



RESEARCH ARTICLE

Are There Obstacles Faced by Nurses in Administering High Alert Medication (HAM) Safely? A Scoping Review

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ABSTRACT

High-Alert Medication (HAM) is one of the three main factors causing adverse drug reactions if errors occur in their management or administration. Nurses play a crucial role in ensuring the safety of medication administration. However, there are several barriers that nurses face in identifying and ensuring its safe management and administration. This study aims to summarize the barriers in HAM management and the strategies to enhance its safety based on the perceptions of nurses. This study employs a scoping review, with a systematic literature search conducted across five databases: Scopus, Science Direct, ProQuest, PubMed, and Google Scholar. The search focused on English-language articles from the past six years (2019-2024) that are related to the main topic of discussion. Fourty articles were selected, and 10 (n = 10) were considered relevant to the review after a full-text review. All of the studies were cross sectional studies and more than half of the studies (n = 7) were conducted in Asia. Based on the analysis of 10 articles, the barriers nurses face in managing the administration of HAM include a lack of knowledge and training on its administration and regulations, non-standardized operational procedures, and insufficient interpersonal communication as well as organizational culture regarding safety. **Conclusion:** Improving knowledge, education, training, the establishment of procedures, communication, and organizational culture are some strategies to reduce the barriers nurses face in managing HAM administration.

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1. INTRODUCTION

Currently, patient safety has become one of the important global issues, with an increase in reports of medical errors occurring in patients (Lutfi et al., 2022). Globally, the losses due to medical errors are estimated to reach \$42 billion USD annually (WHO, 2024). Medical errors are predominantly dominated by medication errors, which lead to increased adverse drug reactions (ADR), higher

morbidity and mortality rates, increased costs, and longer hospital stays (Rasool et al., 2020). One of the high-risk factors for incidents of Adverse Drug Reactions (ADR) is the use of High Alert Medication (henceforth HAM) (Kim et al., 2022). The management of HAM administration requires a high level of vigilance and precision to avoid medication administration errors.

HAM is drug that pose a high risk of causing serious adverse effects or even death if not administered correctly (Institute for Safe Medication Practices, 2018). The World Health Organization states that this medication is one of the three main factors contributing to high-risk situations associated with significant hazards due to unsafe medical practices or medication errors (WHO, 2019). It refers to drugs that have the potential to increase the risk of harm to patients if used improperly (Institute for Safe Medication Practices, 2018). It has the potential to increase the risk of harm to patients, with error rates ranging from 0.24 to 89.6 errors per 100 prescriptions (Aradhya et al., 2023). Meanwhile, the overall prevalence of adverse outcomes due to medical errors involving HAM ranges widely from 3.8% to 100%, with a combined prevalence of 16.3%. The severity rates of errors range from 0.1% to 19.2% for moderate errors, 0.2% to 15.4% for serious errors, and 1.9% resulting in fatality for patients (Alves et al., 2021). The National Medication Safety Committee (NMSC) identifies 5 core HAM with the highest reported local errors, namely Insulin, Coagulant, Opioids, Concentrated Electrolytes, and Cytotoxic chemotherapy agents (National Guidelines on High Alert Medications, 2021). The high prevalence rates make identification and prevention efforts critically important.

Nurses, as healthcare providers, are responsible for ensuring patient safety in the use of HAM to prevent medication administration errors. This includes practices such as double-checking, evaluating drug reactions and side effects, and communicating with physicians and pharmacists to ensure accurate and complete information about HAM (Hanson & Haddad, 2023). Common causes of medical errors are medication errors, inadequate communication, lack of knowledge, complex workflow, nurse fatigue, technical failures, and inadequate policies (Cajanding, 2017). The most crucial step in preventing patient harm from HAM is to raise awareness among staff about the presence of these medications in their local practice areas (Aziz et al., 2024). Nurses play a crucial role because they are in a better position to observe patient responses to drug therapy (Hussain et al., 2020).

