Assiut Scientific Nursing Journal
http://asnj.journals.ekb.eg http://www.arabimpactfactor.com
DOI: 10.21608/asnj.2024.317485.1899 http://olddrji.lbp.world/indexedJournals.aspx
https://vlibrary.emro.who.int/journals/assiut-scientific-nursing-journal

Nurses' Perception of Medication Administration Error to Critically Ill Patients

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Abstract:
Medication administration errors are a significant concern in critical care settings due to the high acuity of patients and the complexity of their medication regimens. Several factors have been identified as contributing towards the incidence of medication administration errors among critically ill patients. **Aim of the study:** assess Nurses' perception of medication administration error to critical ill patients. **Design**: cross – sectional observational research design. **Setting:** The study was conducted at Intensive care units of Al-Rajhy hospital at Assuit university hospital. **Sample:** Convienence sample of all Nurses who work in the ICU 38 nurses. **Tools: - Tool I:** nurses personal data. **Tool II:** Nurses' perception of factors associated with medication administration error. **Results**: the result of current study showed that 86.84% of nurses was affected with workload, Regarding Physician related factors 73.68% Physicians change orders frequently Regarding medication related factors there are Polypharmacy 94.7%. Regarding Practice - related factors just 47.36% of nurses administer medication at the right time, Regarding Nurses' perception about environmental factors Lack of adequate staffing compared to the number of patients 97.3%. **Conclusion:** fatigue and workload of nurses, Lack of adequate staffing compared to the number of patients which reflected on administer medication at the right time to the patient and Polypharmacy presented as risk factors of medication administration errors **Recommendations:** Develop and implement protocol for nurses regarding factors associated with medication administration errors.

Keywords: Critically Ill, Medication & Nurses' perception.

Introduction
Unsafe drug practices are the leading source of preventable patient harm in healthcare systems around the world and the majority of this occurs during medication delivery. Nurses have an important role in both the occurrence and prevention of medication delivery errors. **(Wondmieneh et al, 2020)**

Physicians prescribe prescriptions, pharmacists dispense and store medications, and nurses administer those medications. As a result, any medical workers can make errors in drug delivery, and nurses providing the final stage in that cycle. **(Härkänen et al, 2019)** Nurses must deliver medication to patients at the appropriate time, manner, and form. **(Brabcová et al, 2021)**

Medication administration errors (MAEs) are described as "any preventable occurrence that may cause or contribute to improper medication use or adverse effects on patients during the medicine is supervised by a health care provider, patient, or consumers" **(National Coordinating Council for Medication Error Reduction and Prevention, 2020)**

MAEs are caused by a variety of factors, including personal, institutional, substance, and technical difficulties, which can affect patients. **(Prokešová et al, 2022)**

MAEs frequently involve non-administration, wrong medication substitution, wrong dose, structure, and method of handling, delivery of an unprescribed medication, improper medication handling or delivery technique, plus wrong administration of time. **(Jessurun et al, 2023)**

MAEs happen when inadequate medication system and/or human elements such as fatigue, bad circumstances in the environment, or personnel shortages interfere with prescription, transcribing, dispensing, handling, and monitoring procedure, resulting in serious injury, disability, or even death. **(WHO, 2022)**

Causes of MAEs regarding knowledge include inadequate medication knowledge, human circumstances (e.g., exhaustion and complacency), and the surrounding environment (e.g., distractions, severely workload, and instrument design). (**Kuitunen et al, 2021)**

Older age, an overworked healthcare system, a greater number of medications in a prescription, multiple medical conditions, numerous physicians to one patient, and a trainee practitioners all increased the likelihood of medication administration errors occurring. The danger was not substantially connected with a patient's sex, prescription by a physician, the presence of a past medical history, prescription generation using online software, and prescriptions review by a pharmacist in the clinic**. (Rasool et al, 2020)**

