processes	Non-interventional, observational multicenter	1. Safety climate and team processes are comparatively important determinants of adverse events occurrence.
Martin Delgado, J. 2020 (45)	Spain	Investigating the effect of Root Cause Analysis in preventing error recurrence	Systematic review	1. The main weakness of RCA is its recommendations. 2. Poorly designed RCAs may not be enough to prevent new errors from occurring, and may even lead to new errors.

Two groups of results were found in the present study: A) Factors related to the recurrence of medical errors, and B) Strategies to prevent the recurrence of medical errors.

A) Factors related to the recurrence of medical errors

Two categories of human, and environmental and organizational factors were identified, along with six items, explained below.

Human factors

Fatigue: In some studies, fatigue has been identified as the most important cause of error and its recurrence (19, 23, 31). In one study, fatigue was

reported as a contributing factor to anesthesia errors (28). Also, high workload and insufficient sleep lead to fatigue, which increases the frequency of mistakes (19,27, 30).

Stress: According to studies, stress is one of the most important factors in the occurrence and recurrence of medical errors (19, 23, 27, 42). We also found that people with neuroticism (including anxiety, anger, irritability, vulnerability and depression) were more likely to make medical errors (37).

Inadequate knowledge: Insufficient knowledge and skills are the most common cause of medication errors (21). In addition, inadequate knowledge can lead to stress and fatigue and increase medical errors (23). Studies conducted in the neonatal ward and operating room have shown that lack of sufficient knowledge and skills leads to the recurrence of medical errors (25, 43).

Environmental and organizational factors

Ineffective management: In this category, the following factors were found to lead to medical error recurrence: existence of strong authority in the organization that suppresses the possibility of identifying and learning from errors (43); expansion of hierarchical boundaries in an organization (such as a hospital) that requires a team structure (28); failure to provide timely and

correct patient safety instructions and the results of Root Cause Analysis (RCA) to stakeholders (28, 38); lack of formal oversight of the implementation of safety protocols, and their failure to become an automatic part of the workflow of employees (28); not considering reminders (such as system alarms) and dependence on incomplete human memory, (28).

Various distractions: According to the studies, distraction of the medical staff caused by unnecessary visits to hospital wards, unnecessary telephone calls, staff irregularities, and irregular placement of equipment and medications, leads to surgical, anesthesia and medication errors (18, 23, 31).

Poor teamwork: Poor team communication is one of the most important factors in error recurrence and may cause harm to patients (25, 31, 43). Such weak connections are usually due to poor teamwork between physicians and nurses, which endangers patient safety (25, 43).

B) Strategies to prevent the recurrence of medical errors

According to the studies, six factors were identified as effective in preventing the recurrence of errors, including: 1) use of electronic systems, 2) attention to human behaviors, 3) workplace culture, 4)

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proper workplace management, 5) training, and 6) paying attention to teamwork.

Use of electronic systems: The findings of several studies have emphasized the importance of using electronic systems such as CPOE (Computerized Provider Order Entry) and barcode systems to prevent the recurrence of errors (14, 19, 21, 23, 28, 32, 46). The barcode system can reduce misdiagnosed drugs, prevent misidentification of the patient and misuse of time, and reduce missed and wrong dose errors (46). Therefore, the installation of barcoded wristbands for all patients should be considered at the time of admission (21). Also, e-prescriptions significantly reduce medication errors and do not put patients at risk for illegible handwriting and related causes (23). Such technologies do not replace specialists involved in patient care, but rather organize information and allow specialists to perform valuable tasks such as complex decision-making and communication while the system performs repetitive and tedious tasks (26).

Attention to human behaviors: Numerous studies have addressed human factors and behavioral issues as a strategy to prevent the recurrence of errors (19, 24, 31, 33, 36, 37, 40, 43). Based on one study, extrovert, conscientious people with strict work ethics committed fewer errors, and those with problem-solving skills did not commit medical errors (37). In addition, the ability to think systematically plays a role in reducing the incidence of medical errors (36). Several studies have found a significant relationship between having a deep understanding of anthropological factors and a reduced amount of incurring "never events" (33, 43). Moreover, in order to eliminate human errors, we should have knowledge of human behaviors and consider the two categories of schematic behaviors and attention-related behaviors. Schematic behaviors are reflective and can be considered in error reduction by using checklists and attracting public attention. Attention-related behaviors, on the other hand, are related to problem-solving skills, and are therefore more difficult to control and require professional supervision and training to reduce errors (34). In some studies, individual and organizational responsibility and accountability have been found to be effective in reducing errors (24, 31, 40).

