https://doi.org/10.48047/AFJBS.6.2.2024.2333-2342

African Journal of Biological Sciences

Journal homepage: http://www.afjbs.com

Research Paper Open Access

Brief Overview about Medication Administration Errors among Nurses

Iman Tahseen Elsayed Askar, Aida Abdelhamid Hasan, Samah Samir Sheta, Raghda Ali Elshamy

Community, Environmental and Occupational Medicine Department, Faculty of Medicine, Zagazig University
Corresponding author: Iman Tahseen Elsayed Askar
Email: emye83748@gmail.com

Article History

Volume 6, Issue 2, Apr-Aug 2024

Received: 30 July 2024

Accepted: 21 August 2024

Published: 21 August 2024

doi: 10.48047/AFJBS.6.2.2024.2333-2342

Abstract: Background: It is widely acknowledged that nurses are a crucial component of the healthcare system. They are an integral part of clinical services and have primary responsibility for a significant proportion of patient care in most healthcare settings. Medication errors are among the most prevalent health errors threatening patients' safety and are regarded as an index for determining patients' safety in hospitals. An administration error is an error originating during the process directly associated with drug administration at the nursing unit, when a discrepancy occurs between the drug received by the patient and that intended by the prescriber. Patient safety is a significant challenge facing healthcare systems today. Ways to reduce medication errors and enhance patient safety and quality of care have become key topics for discussion worldwide. Drug administration is vital for patient safety, and medication administration errors (MAEs) are directly associated with mortality and morbidity rates. MAEs are reportedly experienced by 2–14% of hospitalized patients and are estimated to kill 7000 patients and injure at least 1.5 million patients per year. In theory all medication errors are preventable and almost a third of unwelcome drug events are preventable. Medication errors are multidimensional problems and for solving them we should find multilateral solutions.We can reduce the medication errors through risk management which it is a daily and continous program for dianosis and intervention. Risk mangement is a problem-centerd approach. The opportunity to learn from these mistakes may, in turn, be lost. Although researchers and experts claim that medication errors should be viewed as a system failure rather than a personal inadequacy , it is unclear to what extent nurses think about the factors contributing to medication errors. Recommendations to prevent medication error include better collaboration between patients and health professionals, wider use of information technology and ensuring that all employees take an active part in developing and improving policies and procedures

Keywords: Medication Errors, Nurses

Introduction

Nurses are prone to occupational hazards in the course of their day to day activities in the health care settings **(1).** Given the nature of nursing working environment, responsibilities and duties, nursing is a uniquely

hazardous occupation, nurses and health care personnel are on the frontline of numerous occupational hazards and are most vulnerable to occupational health hazards in the workplace **(2).**

Hazards are categorized to:

A) Physical hazards, is defined as bodily pain and biological disturbances such as; sleep disturbances, leg pain, back pain, body pain, circulatory disturbances, arm pain, shifts in appetite, digestive disturbances. auditory disturbances, visual disturbances and respiratory disturbances **(2).**

B) Psychological hazards:

Working in shifts and caring of incurable patients puts a considerable psychological, spiritual, and physical pressures on nurses. As a result, fatigue is a common feeling among nurses by 43.4% **(3).**

Psychological hazard is defined as negative self perception, negative outlook on life in general, and shifts in mood such as; irritation with everything, loss of self-confidence, feeling of emptiness, loss of self control, feeling of bitterness, feeling of defeat, crying for no apparent reason, willingness to give everything up, long-lasting feeling of despair, negative image of oneself and difficulties to concentrate**(2).**

Many nurses have reported experiencing high levels of occupational stress in their work environment. Stress, as an outcome of stressful workplaces and tasks, affects nursing behavior in hospital wards **(4).**

Stress has been observed among various professionals, including intensive care unit (ICU) nurses, due to their close contact with patients in distress and at the risk of death. This situation becomes worse due to the need for direct and intensive care **(5).**

Nurses, especially in emergency department, continue to experience high rates of on-the-job violence. According to a 2011 study by the Emergency Nurses Association (ENA), the 53.4% of nurses reported experiencing verbal abuse and more than one in 10 (12.9%) reported experiencing physical violence **(6).**