Several studies have examined the barriers nurses face in managing HAM administration. However, to date, there is no article that summarizes these barriers comprehensively and outlines what can be done to improve the safety of the administration. Nurses require greater support and guidelines to minimize medication errors (He et al., 2022). Based on this fact, the author aims to summarize the barriers in managing HAM and strategies to enhance the safety of its administration based on nurses' perceptions.

2. METHOD

Scoping review is an overview of relevant questions that can be answered using analytical techniques to identify, select, and critically evaluate available research (DistillerSR, 2023). A scoping review search protocol is critically designed based on scientific research to obtain relevant results through searching, identifying, assessing, and evaluating evidence-based studies (Munn et al., 2018). This kind of review is structured using the PRISMA Checklist 2020 guidelines, which consist of a 27-item checklist and a four-phase flow diagram to aid in critically and comprehensively evaluating the study (Sohrabi et al., 2021).

Searching strategy

Literature search was conducted in 5 databases: Google Scholar, ScienceDirect, ProQuest, PubMed, and Scopus. Articles included in this literature review meet the following criteria: (1) focus on barriers nurses face in managing HAM, (2) written in English, (3) published in the last 6 years (2019-

2024), and (4) related to nursing. Experimental studies were selected based on PICO keywords (Table 1).

Table 1: Description of PICO strategy

Acronym	Definition	Description
P	Participant	Nurse or clinical nurse or registered nurse
I/E	Intervention	Barriers or obstacles
C	Control or comparison	No comparison
O	Outcome	High alert medication or high alert medicine and safety medication

Results of the search and quality assessment of articles

Literature search was conducted in 4 databases: ScienceDirect (n=33), Google Scholar (n=28), ProQuest (n=17), PubMed (n=10), and Scopus (n=7). Screening of all articles at each stage was performed by two reviewers, and any disputes were discussed and resolved through consensus. A total of 95 articles were initially identified across the five databases searched within the last 6 years, focusing on open access articles related to nursing journals. After screening, 34 articles were retained, and based on inclusion and exclusion criteria, 10 articles were found suitable for the research topic.

Next, the reviewers conducted screening to assess the eligibility of articles based on inclusion and exclusion criteria (Figure 1). Subsequently, to evaluate the suitability of articles for inclusion, the authors used the Critical Appraisal Skills Programme (CASP) (Critical Appraisal Skills Programme, 2018) and tools called *Centre for Evidence-Based Medicine (CEBM) (Center for Evidence-Based Medicine, 2014)*.

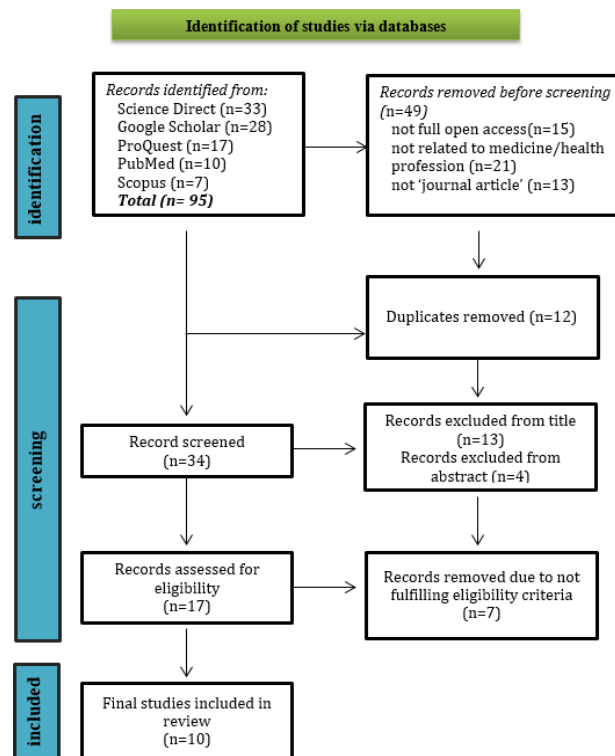


Figure 1: PRISMA flow diagram study selection

3. RESULT

Method

From the 10 selected articles, all studies utilized the cross-sectional research method. These studies were conducted in several countries, including Pakistan (n=2), Nigeria (n=1), China (n=1), Egypt (n=1), Saudi Arabia (n=1), Turkey (n=1), Palestine (n=1), Brazil (n=1), and South Carolina (n=1).