Proper workplace management: One of the main components of management is supervision. Some procedures that have prevented the recurrence of errors include continuous audits, implementation of powerful documentation such as valid checklists for safe surgery and anesthesia (31, 32, 39), and

strict supervision of compliance and corrective measures (28). Proper alignment of forces and increased use of experienced and more educated staff have also been effective in preventing errors. Examples of such measures include increasing the working hours of RN nurses and reducing the working hours of LPN nurses. Also, increasing the number of nurses has reduced the rate of patient fall (13). Hospitals can also help reduce medical errors through stronger and more reliable safety management, including error reporting, learning from errors, information transparency, and providing timely error feedback (23, 43).

Workplace culture: According to studies, medical errors will be reduced in the presence of proper workplace culture (22, 28, 30, 34, 39, 44). In one study, a positive relationship was found between workplace culture and learning from errors (39), and other studies have identified a positive relationship between culture and teamwork (22, 44).

Training: Numerous studies have shown that training in different areas is effective in preventing errors (20, 32, 34, 35, 39, 46). Studies have emphasized the importance of including error training in the university curriculum as part of the education of medical staff to fully acquaint them with the issue before starting work, stating that this

will ultimately help reduce medical errors (34, 46). Training campaigns with varied and specific topics in the field of patient safety have been very useful in reducing errors (for instance the campaign of "sign your site") due to the extent of these campaigns (20, 32, 35). In addition, using educational models such as the Potential Risk Assessment Model (26) and the Eidenhaven Classification Model (14) will improve learning from errors and reduce medical errors. Although RCA is used to provide solutions to prevent the recurrence of errors, it appears that this method cannot prevent errors from recurring (38, 45). One study found that physicians' participation in RCA recommendations was low (38) and that the RCA often provided recommendations that replicated existing policies or previous recommendations (38, 45).

Paying attention to teamwork: Doing the right thing as a team is effective in preventing mistakes (28, 31, 32, 41, 44). Teamwork is especially significant between physicians and nurses, and in areas such as the operating room and among the surgical team members (28, 31, 37, 41). Therefore, various team-building programs can be used to increase teamwork skills among staff (28).

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Discussion

Based on our review, two main categories of factors (human, and environmental and organizational) and their six sub-categories were identified as associated with error recurrence. The sub-categories were fatigue, stress, inadequate knowledge, existence of various distractions, poor teamwork, and ineffective management. In the field of error prevention strategies, six factors were identified, including the use of electronic systems, attention to human behaviors, proper workplace management, appropriate workplace culture, training, and attention to teamwork.

Fatigue and stress were identified as significant factors associated with error recurrence (21, 28, 31, 37, 39, 46). It seems that even if error prevention measures are implemented, efforts in this area will not be successful unless issues such as fatigue and stress are addressed. Inadequate knowledge was another factor that led to error recurrence (18, 19, 23, 39), and therefore we found it essential that well-informed personnel be employed in relevant departments. Neuroticism was yet another factor to be considered when hiring staff, because neurotic people were more likely to make medical errors.

In the field of environmental and organizational factors, poor teamwork was shown to lead to the recurrence of medical errors (18, 23, 46). Paying attention to the cooperative nature of hospital duties is a point that must be constantly emphasized, and all team members must be committed to it. In addition, hospital management should prioritize strengthening team skills in training programs. Therefore, different methods of reinforcing teamwork must be employed, particularly between physicians and nurses. Distraction was found to be another factor associated with error recurrence (27, 39, 46), so interruptions must be carefully identified and removed (including all irregularities in departments and units). Distraction alone can overshadow all efforts to prevent errors, and therefore strategies to avoid it and enhance attention and concentration in the workplace will be effective in preventing the recurrence of errors. In this regard, improving environmental conditions need to be on health managers' agenda.

In the area of ineffective management, the existence of strong authority in the organization suppresses mental communication and prevents active learning from mistakes by creating fear among staff and hierarchical boundaries, leading to the recurrence of mistakes. This indicates the need to create a friendly atmosphere (18, 29), which encourages learning from errors and supports

retelling them, and can eventually prevent error recurrence.