MAEs has the ability to lead to harm to the patient. It is the primary reason of threaten trust in the medical system, provoke preventive therapy, and lengthen patients' hospitalization, creates extra cost and maybe death. **(Tsegaye et al, 2020)**

The majority of medication administration errors are avoidable; a skilled healthcare professional's evaluation of the medications can identify these errors, and reconciling can assist eliminate them before they affect the patient. **(Rasool et al, 2020)**

The intensive care unit, also known as the ICU, writes the most prescriptions for medications per patient day. Medication administration errors are more likely due to the complex disease of patients and the changing circumstances of the ICU. **(Laher et al, 2021)**

Medication administration errors are common in the critical care unit, although not always discovered. Errors in providing specialized treatment to extremely ill patients might lead to severe consequences. **(Suclupe et al, 2020)**

Nurses in the ICU are responsible for preparing and administering intravenous drugs. Their observations and opinions may provide valuable insights. This information is crucial for optimizing operations and assessing the viability of technical approaches to prevent major adverse events. **(Beaudart etal., 2023)**

Significance of the study:

Medication administration errors cause increase in the length of stay of hospitalized patients and make disability and even death in 6.5% of hospitals admissions**. (Abukhader & Abukhader, 2020)**

In 2017 WHO report estimates that drug errors spend a lot of billions per year, accounting for 0.7% of overall health expenditures worldwide. **(WHO, 2022)**

Medication administration errors, meaning errors in drug prescriptions, dispensing, and delivery that can or cannot cause harm to patients, account for 78% of significant errors in critical care facilities (ICUs). **(Laher et al, 2021)**

Medical errors represent the third most common cause deaths in the United States. Reporting any medical errors is vital for better understanding the problem and implementing solutions that address fundamental causes. **(Aljabari, Kadhim, 2021)**

Operational definition:

Medication administration errors: refer to any unintentional events that occur during the administration of a medication. Preparations for administration may lead to inappropriate medication usage, patient injury, or even life-threatening situations. **(Ebrahim, et al, 2020)**

Nurses perception: is the degree to which nurses at the healthcare organization accept and adopt a certain plan in order to alter the current status **(El said et al, 2023)**

Aim of the study

Assess Nurses' perception of medication administration error to critically ill patients**.**

Subjects and Methods

Research design:

Cross – sectional observational research design was used to conduct this study. Cross-sectional studies are actually observational studies it evaluate data about the population in a single-point in time and commonly used to assess health outcomes, identify health factors, and describe demographic characteristics. They're important for gathering early evidence in Planning for future higher studies. **(Wang,Cheng, 2020).**

Research question:

What is Nurses' perception of medication administration error to critical ill patients**?**

Setting:

The study was carried out in Intensive care unit of Al-Rajhy hospital at Assuit university hospital. It consists of 2 ICUs; (10 beds in each).

Subjects:

Convienence sample of all nurses who work in the above mentioned setting 38 nurses.

Data Collection Tools:

Tool I: nurses personal data:

This tool was adopted from **(Fathy et al, 2020)** it covered the following areas: age, educational level, and work experience.

Tool II: Nurses perception of factors associated with medication administration error:

This tool was developed by researcher after reviewing relevant literatures **(Beaudart etal., 2023), (Tsegaye etal., 2020) (Taha, Fathy, 2022).** It assessed Nurses perception of factors associated with medication administration error; it consisted of 44 factors divided in two parts:

- **Part I:** It consisted of 16 statements divided into three groups; nurse-related factors, physician-related factors and medication related factors .
- **Part II:** It consisted of 28 statements divided into three groups; Nurses' perception regarding environmental factors, Nurses' perception about

Infusion-pump related factors and Practice - related factors.

Scoring system:

In the previous two parts, participants assessed their agreement with each item on a five-point scale. Likert-type .The scale ranges from 1 (strongly disagree) to 5 (strongly agree). To compute subscale values, add each item's value and divide by the number of elements in the subscale: environmental factors, nurse-related factors, physician-related factors, medication related factors, Infusion – pump related factors and Practice - related factors.