C) Social hazards, is defined as a feeling of isolation and difficulties in family relationships, such as; family relation difficulties, affective relation difficulties, insensitivity towards others, social life difficulties , find it difficult to make friends, social isolation, difficulty in making decisions regarding personal life, overall disinterest towards others and uncontrolled aggressiveness**(2).**

D) Biological hazards:

Healthcare workers are at high risk of infection from blood-borne pathogens, such as Hepatitis B and C Virus, and Human Immunodeficiency. Occupational exposure to needle-stick injuries (NSIs) continue to have a major health problem in the healthcare systems of developing countries (**7).**

It is estimated that 600000 to 800000 needle-stick injuries occur each year in all healthcare settings**.** Severe acute respiratory syndrome (SARS), tuberculosis, and methicillin resistant staphylococcus infection are other infectious diseases that can afflict nurses **(6).**

E) Chemical hazards may result from patient treatment and maintenance of a proper environment in healthcare settings, which may cause asthma or trigger asthma attacks. Nurses chemical exposure can result from sterilants, cleaning compounds, hazardous drugs, disinfectants, mercury, anesthetic gases, latex etc. Chemical hazards considered unsafe and the most serious, as it's more not easy to detect their short and long term effect on the affected nurse**(8).**

These occupational hazards along with many other problems such as night shifts and sleep deprivation have changed nursing to a dangerous occupation that may explain the high rate of stopping the work in nursing. Some interventions including greater access to patient lifting and transfer devices and more use of safe needle devices can improve the situation. Every healthcare setting should address this important issue and give priority to the safety of nurses **(6).**

Medication Errors

Medication Safety concept:

Medicines play an essential role in treatment of illness, managing chronic conditions and maintaining health and wellbeing. Many of advances in life expectancy and improved patient quality of life are attributed to advancements in the availability and use of medicines. Increased choice of treatments, including the use of high-risk medicines adds complexity, and medication safety needs to be understood in relation to increasingly complex health systems as new treatments can involve multiple medicines and higher risk of medication errors **(9).**

Safety in healthcare settings including medication safety is considered an important and under-researched area around the world (**10)**

Patient safety has long been a major concern for healthcare professionals and its significance has been expanded with the increasing need for hospital accreditation. Among patient safety issues such as patient identification, transfusion error, falls and suicide, medication safety has been considered as a major indicator of health-care quality **(11).**

Medication errors are among the most prevalent health errors threatening patients' safety and are regarded as an index for determining patients' safety in hospitals**.** So, medication safety is an essential component of patient safety in health care delivery and providing strategies to effectively prevent medication errors and adverse drug events in hospitals has gained international recognition **(12).**

Medications are offered through health services all over the world. However, with substantial and increasing medication use comes a growing risk of harm **(9).**

The reality that medical treatment can harm patients is one that the healthcare community has had to come to terms with over recent years. In particular, adverse events associated with medication appear among the chief causes of this harm while patients reside in hospitals. Safety of hospitalized patients in the intensive care units (ICUS) is threatened due to incidents and adverse events, including medication errors. But also, preventable adverse drug events (ADES) occurring during the medication use process in hospitals are associated with additional length of stay and healthcare costs **(13).**

As a consequence, public health emergencies (PHE) can disrupt personal medication practices and increase the risk of medication-related harm and other negative medication-related outcomes. In USA, the medication error-related deaths have been more than the deaths related to the car accidents, breast cancer and human immunodeficiency virus/acquired immune deficiency syndrome **(14)**.

Types of ME

There are a number of different approaches to classifying medication errors. One approach is to base the classification on the stage in the sequence of medication use process, such as prescribing, transcribing, dispensing, administration or monitoring. Another approach classifies errors according to whether they occur from mistakes made when planning actions (knowledge-based or rule-based mistakes) or errors in the execution of appropriately planned actions (action-based errors, known as "slips", or memory-based errors, known as "lapses"). Further approach is to consider the types of errors occurring, such as wrong medication, dose, frequency, administration route or patient **(14)**

Classification of medication errors according to stage of process:

There are five stages of the medication process: (a)ordering/prescribing, (b)transcribing and verifying, (c) dispensing and delivering, (d) administering, and(e) monitoring and reporting. ME could be occurred during (ordering, transcribing, dispensing, administering, or monitoring) of medication process. In hospitals, three fourth of ME occurs at the prescribing and administration stages. However, prescription errors occur at rate 0.1-0.3 errors per patient per day **(15).**

As shown in **Figure 1** the first step in the medication flow procedure is the prescribing of the drug, followed by its dispensing, then administration and finally the monitoring of its effects and side-effects. Accordingly, medication errors can occur at any of these stages. Therefore, medication errors can be conceptualised in terms of the stage at which they occur **(16).**

Figure 1: A simplistic classification of the medication flow stages where a medication error could take place at each of these stages **(16)**

Prescribing/ordering:

Prescription of drugs can be divided into an intellectual part—decision making, i.e. knowledge of diagnosis, interactions, and contraindications, and a technical part including communication of essential information, i.e. drug name, dose, form of administration **(17).**

Of the five stages, ordering/prescribing most often initiates a series of errors resulting in a patient receiving the wrong dose or wrong medication. In this stage, the wrong drug, dose, or route can be ordered, as can drugs to which the patient has known allergies. Workload, knowledge about the prescribed drug, and attitude of the prescriber-especially if there is a low perceived importance of prescribing compared with other responsibilities-are significantly associated with ADES **(17).**

Examples of the types of errors committed in this stage include illegible and/or incomplete orders, orders for contraindicated medications, and inappropriate doses **(18).**

Transcribing, dispensing, and delivering:

In some settings, medication orders are transcribed, dispensed, and then delivered for nurse administration. In certain circumstances and settings, both nurses and pharmacists are involved in transcribing, verifying, dispensing, and delivering medications, Examples of errors that can be initiated at the transcribing, dispensing, and delivering stages include failure to transcribe the order, incorrectly filling the order, and failure to deliver the correct medication for the correct patient **(18).**

Medication administration:

Prescribing and drug administration appear to be associated with the greatest number of medication errors (MEs), whether harm is caused or not. Nurses are primarily involved in the administration of medications across settings ,nurses can also be involved in both the dispensing and preparation of medications (in a similar role to pharmacists), such as crushing pills and drawing up a measured amount for injections. Early research on medication administration errors (MAES) reported an error rate of 60 percent,34 % mainly in the form of wrong time, wrong rate, or wrong dose. In other studies, approximately one out of every three ADEs were attributable to nurses administering medications to patients **(19).**

Monitoring and reporting

Monitoring and reporting is a newly identified stage about which there is little research. Some of the most noted and early work on medication safety found hospitalized patients suffer preventable injury or even death as a result of ADEs associated with errors made during the prescribing, dispensing, and administering of medications to patients **(18).**

Due to the increasing complexity of the medication system, a system that can monitor all stages, from prescribing to administration, is required to assist medication management and reduce medication error. The US was one of the first countries to establish the National Medication Errors Reporting Program (MERP) to monitor medication error. In addition, the National Alert Network (NAN) has also been set up to publish the alerts from MERP to increase the safety of medication use **(20).**

Classification of medication errors based on psychological theory

Classification of medication errors based on psychological theory is to be preferred, as it explains events rather than merely describing them. Its disadvantage is that it concentrates on human rather than systems sources of errors. Psychologists consider an error to be a disorder of an intentional act, and they distinguish between errors in planning an act and errors in its execution. If a prior intention to reach a specified goal leads to action, and the action leads to the goal, all is well. If the plan of action contains some flaw, that is a 'mistake'. If a plan is a good one but is badly executed, that is a failure of skill **(21)**.

This approach yields four broad types of medication error (numbered 1–4 in **Figure 2** . Mistakes can be divided into (i) knowledge-based errors and (ii) rule-based errors. Failures of skill can be divided into (iii) action-based errors ('slips', including technical errors) and (iv) memory-based errors ('lapses').