Sample

There are 10 articles included in the study. The first study is conducted by Zyoud et al., (2019) with a sample size of 280 nurses from the emergency department (UGD), ICU, pediatric ward, and medical ward. Similar study was conducted by He et al., (2022) with a sample of 966 nurses, consisting of 336 participants working in the ICU and 330 working in the pediatric ward. Next study was conducted by Salman et al., (2020) with a study sample consisting of 2,363 registered nurses (RNs). Similar study was conducted by Sessions et al., (2019) with a sample size of 18 registered nurses (RNs) in acute care. Another study conducted by Aziz et al., (2024) examined a sample of 133 nurses who have Post-RN qualifications or a BSN degree. The next study is conducted by Mohamed & Abdalla, (2022), with the sample consisting of 88 NICU nurses. Jafaru & Abubakar, (2022), in their research, also utilized a sample of 248 respondents, including registered nurses (RNs), midwives, and participants with post-registration qualifications. The next study was done by Pierobon et al., (2022) that involve 26 nurses. In their research, Taslim et al., (2024) used a sample of 292 working nurses and 126 nursing students. The last study was conducted by ÖZTÜRK et al., (2022) with a sample of 146 healthcare professionals consisting of nurses, healthcare technicians, and pharmacists.

Barriers in managing high alert medicine administration and strategies to enhance HAM safety

Several studies have been conducted to understand the barriers nurses face in managing HAM administration and strategies to enhance its safety. Ten articles have met the inclusion and exclusion criteria.

Table 2: Synthesis grid: barriers in managing high alert medicine administration and strategies to enhance HAM safety

No	Researchers and Countries	Research Design	Objectives	Sample Size	Result
1	Taslim et al., (2024), Saudi Arabia	Cross-sectional	to understand nurses' perceptions regarding cardiovascular treatment with high-risk medications in the Kingdom of Saudi Arabia (KSA).	A sample of 292 working nurses and 126 nursing students in the ICU and emergency department.	The research findings indicate low level of knowledge regarding high-risk cardiovascular medications among nurses. Advanced pharmacology education and curriculum enhancements are necessary in nursing schools to address this issue.
2	Aziz et al., (2024), Pakistan	Cross-sectional	to assess the knowledge and regulation of high-alert medications in the oncology department of a tertiary care hospital.	The sample consists of 133 nurses, with the majority having Post-RN qualifications or a BSN degree.	The results indicate low nurse knowledge, disputes between nurses and doctors, and the absence of standardized operating procedures for HAM. Enhancing nurse education and establishing clear guidelines would be appropriate solutions.