Prevention of medical errors within an organization requires systematic management strategies. Healthcare providers need education and training to understand the importance of reporting medical errors. It is the ethical duty of organizations to create an environment where healthcare providers feel supported in reporting, disclosing and discussing errors (47). Other factors related to error recurrence are lack of proper and complete sharing of protocols, and lack of learning from errors (32). Communication researchers suggest that the ways healthcare providers 'story' their experiences of mistakes can help to understand medical errors (48). Hence, it is necessary to create a smooth and organized structure. This structure should ensure that all stakeholders have access to essential information including patient safety instructions and the results of error analysis. In addition, this information should become an automated part of their workflow.

According to strategies pertaining to the field of prevention, human factors such as problem-solving skills, systemic thinking ability and personality traits (18, 26, 28, 34, 43, 46), and training in these skills and abilities should be considered in academic and in-service training programs. The reason is that in a hospital setting where staff are constantly confronted with multiple incidents, having such skills enhances effectiveness. Furthermore, personality traits should be considered in the recruitment of staff.

In addition to preventing errors from recurring, the use of electronic systems (14, 19, 28, 32, 35, 39, 42) such as barcoding and CPOE, as well as electronic alarms, can be very useful, since they allow staff to focus on sensitive tasks with more ease and efficacy. In a study conducted to examine whether physicians' use of electronic systems promotes patient satisfaction or blame for medical outcomes, it was found that using a decision support system was very effective in reducing blame after medical errors (49).

According to these studies, proper management of the work environment and ensuring the correct performance of activities through valid checklists (32, 42, 44, 46), seriousness in following compliance and corrective actions, and hiring experienced and well-educated personnel can prevent errors from recurring.

In the field of education, error training should be included in the university curriculum (22, 29). In addition, training campaigns to prevent the recurrence of errors have been very useful because they focus on specific topics (such as sign your site)

(20, 33, 42). Also, promotion of such campaigns among large groups of stakeholders has been effective in creating a culture of that issue.

Although RCA used to be considered an effective strategy to prevent the recurrence of errors, our review did not find confirming evidence (29, 40). It seems that there should be revisions regarding the use of this method to avoid repeating previous recommendations.

Limitations

This scoping review should be read in the light of certain limitations. We conducted a literature search in four major electronic databases: PubMed, Embase, Scopus, and Cochrane Library, but did not have access to the CINAHL database. Furthermore, we did not search "gray" literature. In line with the scoping review methodology, we did not assess the risk of bias of the included studies. Although we observed methodological heterogeneity in the included studies, we did not include or exclude studies based on quality assessment, which is necessary for a systematic review. Therefore, caution is advised when drawing conclusions based on the combined data from this study

Conclusion

This study aimed to identify the factors associated with error recurrence and strategies to prevent it; because it seemed that despite years of preventive measures against medical errors, these errors are still repeated. This study showed that other factors, most of which are contextual and have psychological dimensions, affect the recurrence of errors. Therefore, it is important to identify the reasons and remove the main factors leading to their recurrence. Clearly, it is not sufficient to use methods such as RCA in this field, and one can hope for the effectiveness of patient safety efforts if and when these factors are eliminated. This study found that using a combination of methods related to health management, psychology and behavioral sciences, as well as electronic systems can be effective in preventing the recurrence of errors. It should be added that further studies are needed to focus on the root causes of recurring errors.

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Conflict of Interests

The authors have no conflict of interests to declare.

References

1. Vaziri S, Fakouri F, Mirzaei M, Afsharian M, Azizi M, Arab-Zozani M. Prevalence of medical errors in Iran: asystematic review and meta-analysis. BMC Health Serv Res
. 2019; 19(1): 622.

2. Institute of Medicine (US) Committee on Quality of Health Care in America. Kohn LT, Corrigan JM, Donaldson MS, eds. To Err is Human: Building a Safer Health System. Washington (DC): National Academies Press (US); 2000.

3. Askarian M, Sherafat SM, Ghodsi M, et al. Prevalence of non-reporting of hospital medical errors in the Islamic Republic of Iran. East Mediterr Health J. 2020;26(11): 1339-46.