Methods

1. The study began in September 2023, with a literature review, study idea, and tool construction lasting until October.
2. Study tool were developed by the researcher based on national and international related literature
3. Content validity was done by five specialists from the nursing and medical fields at Sohag University who evaluated the tools for clarity, relevance, comprehensiveness, and understanding.
4. The pilot study carried out on 10% of the studied sample (4 nurses) they were used to determine the tools' applicability and clarity as well to estimate time needed to fill in the data collection tools. The data from the pilot study were analyzed; there was no changes made to the tools utilized, nurses from the pilot study were not enrolled in the main research study
5. Reliability of Nurses perception of factors associated with medication administration error tool was assessed in a pilot study by measuring their internal consistency using Cronbach's alpha coefficient method (0.73).

Ethical considerations:

1. The nursing faculty's ethics committee at Assuit University approved the research proposal, Date (27/8/2023) , number (1120230654)
2. The research presented no harm to the study subjects.
3. Confidentiality and privacy of the studied nurses were asserted by the investigator.
4. Explanation of the aim and nature of the study was done to studied nurses.
5. They had the right to refuse participation in the study.
6. Written consent was obtained from nurses who were participated in the study.

Data collection:

- The researcher collected data for six months, from October 2023 to March 2024.
- Nurses personal data were collected from nurses who working in ICU.
- The researcher introduced herself to nurses and explains the purpose and importance of the study so the approval for participation was secured from them.
- All participants were assessed at admission using Tool I. Tool I was utilized to evaluate characteristics of the nurses.
- Tool II assessed risk factors for medication administration errors it include nurses - related factors, physician - related factors, medication - related factors, also assessed Nurses' perception about environmental factors for medication administration errors, Nurses' perception about Infusion-pump related factors for medication administration errors and Practice - related factors

Statistical analysis:

The researcher submitted the data through a personal computer. All data were analyzed using the Statistical Package for the Social Sciences (SPSS) version 26.0 software, and Excel was employed to generate the figures. The researcher examined, classified, and coded the content of each tool. Categorical variables were presented as numbers and percentages, while continuous variables were described using the mean and standard deviation (Mean, SD)

Results:

Table (1): Distribution of the studied nurses according to their personal characteristics (N=38)

Nurses characteristic		No.	%
Age	20 -24	10	26.3
	25 – 30	17	**44.7**
	31- 35	8	21.05
	>35	3	7.89
Educational level	Baccalaureate	4	10.52
	Nursing institute	34	**89.47**