3	Jafaru & Abubakar, (2022), Nigeria	Cross-sectional	to test the correlation between medication safety practices and perceived barriers among nurses in northern Nigeria.	The sample in the study consists of 248 participants, including registered nurses (RNs), registered midwives, and respondents with post-registration qualifications.	Nurse barriers include high workload or patient-nurse ratios, insufficient supervision, coordination, policies, facilities, and patient monitoring after medication administration. There should be policies guiding medication administration in all hospitals.
4	Pierobon et al., (2022), Brasil	Cross-sectional	to assess nurses' knowledge about the administration and regulation of HAM in oncology hospitals in Brazil.	The study involves 26 nurses who meet the inclusion criteria.	Most nurses reported not receiving training in HAM administration. A suitable strategy would involve promoting formal education to train professionals through continuous education on the use of HAM.
5	He et al., (2022), China	Cross-sectional	to assess knowledge in decision-making and decision support needs regarding HAM among pediatric nurses in China.	The study sample consists of 966 nurses, with 336 participants working in the ICU and 330 in the pediatric ward.	The research results indicate a lack of knowledge about HAM and difficulties in decision-making when dealing with HAM. Nurses require support not only through training but also adequate technology, beneficial interprofessional collaboration, and a positive institutional culture.
6	Mohamed & Abdalla, (2022), Mesir	Cross-sectional	to evaluate the effectiveness of nursing guidelines on nurses' performance regarding HAM in the Neonatal Intensive Care Unit (NICU).	The sample consists of 88 NICU nurses who were studied over a period of 6 months.	The research findings indicate that 75% of nurses did not attend training courses on HAM, and there was a lack of guidelines for HAM administration. The implementation of nursing guideline interventions improved the knowledge and practices of neonatal nurses regarding HAM.
7	ÖZTÜRK et al., (2022), Turki	Cross-sectional	to evaluate the reliability of the HAM questionnaires among healthcare professionals in Turkey.	The sample consists of 146 healthcare professionals, including nurses, healthcare technicians, and pharmacists.	Nurse barriers include opinion disputes among pharmacists, nurses, and prescribers, confusing perceptions, and illegible prescriptions when administering HAM. Solutions include improving communication skills, reliable documentation, computerized medication systems, and supervision.
8	Salman et al., (2020), Pakistan	Cross-sectional	to assess the knowledge of HAM among registered nurses in Pakistan.	The study sample consists of 2,363 registered nurses.	The main barriers faced by nurses include receiving uncertain answers from colleagues, lack of availability for consultation, and receiving verbal orders. Recruiting medical experts (clinical pharmacists and pharmacovigilance officers) to ensure consultation and availability of standardized operating procedures for HAM would be beneficial.
9	Zyoud et al., (2019), Palestina	Cross-sectional	to assess the level of knowledge of HAM among nurses in government hospitals in the West Bank, Palestine.	The sample consists of 280 nurses from the emergency department (UGD), ICU, pediatric ward, and medical ward.	The research findings indicate that nurses have insufficient knowledge, inconsistency in opinions between doctors and nurses, and the absence of standardized operating procedures. Establishing standardized operating procedures and regulations, along with additional continuous education and

					professional training, are recommended.
10	Sessions et al., (2019), South Carolina	Cross-sectional	to understand nurses' perceptions regarding support and barriers to the HAM safety.	The sample consists of 18 registered nurses (RNs) in acute care.	The research findings reveal a lack of organizational safety culture, collaboration, as well as RNs competence and engagement. It underscores the importance of intra- and inter-professional collaboration, nurse engagement, and involving patients in HAM safety initiatives.

Here are the obstacles in managing HAM administration and strategies to enhance the safety of its administration in nurses' perceptions (Table 3).

No	Studies	Nurse Barriers	Strategies
1	Taslim et al., (2024)	Lack of knowledge related to high-risk cardiovascular medications and insufficient advanced pharmacology curriculum and education.	The implementation of curriculum and advanced pharmacology education in nursing schools focusing on HAM.
2	Aziz et al., (2024)	Low levels of nurses' knowledge about HAM administration procedures, disputes between nurses and doctors, and the absence of standard operating procedures.	Improving nurse education and establishing clear guidelines.
3	Jafaru & Abubakar, (2022)	High workload or nurse-patient ratio, lack of supervision, coordination, policies, facilities, and patient monitoring after medication administration.	Creating policies that guide HAM administration.
4	Pierobon et al., (2022)	Nurses not attending training on HAM administration.	Promoting formal education and training professionals through continuous education.
5	He et al., (2022)	Lack of knowledge and support in the stages of administering HAM.	Nurses need support in training, adequate technology, and interprofessional collaboration.
6	Mohamed & Abdalla, (2022)	Nurses not attending HAM training and lack of its administration guidelines.	Procurement of training and guidelines for HAM intervention nursing.
7	ÖZTÜRK et al., (2022)	Disagreements among healthcare professionals and illegible prescriptions when administering HAM.	Improving communication skills, reliable documentation, computerized medication systems, and supervision.
8	Salman et al., (2020)	Receiving uncertain answers from colleagues, lack of available experts for consultation, and frequent receipt of verbal orders.	Healthcare facilities should recruit medication experts (clinical pharmacists and pharmacovigilance officers).
9	Zyoud et al., (2019)	Lack of knowledge, collaboration, and absence of standard operating procedures for HAM.	Establishing standard operating procedures, providing continuous education, and professional training on HAM.
10	Sessions et al., (2019)	Lack of organizational culture regarding safety, collaboration, as well as competency and involvement of registered nurses (RNs).	Intra and interprofessional collaboration, nurse involvement, and patient engagement in HAM safety.