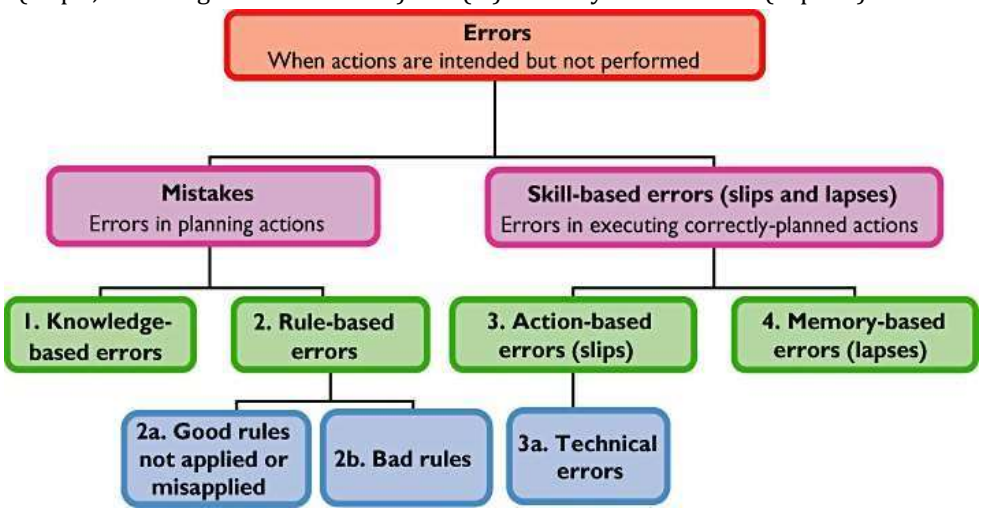

Fig 2: The classification of medication errors based on a psychological approach (reproduced from reference 15, with permission from Wolters Kluwer Health/Adis©; Adis Data Information BV (2006);

Knowledge-based errors can be related to any type of knowledge, general, specific, or expert. It is general knowledge that penicillins can cause allergic reactions; knowing that your patient is allergic to penicillin is specific knowledge; knowing that co-fluampicil contains penicillins is expert knowledge. Ignorance of any of these facts could lead to a knowledge-based error **(22).**

Rule-based errors can further be categorized as (a) the misapplication of a good rule or the failure to apply a good rule; and (b) the application of a bad rule **(23)**.

An action-based error is defined as 'the performance of an action that was not what was intended'. A slip of the pen, when a doctor intends to write diltiazem but writes diazepam, is an example. Technical errors form a subset of action-based errors. They have been defined as occurring when 'an outcome fails to occur or the wrong outcome is produced because the execution of an action was imperfect'. An example is the addition to an infusion bottle of the wrong amount of drug **(22).**

Memory-based errors occur when something is forgotten; for example, giving penicillin, knowing the patient to be allergic, but forgetting **(23)**.

According to studies made in the USA, the most common types of MEs were the following: omission error, improper dose/quantity, prescribing error, unauthorized drug,w rong time, extra dose, wrong patient, wrong drug preparation, wrong dosage form, wrong route, and wrong administration technique **(15).**

Nursing and medication errors:

In hospitals, medication delivery passes through 3 steps, the physician orders the medication, a pharmacist prepares the medication, and the nurse administers it. So, although medication delivery to the patient is not only the responsibility of the nurse, but this step should be paid more attention as; if the physician makes an error (prescription error), there are 2 chances to catch it. If a pharmacist makes an error (preparation error), there is 1 chance to catch it. If the nurse makes an error (administration error), it often reaches the patient **(24).**

In fact, the responsibilities of the nurses are to prepare the medications, administer them to the patient, monitor, evaluate and report any adverse drug reaction (ADR) due to medication **(24).**

During medication administration, nurses play a significant role in securing patient safety. Furthermore, nurses are responsible for checking whether a prescription is appropriate and administering the right medication, with right dose, to the right patient through the right route at the right time (the five rights) **(11).**

Nurses are known to have an important role in ADR reporting and constitute a potentially valuable source for spontaneous ADR reports in hospitals **(25).**

nurses spend 40 percent of their time on average in hospital for giving medicine to their patients **(25).**

Administration error:

An error originating during the process directly associated with drug administration at the nursing unit, when a discrepancy occurs between the drug received by the patient and that intended by the prescriber **(26**).