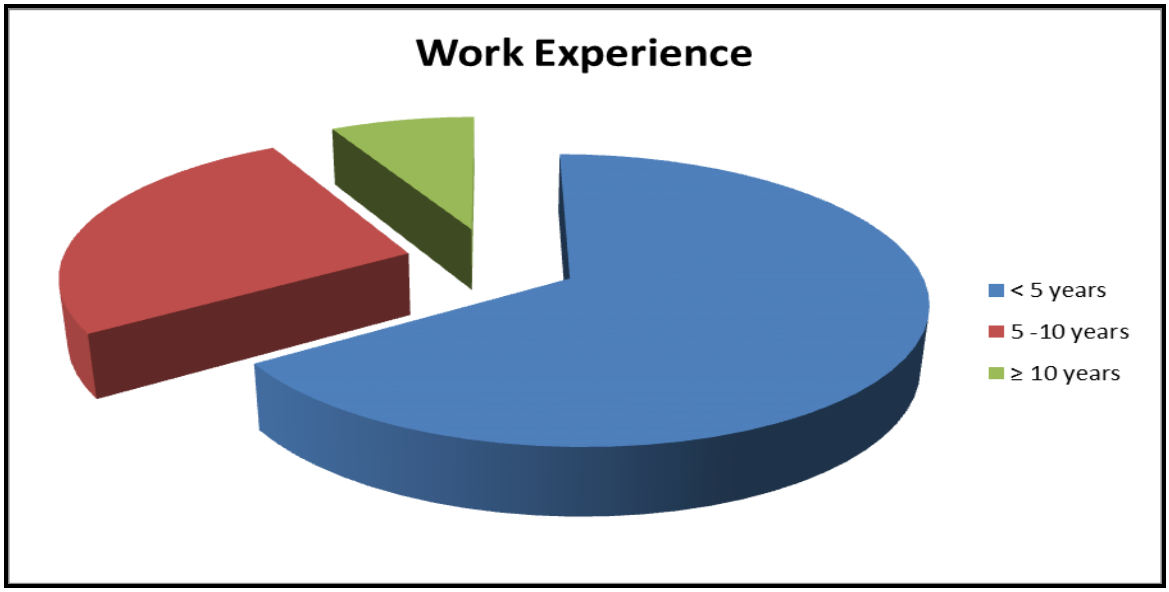

Figure (1): Distribution of the studied nurses perception according to work experience (N =38)

Table (2) Nurses perception of factors associated with medication administration error (N =38)

Agreement rates		
Nurse – related factors	**No**	**%**
Previous training in medication administration	31	81.57
Poor communication between nurses	4	10.52
Workload and fatigue	33	**86.84**
Insufficient knowledge of medication	3	7.89
Wrong reading of the file	2	5.2
Shortage of work experience	3	7.89
Lack of documentation before and after administration	28	73.68
Physician related factors	No	%
Physicians' medication orders are not legible	2	5.2
Physicians change orders frequently	28	**73.68**
Abbreviations are used instead of writing the orders out completely.	4	10.52
Verbal orders are used instead of written orders.	3	7.89
Poor communication between physicians and nurses	2	5.2
Medication related factors	No	%
Unclear medication name	6	15.78
Different medications look alike	25	65.7
Many patients are in the same or similar medication	30	78.94
Polypharmacy—more than 5 prescribed medications	36	**94.7**

Table (3): Nurses perception of factors associated with medication administration error

Nurses' perception about environmental factors	**No**	**%**
Lack of adequate staffing compared to the number of patients.	37	**97.3**
Presence of Frequent staff changes and frequent transfers of care	35	92.1
Urgent admissions of patients	30	78.9
Multiple different caregivers working	35	92.1
Complex environment in ICU	33	86.8
Use of new technologies and treatments in ICU	25	65.7
Time of Shifts: appropriateness of early shift	34	89.4
Time of Shifts: appropriateness of late shift	33	86.8

Nurses' perception about environmental factors	No	%
Nurses' opinion about Infusion – pump related factors		
Problem in the pre-administration process	8	21.05
Presence of Multiple Connections of the infusion pump	33	86.8
Presence of Snapping the correct syringe into the pump	1	2.6
Programming \ choosing the right pump (software)	34	89.47
Infusion pump failure	35	**92.1**
Failure of Device maintenance	22	57.8
Insufficient information about the infusion	2	5.2
Late response to infusion alarm	7	16.6
Practice - related factors		
Checked a valid, prescribed drug in the medication record	36	94.7
Washed hands before handling medication	28	73.6
Prepared the necessary equipment	35	92.1
Double checks the drug name and dosage with the prescribed drug the record	34	89.47
Labeled syringes and bags with prescribed drugs	33	86.8
Checked the expiry date of prescribed drug	28	73.68
Checked the specific instructions before administration	25	65.7
Prepared the dose correctly	37	97.3
Administer medication at the right time.	18	**47.36**
Checked the last time the drug the drug has been administered	30	78.9
Checked the right prescribed dose of each drug in the chart	32	84.2
Checked the prescribed route	33	86.8

Table (1): Regarding nurses personal data, it noticed that 44.7% of the studied nurses aged between 25-30 years, concerning educational level 89.74% of the studied nurses had Nursing institute.