4. DISCUSSION

Method

Based on the reviewed articles, ten articles used the cross-sectional research method. Cross-sectional studies measure the outcomes and exposures of research participants simultaneously, and can assess disease prevalence or calculate the Odds Ratio as a measure of the relationship between variables (Wang & Cheng, 2020). This indicates that the cross-sectional research design is most suitable for

identifying and evaluating barriers in managing HAM administration and strategies to enhance its safety from the perspective of nurses.

Sample

From the literature review conducted, the largest sample size found was 2,363, and the smallest sample consisted of 18 subjects. This corresponds to the statement that cross-sectional studies use sample sizes that depend on several factors, and there is no universal answer for determining the sample size (Neerman, 2021). The respondents' characteristics were predominantly registered nurses (RNs) and clinical nurses with work experience in hospitals.

Barriers in the management of HAM administration as perceived by nurses

Several reviewed articles indicate barriers among nurses in managing HAM. Lack of knowledge is identified as one of the challenges nurses face during HAM administration (GÜNEŞ et al., 2021). This theory is consistent with studies conducted by Taslim et al., (2024), Aziz et al., (2024), He et al., (2022) and (Zyoud et al., 2019) stating that nurses lack of knowledge in understanding the procedures for administering and managing HAM, leading to difficulties in HAM administration management.

Challenges to medication safety can occur at every stage of the drug use process, including during collaborative work among healthcare professionals (Grimes & Guinan, 2023). This finding is consistent with the study conducted by (ÖZTÜRK et al., 2022) stating that the most common barriers encountered in medication administration include disagreement between pharmacists, nurses, and prescribers, as well as illegible prescriptions when administering HAM. Furthermore, inconsistency in opinions between doctors and nurses (Zyoud et al., 2019), disputes between nurses and doctors (Aziz et al., 2024), receiving uncertain answers from colleagues, lack of available experts for consultation, and receiving verbal orders (Salman et al., 2020) become additional barriers for nurses in managing HAM administration. Jafaru & Abubakar, (2022) state that high workload or patient-to-nurse ratios, inadequate supervision, coordination, policies, and facilities, as well as insufficient patient monitoring after medication administration will increase medication errors with HAM. Similar study conducted by Sessions et al., (2019) also confirms that nurses face barriers in managing HAM administration due to a lack of organizational culture regarding safety, competency, and RN involvement.

The main cause of medication administration errors is non-standardized standard operating procedures (SOPs) (Puspitasari et al., 2022). This theory is supported by study conducted by Aziz et al., (2024), Zyoud et al., (2019) and Mohamed & Abdalla, (2022) confirming that the absence of standardized operating procedures or guidelines for administering HAM leads to a barrier for nurses in identifying and potentially exacerbating the risk of medication errors. Additionally, inadequate preparation and training are factors that hinder nurses in managing HAM effectively (Farouk Abd El Hafez et al., 2023). This finding is consistent with research conducted by Mohamed & Abdalla, (2022). In the finding, it is stated that nurses do not receive training on HAM. It is also consistent with the study conducted by Pierobon et al., (2022) which finds that there are 57,7% nurses not attending HAM training.