4. Bates DW, Singh H. Two decades since to err is human: an assessment of progress and emerging priorities in patient safety. Health Aff (Millwood). 2018;37(11):1736-43.

5. Bonney W. Medical errors: moral and ethical considerations. Journal of Hospital Administration. 2014;3(2): 80-8.

6. Rathert C, Philips W. Medical error disclosure training: evidence for values-based ethical environments. Journal of Business Ethics. 2010; 3(97):491-503.

7. Makary MA, Daniel M. Medical error—the third leading cause of death in the us. BMJ. 2016; 353: i2139.

8. Van Den Bos J, Rustagi K, Gray T, Halford M, Ziemkiewicz E, Shreve J. The $17.1 billion problem: The annual cost of measurable medical errors. Health Aff (Millwood).2011; 30(4): 596-603.

9. Sutherland A, Canobbio M, Clarke J, Randall M, Skelland T, Weston E. Incidence and prevalence of intravenous medication errors in the UK: a systematic review. Eur J Hosp Pharm. 2020; 27(1): 3-8.

10. Department of Health and Social Care. The report of the short life working group on reducing medication-related harm. 2018; [cited October 2022]; Available from: https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/68 3430/short-life-working-group-report-on-medication-errors.pdf

11. Ahsan A, Setiowati L, Noviyanti LW, Rahmawati IN, Ningrum EH, Putra KR. Nurses' team communication in hospitals: a quasi-experimental study using a modified TeamSTEPPS. J Public Health Res. 2021;10(2): 2157.

12. World Health Organization. Patient safety. [cited October 2022]; Available from: Https://www.Who.Int/health-topics/patient-safety#tab=tab_1 2020.

13. Bowden V, Bradas C, McNett M. Impact of level of nurse experience on falls in medical surgical units. J Nurs Manag. 2019; 27(4): 833-9.

14. Brandao P, Rodrigues S, Nelas L, Neves J, Alves V. [Adverse events and near misses in medical imaging]. Acta Med Port. 2011; 24(1):169-78.

15. Charpiat B, Bedouch P, Conort O, Rose FX, Juste M, Roubille R. [Opportunities for medication errors and pharmacist's interventions in the context of computerized prescription order entry: a review of data published by French hospital pharmacists.] Ann Pharm Fr. 2012; 70(2): 62-74.

.16 Arksey H, O'Malley L. Scoping studies: towards a methodological framework. International Journal of Social Research Methodology. 2005; 8(1):19-32.

17. Peters MD, Marnie C, Tricco AC, et al. JBI Evid Synth. Updated methodological guidance for the conduct of scoping reviews. 2020; 18(10): 2119-26.

18. Flynn EA, Barker KN, Gibson JT, Pearson RE, Berger BA, Smith LA. Impact of interruptions and distractions on dispensing errors in an ambulatory care pharmacy. Am J Health Syst Pharm. 1999; 56(13): 1319-25.

19. de Carvalho M, Vieira AA. [Medical errors in hospitalized patients]. J Pediatr (Rio J). 2002; 78(4): 261-8.

20. Meinberg EG, Stern PJ. Incidence of wrong-site surgery among hand surgeons. J Bone Joint Surg Am. 2003; 85(2):193-7.

21. Berman A. Reducing medication errors through naming, labeling, and packaging. J Med Syst. 2004; 28(1): 9-29.

22. Meaney ME. Error reduction, patient safety and institutional ethics committees. J Law Med Ethics. 2004; 32(2): 358-64.

23. Deans C. Medication errors and professional practice of registered nurses. Collegian. 2005; 12(1): 29-33.

24. Ziv A, Ben-David S, Ziv M. Simulation based medical education: an opportunity to learn from errors. Med Teach. 2005; 27(3): 193-9.

25. Jirapaet V, Jirapaet K, Sopajaree C. The nurses' experience of barriers to safe practice in the neonatal intensive care unit in Thailand. J Obstet Gynecol Neonatal Nurs. 2006; 35(6): 746-54.

26. Hovor C, O'Donnell LT. Probabilistic risk analysis of medication error. Qual Manag Health care. 2007;16(4): 349-53.

27. Hakimzada AF, Green RA, Sayan OR, Zhang J, Patel VL. The nature and occurrence of registration errors in the emergency department. Int J Med Inform. 2008; 77(3): 169-75.