Figure (1): Regarding Work experience, 65.7% of the studied nurses had less than 5 years' experience.

Table (2): Represents distribution of Nurses perception of factors associated with medication administration error. Regarding Nurse - related factors. It noticed that 86.84% of nurses was affected with Workload and fatigue. **Regarding Physician related factors** Physicians change orders frequently, with percentage of 73.68%, **regarding medication related factors,** there are Polypharmacy-more than 5 prescribed medications with percentage of 94.7%, followed by 78.94% many patients are in the same or similar medication.

Table (3): Represents distribution of Nurses perception of factors associated with medication administration error., there are Lack of adequate staffing compared to the number of patients with percentage of 97.3%, **Regarding Nurses' perception** about Infusion – pump related factors 92.1% Infusion pump failure .**Regarding Practice - related factors** just 47.36% of the studied nurse Administer medication at the right time.

Discussion

Medication management is a key aspect of health care that includes prescribing, dispensing, preparing, administering, and monitoring drugs. To ensure safe and optimal drug delivery, health providers and patients must have a comprehensive understanding of the potential harm that medications can cause, as well as how safe practices can help reduce the occurrence of medication errors**.(Hammer et al, 2019)**

Medication errors are accidental and can be prevented or minimized by minimizing risk factors. Patients with persistent illnesses are more likely to experience drug mistakes. **(Rasool et al, 2020)**

Regarding Personal data of studied nurses , The current study verified that more than one third of the studied nurses aged between 25-30 years , more than two third of the of the studied subjects had ursing institute,. this is not similar to **Fathy et al, (2020)** in their study (Nurse's knowledge and Practice regarding Medication Errors in Critical Care Units: Descriptive study) who found that most of nurses, their age ranged between(20-29) years, but regarding nurses level of education nearly two thirds of nurses also were technical institute graduation.

The present study verified that more than two third of the studied nurses had less than 5 years experience. This observation is affirmed with the study done by **Aziz Mamdouh et al, (2020)** who studied (Assessment of Nurses' Performance Regarding the Implementation of Patient Safety Measures in Intensive Care Units) and found that the majority of them had less than 5 years of experience .

Regarding Nurses perception of factors associated with medication administration error, Regarding Nurse - related factors, the current study show that the highest agreement rate of the nurses was regarding to workload and fatigue, the researcher suggested that this was related to Lack of adequate staffing compared to the number of patients. the current result is agreed with **Mekonen et al, (2020)** in study of (Magnitude and associated factors of medication administration error among nurses working in Amhara Region Referral Hospitals, Northwest Ethiopia), reported that Night-shift nurses who work during night time are at greatest risk of sleep deprivation as they have the challenge of their work schedules going against their body's natural circadian rhythm.

This can result in MAEs due to impaired mathematical skills as a result of mental fatigue or decreased observational skills due to fatigue. **Also,** this result is compatible with **Rasool et al, (2020)** who report that Overburden and fatigue can affect the efficiency of health professionals.

In addition, the current study is not similar to the study done by **Manias et al, (2021)** in study of (Associations of person-related, environment-related and communication related factors on medication errors in public and private hospitals: a retrospective clinical audit) and found that less than one third of studied population affected with workload and fatigue.

Regarding Physician related factors, the current study show that more than two third of the studied nurse agreed about that Physicians change orders frequently, this was interpreted with change in patients condition and lab results, this is lined with **Alzoubi et al, (2023)** in their study about (Medication administration error perceptions among critical care nurses: a cross-sectional, descriptive study) and found that more than two third of Physicians change orders frequently.

Regarding medication – related factors, the current study show that more than two third of the studied nurse agreed regarding the presence of Polypharmacy-more than 5 prescribed medications and this was attributed by presence of multiply comorbidities in patients , this was lined with **Rasool et al, (2020)** who studied (Risk Factors Associated With Medication Errors Among Patients Suffering From Chronic Disorders) and found that more than two third of Patients prescribed with five or more drugs .