In general, the errors can be happened in different steps of the medication process, but a considerable number of errors occur during medication administration that registered nurses play a vital role in it because of their responsibility for administering drugs in the hospitals**.** Giving drug is one of the most important, complexes, yet most vital processes of nursing care and it needs the right knowledge and function of nurses. Medication errors can have undesirable consequences for patients such as: Increased length of hospitalization, increased costs of hospitalization, disability and distrust in the healthcare system, severe injury or even patient death **(27).**

To ensure safe drug administration, nurses are encouraged to follow the five rights ('R's; patient, drug, route, time and dose) of medication administration to prevent errors in administration **(28).**

Nurses are primarily involved in the administration of medications across settings. Nurses can also be involved in both the dispensing and preparation of medications (in a similar role to pharmacists), such as crushing pills and drawing up a measured amount for injections **(18).**

Drug administration is an activity that is prone to errors, partly attributed to the rapid development in medical technology, leading to a tremendous increase in types and complexity of medical devices as well as the number of medications being introduced into the market.In addition, there are various routes of administration, different dosages, dosage forms and dosing regimens which are often changed according to the patient's clinical condition and diagnostic test results available **(29).**

The intravenous route of administration carries the highest rate of errors, for example many patients die when taking the cytotoxic drugs intrathecal instead of intravenous**.** In a study performed by **Hughes and Oritz (18)**, they concluded that intravenous drugs have a rate of error exceeding 50% either in the preparation or administration of the drug. The most common type of error identified was the deliberate violation of guidelines when injecting a bolus medication faster than the recommended time of 3-5 minutes.

Medication administration error (MAE) is one of the most common errors in the medication error process and occurs when a discrepancy occurs between the drugs received by the patient and the drugs intended by the prescriber **(30)**

Patient safety is a significant challenge facing healthcare systems today. Ways to reduce medication errors and enhance patient safety and quality of care have become key topics for discussion worldwide. Drug administration is vital for patient safety, and medication administration errors (MAEs) are directly associated with mortality and morbidity rates. MAEs are reportedly experienced by 2–14% of hospitalised patients and are estimated to kill 7000 patients and injure at least 1.5 million patients per year. Despite the efforts by nursing scholars to develop nursing theory and the expansion of practicing arenas by clinical nurses, drug administration remains a traditional task of nurses, consuming up to 40% of work time and involving significant responsibility **(31).**

Nurses and preventing a medication error:

In theory all medication errors are preventable and almost a third of unwelcome drug events are preventable. Medication errors are multidimensional problems and for solving them we should find multilateral solutions. We can reduce the medication errors through risk management which it is a daily and continous program for dianosis and intervention. Risk mangement is a problem-centerd approach **(27).**

The main goals of care in health care systems are preservation and promotion of health **(32).**

Patient safety is one of the main concepts in the field of health care provision and a key factor in maintaining the quality of health care services **(32).**

Preservation of patient safety is a major concern in health care provision systems **(32).**According to **Valentin et al. (33)** one of the important stages of raising the safety level of patients is identification of medication errors and their causes.

Since the Institute of Medicine (IOM) raised awareness about human errors in 2000, many attempts have been made to improve patient safety, such as epidemiological and etiological identification of medication errors**,** identifying the types of errors is the first step toward preventing them **(32).**

It is the nurse's role to provide the best possible quality of care and patient safety**.** Nursing professionals must accept responsibility for reducing errors that occur during the administration of medication. However, shame, guilt and fear of punishment may cause nurses to be reluctant to report mistakes , which makes the analysis of incident reports related to medication errors and any estimation of frequency difficult **(34).**

The opportunity to learn from these mistakes may, in turn, be lost. Although researchers and experts claim that medication errors should be viewed as a system failure rather than a personal inadequacy, it is unclear to what extent nurses think about the factors contributing to medication errors **(34),** Therefore, nursing staff are the first line in MAE prevention**.** Understanding factors related to MEs requires reporting by healthcare workers such as physicians, pharmacists and nurses. Accurate reporting is critical to ensure robust reliable data for improvement efforts. Voluntary reporting is the "primary means of providing early warnings of new types of errors, (and) errors at the interfaces between care providers". To reduce the number of prescribing errors, computerized provider order entry (CPOE) systems have been developed to eliminate illegible orders, unusual dosages and contraindications. This can reduce ordering errors by 93% **(35).**