Strategies to improve the safety of HAM management

There are several strategies that can be implemented to improve HAM administration and to reduce barriers in managing its administration among nurses. Key steps include the adoption of clear guidelines and strategies to enhance the quality and safety of medication administration (Wondmieneh et al., 2020). This theory aligns with the research conducted by Pierobon et al., (2022), Aziz et al., (2024) and Taslim et al., (2024) stating that encouraging formal education related to pharmacology curriculum, training professionals through continuous education, and establishing clear guidelines are important steps to reduce the risk of errors in administering HAM. Furthermore,

Mohamed & Abdalla, (2022), Zyoud et al., (2019), Jafaru & Abubakar, (2022) recommend the importance of using standardized nursing intervention guidelines or procedures. Every healthcare facility should recruit medication experts (clinical pharmacists and pharmacovigilance officers) to ensure consultation and availability of HAM standardized operating procedures for the storage, distribution, and administration (Salman et al., 2020).

Interpersonal communication is positively associated with safety perceptions and appears to have an inhibiting effect on threat perception (Dietl et al., 2023). This theory aligns with research findings found in Sessions et al., (2019), ÖZTÜRK et al., (2022) and He et al., (2022) which state that it is crucial to build mutually beneficial intra- and inter-professional collaborations, involve patients, ensure reliable documentation, implement computerized medication systems, utilize adequate technology, and to foster a positive institutional culture to enhance the safety of HAM administration.

5. CONCLUSION

This scoping review provides an overview of several management barriers and strategies to enhance HAM safety from the perspective of nurses. The barriers identified include nurses' lack of knowledge and training regarding administration and regulations, non-standardized standard operating procedures, and insufficient interpersonal communication and organizational safety culture. Strategies to enhance the safety include providing continuous education and training, establishing nursing guidelines/standard operating procedures for HAM administration and regulation, and improving intra- and inter-professional communication.

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REFERENCES

- Alves, S., Cardoso, B. M., Andrade, D., Gonzaga, T. N., Santos, C., Sabrina, Santana, A., Santos, Silva, A. da, Júnior, L., Pereira, D., Filho, O., & Dias, A. (2021). Harm Prevalence Due to Medication Errors Involving High-Alert Medications: A Systematic Review. *Journal of Patient Safety*, 17(1). <https://doi.org/10.1097/PTS.0000000000000649>
- Aradhya, P. J., Ravi, R., Subhash Chandra, B. J., Ramesh, M., & Chalasani, S. H. (2023). Assessment of Medication Safety Incidents Associated with High-alert Medication Use in Intensive Care Setting: A Clinical Pharmacist Approach. *Indian Journal of Critical Care Medicine*, 27(12), 917–922. <https://doi.org/10.5005/jp-journals-10071-24588>
- Aziz, S., Saddique, H., & Tasneem, S. S. (2024). Knowledge about Administration and Regulation of High Alert Medication among Nurses in Oncology Department. *Journal of Health and Rehabilitation Research*, 4(3), 509–513.
- Cajanding, J. M. R. (2017). Administering and monitoring high-alert medications in acute care. *Nursing Standard*, 31(47), 42–52. <https://doi.org/10.7748/ns.2017.e10849>
- Center for Evidence-Based Management. (2014). *Critical Appraisal of a Case Study Appraisal questions*. 2014.
- Critical Appraisal Skills Programme. (2018). *CASP 2018: Checklist for critical appraisal of Studies*.
- Dietl, J. E., Derksen, C., Keller, F. M., Schmiedhofer, M., & Lippke, S. (2023). Psychosocial Processes in Healthcare Workers: How Individuals' Perceptions of Interpersonal Communication Is Related to Patient Safety Threats and Higher-Quality Care. *International Journal of Environmental Research and Public Health*, 20(9). <https://doi.org/10.3390/ijerph20095698>
- DistillerSR. (2023). *The Importance of Systematic Reviews in Nursing*.
- Farouk Abd El Hafez, M., Gamal El-Deen, G., & Mohamed, A. (2023). Nurses' Competence Level toward High Alert Medications in Critical Care Units: Designed Nursing Protocol. *Minia Scientific Nursing Journal*, 013(1), 111–116. <https://doi.org/10.21608/msnj.2023.215598.1062>