Moreover, the current result is supported by **Savva et al, (2020)** whose study (Observational Evidence of the Prevalence and Association of Polypharmacy and Drug Administration Errors in Hospitalized Adult Patients) and report that Polypharmacy can be associated with the occurrence of a higher number of MAEs.

Regarding medication-related factors, the current study show that more than two third of the studied nurse agreed regarding the presence of patients on the same or similar medications This was attributed to the similarity of the diagnosis of the patients. This was lined with **Alzoubi et al, (2023)** who study (Medication Administration Error PerceptionsAmong Critical Care Nurses: A Cross-Sectional,Descriptive Study) and found that more than two third of the patients were on the same or similar medications.

Regarding Nurses' perception about environmental factors: the current study show that more than two third of the studied nurse agreed about there are Lack of adequate staffing compared to the number of patients, This was attributed by increase of patients number and shortness of nursing staff .

and that lined with results of **Wondmieneh et al ,(2020)** in study (Medication Administration Errors and Associated Factors Among Nurses) who found that Insufficient staffing (nurse to patient ratio) is represent by two third of results. **Also**, the result is supported by **Beaudart et al., (2023)** who studied (Medication administration errors in the domain of infusion therapy in intensive care units: a survey study among nurses) and reported that high patient-nurse ratio was perceived as the most important risk factor for the occurrence of MAEs.

Regarding Nurses' perception about Infusion – pump : the current study show that more than two third of the studied nurse agreed about there were Infusion pump failure, this was attributed by limitation in resources maintainence , that supported by **Beaudart et al., (2023)** who studied (Medication administration errors in the domain of infusion therapy in intensive care units: a survey study among nurses) and reported that Attention should therefore also be drawn to infusion pump features that were considered as important to reduce MAEs.

Regarding Practice - related factors, the current study show that less than half of the studied nurse agreed about Administer medication at the right time**.** According to investigator opinion, administer medication at wrong time in the current results was related to more than two thirds of the studied nurses agreed about suffering from fatigue and workload. In addition to there are Lack of adequate staffing compared to the number of patients with percentage.

The result is supported by **Beaudart et al., (2023)** who studied (Medication administration errors in the domain of infusion therapy in intensive care units: a survey study among nurses) and reported that wrong time administration errors are the most prevalent error subtypes and can be viewed as a product of systems failures such as workload.

Also the present study is supported by **Tsegaye et al, (2020)** who report that administering medication at a wrong time was the most common type of error.

In addition the current result is affirmed with **Mohammed et al, (2022)** who study (Medication administration errors and associated factors among nurses in Addis Ababa federal hospitals, Ethiopia: a hospital-based cross-sectional study) and found that more than half of founded medication errors were wrong time.

While, the current result is not supported by **Zirpe et al, (2020**) who study (Incidence of Medication Error in Critical Care Unit of a Tertiary Care Hospital: Where Do We Stand?) and found that wrong time (0.5%).

Conclusion:

This study identified that most associated risk factors contributing to medication administration errors were fatigue and workload of nurses and Lack of adequate staffing compared to the number of patients. which reflected on administer medication at the right time to the patient. Also Polypharmacy—more than 5 prescribed medications as risk factors.

Recommendations:

- Develop and implement protocol for nurses regarding factors associated with medication administration errors.
- Conduct Future studies with a bigger sample size of participants and results should be generalized.
- Provide specific guidance on medication double-checking, pharmacology, and identifying the unique needs of critically sick patients.
- Encourage open communication among healthcare teams to address potential pharmaceutical errors without fear of repercussions. Regular interdisciplinary meetings can be helpful.
- Use technology solutions like electronic health records (EHR) and computerized physician order entry (CPOE) to reduce human error. Make sure these technologies are easy to use and incorporate into your daily routines.
- Assess regularly nurse-to-patient ratios and staffing levels to ensure safe medication administration.
- Establish a Culture of Safety: Prioritize patient safety via leadership commitment, continuous training, and recognition of safe practices.