Recommendations to prevent medication error include better collaboration between patients and health professionals, wider use of information technology and ensuring that all employees take an active part in developing and improving policies and procedures. However, to enhance nurses' involvement in preventing medication errors, health care systems require redesign rather than perpetuating the current traditional systems in which individuals are punished for committing medication errors. Such punitive actions are more prevalent in developing countries **(36).**

Nurses and reporting a medication error:

Underreporting medication errors can impede patient safety improvement as it results in gaps in the knowledge of health care professionals about the factors involved in causing medication errors and, thus,

prevents the hospital from the potentially harmful practice. In the third world and developing countries, it is difficult to acquire accurate estimates due to absence of a proper recording and reporting system and shortage of research information, but experts speculate that the rate of these errors is high, and the increasing number of complaints against health care team in courts and to judicial authorities also confirms this **(37).**

In another study in Saudi Arabia, Alsulami et al. concluded that despite sufficient awareness of medication errors and reporting knowledge, there was significant underreporting among health care professionals **(37).**

The first report related to medication errors was released in 1940 and attracted the attention of authorities.

The reporting of medication errors by nurses is equally important to their prevention. Hence, reporting medication errors is equally important to prevent MAEs. Physicians, nurses, and pharmacists are expected to function without errors,which means that they feel ashamed and inadequate when they make mistakes, as they inevitably do **(38).**

Errors are regarded as someone's fault, caused by a lack of sufficient attention or, worse, a lack of caring. In severe cases, the person at fault may be fired or subjected to retraining **(38).**

Not surprisingly, this "blame and train" approach to medical error has created strong pressure on individuals to cover up mistakes rather than admit them **(38).**

Even if punishment is not overt, the realization that colleagues will regard them as incompetent or careless makes many health professionals reluctant to admit or discuss their errors **(38).**

This is the down side of a laudable goal of professional training: developing a Sense of responsibility for the patient. If you feel personally responsible for a patient, you also feel personally responsible for anything that goes wrong **(38).**

Nursing professionals must accept responsibility for reducing errors that occur during the administration of medication. However, shame, guilt and fear of punishment may cause nurses to be reluctant to report mistakes , which makes the analysis of incident reports related to medication errors and any estimation of frequency difficult .The opportunity to learn from these mistakes may, in turn, be lost.**(34).**

Surveying the opinions and reporting behaviour of nurses with respect to medication errors is necessary to learn more about why and how such errors occur. This in turn may provide important insights that can inform the development of guidelines and procedures for preventing medication errors**.** In order to provide patients with safe healthcare services, a working environment where the reporting system encourages staff to report medication errors without any fear or hesitation and is not punitive is required **(11).**

However, evidence concerning nurses' experiences and perspectives regarding medication error practices is limited and further work is needed to examine this important area of practice. Today there are more than 20 thousand types of drugs in the world that all of them despite their therapeutic effects have Complications and their own instructions. So for that nurses and nursing students should have the necessary information about drugs to avoid potential dangers **(39).**

In addition to the fact that the nursing personnel are more involved in medication administration activities than other health-care workers, identifying the factors contributing to medication errors occurrence from the viewpoint of nurses will help reduce the medication errors to a minimum and enhance the quality of nursing services **(40).**

We highlighted the need to address medication errors among nurses. Establishing educational and training programs on MER for nurses in healthcare centers might assist nurses in comprehending medication errors and reporting their occurrence accordingly. The factors identified should also be considered by policymakers and relevant bodies in addressing medication errors among nurses in the country

References:

1. Shafeek, Z. I., Abdelrahman, S. M., Mohamed, E. A., & Ahmad, F. A. (2023). Relation between Working Hours and Occupational Health Hazard among Staff Nurses at Hospitals. Minia Scientific Nursing Journal, 14(2), 67-76.