- Grimes, T. C., & Guinan, E. M. (2023). Interprofessional education focused on medication safety: a systematic review. *Journal of Interprofessional Care*, 37(1), 131–149. <https://doi.org/10.1080/13561820.2021.2015301>
- Güneş, Ü., Ozturk, H., & Ülker, E. (2021). Nurses' Knowledge Level about High-Alert Medications. *Mehmet Akif Ersoy Üniversitesi Sağlık Bilimleri Enstitüsü Dergisi*, 9(1), 12–20. <https://doi.org/10.24998/maeusabed.803284>
- Hanson, A., & Haddad, L. M. (2023). *Nursing Rights of Medication Administration*.
- He, M., Huang, Q., Lu, H., Gu, Y., Hu, Y., & Zhang, X. (2022). Call for Decision Support for High-Alert Medication Administration Among Pediatric Nurses: Findings From a Large, Multicenter, Cross-Sectional Survey in China. *Frontiers in Pharmacology*, 13(July), 1–9. <https://doi.org/10.3389/fphar.2022.860438>
- Hussain, R., Hassali, M. A., Rehman, A. U., Muneswarao, J., Atif, M., & Babar, Z. U. D. (2020). A qualitative evaluation of adverse drug reaction reporting system in pakistan: Findings from the nurses' perspective. *International Journal of Environmental Research and Public Health*, 17(9), 1–15. <https://doi.org/10.3390/ijerph17093039>
- Institute for Safe Medication Practices. (2018). *ISMP List of High-Alert Medications in Acute Care Settings*.
- Jafaru, Y., & Abubakar, D. (2022). Medication Administration Safety Practices and Perceived Barriers Among Nurses: A Cross-Sectional Study in Northern Nigeria. *Global Journal on Quality and Safety in Healthcare*, 5(1), 10–17. <https://doi.org/10.36401/jqsh-21-11>
- Kim, H. R., Sung, M., Park, J. A., Jeong, K., Kim, H. H., Lee, S., & Park, Y. R. (2022). Analyzing adverse drug reaction using statistical and machine learning methods: A systematic review. *Medicine (United States)*, 101(25), E29387. <https://doi.org/10.1097/MD.00000000000029387>
- Lutfi, I., Fitriani, A. D., Nyorong, M., & Masyarakat, F. K. (2022). Factors Affecting Patient Safety Incidents In Datu Beru Takengon Regional Hospital In 2021. *Science Midwifery*, 10(2), 2721–9453. www.midwifery.iocspublisher.org
- Mohamed, H. R., & Abdalla, S. S. (2022). Effectiveness of Nursing Guidelines on Nurses' Performance Regarding High Alert Medications at Neonatal Intensive Care Units. *Evidence-Based Nursing Research*, 4(2), 54–63. <https://doi.org/10.47104/ebnrojs3.v4i2.241>
- Munn, Z., Stern, C., Aromataris, E., Lockwood, C., & Jordan, Z. (2018). What kind of systematic review should i conduct? A proposed typology and guidance for systematic reviewers in the medical and health sciences. *BMC Medical Research Methodology*, 18(1), 1–9. <https://doi.org/10.1186/s12874-017-0468-4>
- National Guidelines on High Alert Medications. (2021). The National Guidelines on High Alert Medications. *Ministry Of Health Singapore, August*.
- Neerman. (2021). *What determines the Sample Size for Cross-Sectional Surveys?* <https://neerman.org/blogs/what-determines-the-sample-size-for-cross-sectional-surveys/>
- Öztürk, F., Altıparmak, Ö., Torun, B., Bektay, M. Y., Sancar, M., & Okuyan, B. (2022). Reliability of High-Alert Medications Questionnaire in Turkish Healthcare Professionals. *Bezmialem Science*, 10(1), 17–23. <https://doi.org/10.14235/bas.galenos.2020.5238>
- Pierobon, N., Batista, J., Marcondes, L., & da Silva, D. P. (2022). Knowledge of nurses in the administration and regulation of high alert medications in oncology. *Enfermeria Global*, 21(3), 96–108. <https://doi.org/10.6018/eglobal.511881>
- Puspitasari, S. D., Dewanto, A., Holipah, H., & Muliawan, A. I. (2022). Seven Rights of Medication Administration: Nurses' Knowledge, Attitude, and Compliance. *Jurnal Kedokteran Brawijaya*, 31(April 2020), 41–45. <https://doi.org/10.21776/ub.jkb.2021.031.02.9s>
- Rasool, M. F., Rehman, A., Imran, I., & Abbas, S. (2020). *Risk Factors Associated With Medication Errors Among Patients Suffering From Chronic Disorders*. 8(November), 1–7. <https://doi.org/10.3389/fpubh.2020.531038>