Limitation of the study:

There may be several challenges to performing a study on the assessment of medication delivery errors among critically sick patients. Below are some common restractions to consider:

1. Sample Size: A small sample size may reduce the generalizability of the findings.
2. Researcher can ignore errors, while employees may underreport mistakes out of fear of punishment.
3. Critically ill patients frequently have several comorbidities and are taking multiple drugs, making it difficult to identify particular medication errors and their causes.

References:

- **Abukhader, I., & Abukhader, K. (2020):** Effect of medication safety education program on intensive care nurses' knowledge regarding medication errors. Journal of Biosciences and Medicines, 8(06), 135.
- **Alzoubi, M. M., Al-Mahasneh, A., Al-Mugheed, K., Al Barmawi, M., Alsenany, S., & Farghaly Abdelaliem, S. (2023):** Medication administration error perceptions among critical care nurses: a cross-sectional, descriptive study. Journal of Multidisciplinary Healthcare, 1503-1512.
- **Aljabari, S., & Kadhim, Z. (2021):** Common barriers to reporting medical errors. The Scientific World Journal, 2021(1), 6494889.
- **Aziz Mamdouh, E., Shehata Mohamed, H., & Abdallah Abdelatief, D. (2020):** Assessment of nurses' performance regarding the implementation of patient safety measures in intensive care units. Egyptian Journal of Health Care, 11(1), 82-100.
- **Brabcová, I., Prokešová, R., Tóthová, V., Hajduchová, H., Chloubová, I., Neugebauer, H., & Kubešová, H. (2021):** Use of FMEA analysis in nursing care risk management. Oncology, 15(4), 197-203.
- **Beaudart C, Witjes M, Rood P & Hiligsmann M. (2023):** Medication administration errors in the domain of infusion therapy in intensive care units: a survey study among nursesn Archives of Public Health volume 81, number: 23 (2023), Pp 1-11.
- **El said, A.F., Sayed, K.A., Shokeir, M.E & Soror, M.S (2023):**Nurses' perception toward organizational change and its Relation to work motivation. Tanta scientific journal, 30(3), 12-26.
- **Ebrahim Elsherbiny, O., Mohamed Weheida, S., & Abd-Elrahman Mohamed, E. (2020):** Barriers to Reporting Medication Administration Errors as Perceived by Nurses Working at Mansoura University Hospital: A Cross-Sectional Study. Egyptian Journal of Health Care, 11(2), 1200-1214.
- **Fathy, A., Khalil, N., Taha, N., & M Abd-elbaky, M. (2020):** Nurse's knowledge and practice regarding medication errors in critical care units: descriptive study. Minia Scientific Nursing Journal, 8(1), 111-120.
- **Hammer, A., Wagner, A., Rieger, M., & Manser, T. (2019):** Assessing the quality of medication

documentation: development and feasibility of the MediDocQ instrument for retrospective chart review in the hospital setting. BMJ open, 9(11), e034609.