2. Sabra, H., & Morsy, S. (2016). Occupational health hazards among nurses at Quena University Hospital. Journal of Nursing and Health Science, 5(3), 28-34.
3. Eldevik, M. F., Flo, E., Moen, B. E., Pallesen, S., & Bjorvatn, B. (2013). Insomnia, excessive sleepiness, excessive fatigue, anxiety, depression and shift work disorder in nurses having less than 11 hours in-between shifts. PloS one, 8(8), e70882.
4. Tajvar, A., Saraji, G. N., Ghanbarnejad, A., Omidi, L., Hosseini, S. S. S., & Abadi, A. S. S. (2015). Occupational stress and mental health among nurses in a medical intensive care unit of a general hospital in Bandar Abbas in 2013. Electronic physician, 7(3), 1108.
5. Preto, V. A., & Pedrão, L. J. (2009). Stress among nurses who work at the intensive care unit. Revista da Escola de Enfermagem da USP, 43, 841-848.
6. Alavi, N. M. (2014). Occupational hazards in nursing. Nursing and midwifery studies, 3(3).
7. Mengistu, D. A., & Tolera, S. T. (2020). Prevalence of occupational exposure to needle-stick injury and associated factors among healthcare workers of developing countries: Systematic review. Journal of occupational health, 62(1), e12179.
8. Elewa, A. H., & El Banan, S. H. A. (2016). Occupational hazards as perceived by nursing interns and protective measures. J Nurs Health Sci, 5(6), 107-18.
9. Duerden, M., Avery, T., & Payne, R. (2013). Polypharmacy and medicines optimisation. Making it safe and sound. London: The King's Fund.
10. McManus, D., & Naughton, B. D. (2020). A systematic review of substandard, falsified, unlicensed and unregistered medicine sampling studies: a focus on context, prevalence, and quality. BMJ global health, 5(8), e002393.
11. Kim, K. S., KWON, S. H., KIM, J. A., & Cho, S. (2011). Nurses' perceptions of medication errors and their contributing factors in South Korea. Journal of nursing management, 19(3), 346-353.
12. Acheampong, F., Anto, B. P., & Koffuor, G. A. (2014). Medication safety strategies in hospitals–a systematic review. International Journal of Risk & Safety in Medicine, 26(3), 117-131.
13. Hug, B. L., Keohane, C., Seger, D. L., Yoon, C., & Bates, D. W. (2012). The costs of adverse drug events in community hospitals. The joint commission journal on quality and patient safety, 38(3), 120-126.
14. Kelishadi, R., & Mousavinasab, F. (2012). Rational use of medicine in the pediatric age group: A summary on the role of clinical pharmacists. Journal of research in pharmacy practice, 1(1), 10.
15. Al Khreem, S. M., & Al-khadher, M. (2021). Perceptions of nurses about medication errors: a cross-sectional study. Journal of Scientific Research in Medical and Biological Sciences, 2(1), 30-41.
16. FRANKLIN, B. D. 2010. Understanding and studying medication error. Available: https://www1.imperial.ac.uk/resources/E6842AC9-18E2-48FD-B94D-37C44514B0A3/cpssq_symposium_20101bdf.pdf (Accessed sep 2023).
17. Dean, B., Schachter, M., Vincent, C., & Barber, N. (2002). Prescribing errors in hospital inpatients: their incidence and clinical significance. Quality and Safety in Health Care, 11(4), 340-344.
18. Hughes, R. G., & Ortiz, E. (2005). Medication errors: why they happen, and how they can be prevented. AJN The American Journal of Nursing, 105(3), 14-24.
19. Kasthuri, P., Chidambaranathan, N., & Venkatesan, L. (2021). Medication Reconciliation. Asian Journal of Diabetology, 22(1), 6-10.
20. Chen, Y., Wu, X., Huang, Z., Lin, W., Li, Y., Yang, J., & Li, J. (2019). Evaluation of a medication error monitoring system to reduce the incidence of medication errors in a clinical setting. Research in Social and Administrative Pharmacy, 15(7), 883-888.
21. Aronson, J. K. (2006). Balanced prescribing. British journal of clinical pharmacology, 62(6), 629.
22. Ferner RE, Langford NJ, Anton C, Hutchings A, Bateman DN, Routledge PA. Random and systematic medication errors in routine clinical practice: a multicentre study of infusions, using acetylcysteine as an example. Br J Clin Pharmacol 2001; 52: 573–7.
23. Hauben M, Aronson JK. Defining 'signal' and its subtypes in pharmacovigilance based on a systematic review of previous definitions. Drug Saf 2009; 32: 99–110.
24. Al-Sarawan, R. A. L. (2014). Medication errors: Nurse's Perceptions of main types and leading factors, and reporting attitudes in North West Bank Governmental Hospitals (Doctoral dissertation).