- Salman, M., Mustaf, Z. U., Rao, A. Z., Khan, Q.-A., Asif, N., Hussain, K., Shehzadi, N., & Muhammad Farhan Ali Khan, A. R. (2020). Serious Inadequacies in High Alert Medication-Related Knowledge Among Pakistani Nurses: Findings of a Large, Multicenter, Cross-sectional Survey. *Frontiers in Pharmacology*, *11*.
- Sessions, L. C., Nemeth, L. S., Catchpole, K., & Kelechi, T. J. (2019). Nurses' perceptions of high-alert medication administration safety: A qualitative descriptive study. *Journal of Advanced Nursing*, *75*(12), 3654–3667. <https://doi.org/10.1111/jan.14173>
- Sohrabi, C., Franchi, T., Mathew, G., Kerwan, A., Nicola, M., Griffin, M., Agha, M., & Agha, R. (2021). PRISMA 2020 statement: What's new and the importance of reporting guidelines. *International Journal of Surgery*, *88*(March), 39–42. <https://doi.org/10.1016/j.ijssu.2021.105918>
- Taslim, N., Alghamdi, A. T., Alqarni, D. A., Rashid, S., & Edge, D. T. (2024). Comparative assessment of high-risk cardiovascular medication knowledge between practising and student nurses: a descriptive multi-centre study. *Medicinski Glasnik*, *21*(1), 166–174. <https://doi.org/10.17392/1659-23>
- Wang, X., & Cheng, Z. (2020). Cross-Sectional Studies: Strengths, Weaknesses, and Recommendations. *Chest*, *158*(1), S65–S71. <https://doi.org/10.1016/j.chest.2020.03.012>
- WHO. (2019). *Medication safety in high-risk situations*. <https://www.who.int/publications/i/item/WHO-UHC-SDS-2019.10>
- WHO. (2024). *Medication Without Harm*. <https://www.who.int/initiatives/medication-without-harm>
- Wondmieni, 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), 1–9. <https://doi.org/10.1186/s12912-020-0397-0>
- Zyoud, S. H., Khaled, S. M., Kawasmi, B. M., Habeba, A. M., Hamadneh, A. T., Anabosi, H. H., Fadel, A. B., Sweileh, W. M., Awang, R., & Al-Jabi, S. W. (2019). Knowledge about the administration and regulation of high alert medications among nurses in Palestine: A cross-sectional study. *BMC Nursing*, *18*(1), 1–17. <https://doi.org/10.1186/s12912-019-0336-0>