- **Härkänen, M., Vehviläinen-Julkunen, K., Murrells, T., Rafferty, A., & Franklin, B. (2019):** Medication administration errors and mortality: incidents reported in England and Wales between 2007−2016. Research in Social and Administrative Pharmacy, 15(7), 858-863.
- **Laher, A., Enyuma, C., Gerber, L., Buchanan, S., Adam, A., & Richards, G. (2021):** Medication errors at a tertiary hospital intensive care unit. Cureus, 13(12).
- **Kuitunen, S. K., Niittynen, I., Airaksinen, M., & Holmström, A. (2021):** Systemic defenses to prevent intravenous medication errors in hospitals: a systematic review. Journal of Patient Safety, 17(8), e1669-e1680.
- **Manias, E., Street, M., Lowe, G., Low, J., Gray, K., & Botti, M. (2021):** Associations of person-related, environment-related and communication-related factors on medication errors in public and private hospitals: a retrospective clinical audit. BMC Health Services Research, 21, 1-13.
- **Mekonen, E., Gebrie, M., & Jemberie, S. (2020):** Magnitude and associated factors of medication administration error among nurses working in Amhara Region Referral Hospitals, Northwest Ethiopia. Journal of drug assessment, 9(1), 151-158.
- **Mohammed, T., Mahmud, S., Gintamo, B., Mekuria, Z., & Gizaw, Z. (2022):** Medication administration errors and associated factors among nurses in Addis Ababa federal hospitals, Ethiopia: a hospital-based cross-sectional study. BMJ open, 12(12), e066531. https://doi.org/10.1136/bmjopen-2022-066531
- **National Coordinating Council for Medication Error Reduction and Prevention (2020):** About Medication Errors. NCCMERP. http://www. nccmerp.org/about-medication-errors. accessed 23rd March 2020.
- **Jessurun, J., Hunfeld, N., de Roo, M., van Onzenoort, H., van Rosmalen, J., van Dijk, M., & van den Bemt, P. (2023):** Prevalence and determinants of medication administration errors in clinical wards: a two-centre prospective observational study. Journal of Clinical Nursing, 32(1-2), 208-220.
- **Prokešová, R., Brabcová, I., Tóthová, V., Hajduchová, H., Chloubová, I., Neugebauer, J.,& Velimská, D. (2022):** Use of SWOT analysis to optimize and reduce the risks of the process of administering drugs by nurses in selected departments of South Bohemian hospitals. KONTAKT-Journal of Nursing & Social Sciences related to Health & Illness, 24(1).
- **Rasool, M., Rehman, A., Imran, I., Abbas, S., Shah, S., Abbas, G., & Hayat, K. (2020):** Risk factors associated with medication errors among patients suffering from chronic disorders. Frontiers in public health, 8, 531038.
- **Savva, G., Papastavrou, E., Charalambous, A., & Merkouris, A. (2022):** Observational Evidence of the Prevalence and Association of Polypharmacy and Drug Administration Errors in Hospitalized Adult Patients. The Senior care pharmacist, 37(5), 200–209. https://doi.org/10.4140/TCP.n.2022.200
- **Suclupe, S., Martinez-Zapata, M. J., Mancebo, J., Font-Vaquer, A., Castillo-Masa, A. M., Viñolas, I., & Robleda, G. (2020):** Medication errors in prescription and administration in critically ill patients. Journal of advanced nursing, 76(5), 1192-1200.
- **Taha, N., & Fathy, A. (2022):** Nurses Practices' Errors Regarding Medication Administration in different Critical Care Units at a Teaching Hospital in Upper Egypt.: An Observational study.
- **Tsegaye, D., Alem, G., Tessema, Z., & Alebachew, W. (2020):** Medication administration errors and associated factors among nurses. International journal of general medicine, 1621-1632.
- **Wang, X., & Cheng, Z. (2020):** Cross-sectional studies: strengths, weaknesses, and recommendations. Chest, 158(1), S65-S71. World health organization , (2022) About Medication without harm Available at https://www.who.int/initiatives/medication-without-harm
- **Wondmieneh, A., Alemu, W., Tadele, N., & Demis, A. (2020):** Medication administration errors and contributing factors among nurses: a cross sectional study in tertiary hospitals, Addis Ababa, Ethiopia. BMC nursing, 19, 1-9.
- **World Health Organization (2022):** about medication error available at https://www.who.int/initiatives/medication-without-harm
- **Zirpe, K. G., Seta, B., Gholap, S., Aurangabadi, K., Gurav, S. K., Deshmukh, A. M., & Pandit, E. (2020):** Incidence of medication error in critical care unit of a tertiary care hospital: where do we stand?. Indian journal of critical care medicine: peer-reviewed, official publication of Indian Society of Critical Care Medicine, 24(9), 799.