25. Vallano, A., Cereza, G. R. A. M., Pedròs, C., Agustí, A., Danés, I., Aguilera, C., & Arnau, J. M. (2005). Obstacles and solutions for spontaneous reporting of adverse drug reactions in the hospital. British journal of clinical pharmacology, 60(6), 653-658.
26. Dean, B., Barber, N., & Schachter, M. (2000). What is a prescribing error?. BMJ Quality & Safety, 9(4), 232-237.
27. Gorgich, E. A. C., Barfroshan, S., Ghoreishi, G., & Yaghoobi, M. (2016). Investigating the causes of medication errors and strategies to prevention of them from nurses and nursing student viewpoint. Global journal of health science, 8(8), 220.
28. Edwards, S., & Axe, S. (2015). The 10 'R's of safe multidisciplinary drug administration. Nurse Prescribing, 13(8), 398-406.
29. Chua, S. S., Tea, M. H., & Rahman, M. H. A. (2009). An observational study of drug administration errors in a Malaysian hospital (study of drug administration errors). Journal of clinical pharmacy and therapeutics, 34(2), 215-223.
30. Bifftu, B. B., Dachew, B. A., Tiruneh, B. T., & Beshah, D. T. (2016). Medication administration error reporting and associated factors among nurses working at the University of Gondar referral hospital, Northwest Ethiopia, 2015. BMC nursing, 15, 1-7.
31. Armitage, G., & Knapman, H. (2003). Adverse events in drug administration: a literature review. Journal of nursing management, 11(2), 130-140.
32. Cheragi, M. A., Manoocheri, H., Mohammadnejad, E., & Ehsani, S. R. (2013). Types and causes of medication errors from nurse's viewpoint. Iranian journal of nursing and midwifery research, 18(3), 228-231.
33. Valentin, A., Capuzzo, M., Guidet, B., Moreno, R., Metnitz, B., Bauer, P., & Metnitz, P. (2009). Errors in administration of parenteral drugs in intensive care units: multinational prospective study. Bmj, 338.
34. Tang, F. I., Sheu, S. J., Yu, S., Wei, I. L., & Chen, C. H. (2007). Nurses relate the contributing factors involved in medication errors. Journal of clinical nursing, 16(3), 447-457.
35. Kaushal, R., Bates, D. W., Landrigan, C., McKenna, K. J., Clapp, M. D., Federico, F., & Goldmann, D. A. (2001). Medication errors and adverse drug events in pediatric inpatients. Jama, 285(16), 2114-2120.
36. Mrayyan, M. T., Shishani, K., & AL-FAOURI, I. B. R. A. H. I. M. (2007). Rate, causes and reporting of medication errors in Jordan: nurses' perspectives. Journal of nursing management, 15(6), 659-670.
37. Mohammad Nejad, I., Hojjati, H., Sharifniya, S. H., & Ehsani, S. R. (2010). Evaluation of medication error in nursing students in four educational hospitals in Tehran. Iranian Journal of Medical Ethics and History of Medicine, 3(1), 60-69.
38. Leape, L. L. (2009). Errors in medicine. Clinica chimica acta, 404(1), 2-5.
39. Baghcheghi, N., & Koohestani, H. R. (2008). Nursing Students Errors in Preparation and Administration of Intravenous Drugs. Strides in development of medical education, 5(1), 43-49.
40. Shahrokhi, A., Ebrahimpour, F., & Ghodousi, A. (2013). Factors effective on medication errors: a nursing view. Journal of research in pharmacy practice, 2(1), 18.