28. Agrawal A. Counting matters: lessons from the root cause analysis of a retained surgical item. Jt Comm J Qual Patient. 2012; 38(12): 566-74.

29. Frith KH, Anderson EF, Tseng F, Fong EA. Nurse staffing is an important strategy to prevent medication errors in community hospitals. Nurs Econ. 2012; 30(5): 288-94.

30. Steyrer J, Schiffinger M, Huber C, Valentin A, Strunk G. Attitude is everything? the impact of workload, safety climate, and safety tools on medical errors: a study of intensive care units. Health Care Manage Rev. 2013; 38(4): 306-16.

31. Barrington MJ, Uda Y, Pattullo SJ, Sites BD. Wrong-site regional anesthesia: review and recommendations for prevention? Curr Opin Anaesthesiol. 2015; 28(6): 670-84.

32. Fraser SG, Adams W. Wrong site surgery. Br J Ophthalmol. 2006; 90(7): 814-6.

33. Stein JE, Heiss K. The Swiss cheese model of adverse event occurrence-closing the holes. Semin Pediatr Surg. 2015; 24(6): 278-82.

34. Chiarini M, De Vita E, Meggiolaro A, et al. [Errors in medicine: perceptions of nursing students in Rome]. Prof Inferm. 2017; 70(4): 206-13.

35. Hartford J, Harrington S. Overcoming a 'never event', a completed audit cycle of 'stop before you block'. Regional Anesthesia and Pain Medicine. 2017; 42(5): e152-e3.

36. Hwang JI, Park HA. Nurses' systems thinking competency, medical error reporting, and the occurrence of adverse events: a cross-sectional study. Contemporary Nurse. 2017; 53(6): 622-32.

37. Babaei M, Mohammadian M, Abdollahi M, Hatami A. Relationship between big five personality factors, problem solving and medical errors. Heliyon. 2018;4(9): e00789.

38. Vrklevski LP, McKechnie L, O'Connor N. The causes of their death appear (unto our shame perpetual): why root cause analysis is not the best model for error investigation in mental health services. J Patient Saf. 2018; 14(1): 41-8.

39. Abbasi F, Pazokian M, Borhani F, Nasiri M. Correlation between workplace culture, learning and medication errors. Revista Latinoamericana de Hipertension. 2019;14(1):102-13.

40. Tigard DW. Taking the blame: appropriate responses to medical error. J Med Ethics. 2019; 45(2):101-5.

41. Lee YJ, Hwang JI. Relationships of nurse-nurse collaboration and nurse-physician collaboration with the occurrence of medical errors. Journal of Korean Academy of Nursing Administration. 2019; 25(2): 73-82.

42. Honno K, Kubo T, Toyokuni Y, Ishimaru T, Matsuda S, Fujino Y. Relationship between the depressive state of emergency life-saving technicians and near-misses. Acute Med Surg. 2020;7(1): e463.

43. Koleva SI. A literature review exploring common factors contributing to never events in surgery. J Perioper Pract. 2020; 30(9): 256-64.

44. Latzke M, Schiffinger M, Zellhofer D, Steyrer J. Soft factors, smooth transport? the role of safety climate and team processes in reducing adverse events during intrahospital transport in intensive care. Health Care Manage Rev. 2020; 45(1): 32-40.

45. Martin-Delgado J, Martinez-Garcia A, Aranaz-Andres JM, Valencia-Martin JL, Mira JJ. How much of root cause analysis translates to improve patient safety. a systematic review. Med Princ Pract. 2020; 29(6): 524-31.

46. Anonymous. Reducing medication errors requires a multifactorial approach. Drugs and Therapy Perspectives. 2004; 20: 22-5.

47. Sorrell JM. Ethics: ethical issues with medical errors: shaping a culture of safety in healthcare. OJIN: The Online Journal of Issues in Nursing. 2017; 22: 2.

48. Noland CM, Carmack HJJQHR. Narrativizing nursing students' experiences with medical errors during clinicals. Qual Health Res. 2015; 25(10): 1423-34.

49. Pezzo MV, Pezzo PP. Physician evaluation after medical errors: does having a computer decision aid help or hurt in hindsight? Med Decis Making. 2006; 26(1): 48-56.