

# Medication Error in the Provision of Healthcare Services: A Serious Public Health Concern

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## Abstract

Medication errors are the most common and widespread medical adverse event that occurs in healthcare settings and can lead to increased patient morbidity, mortality, and healthcare costs. The availability of a wide range of over-the-counter and prescribed medications in the healthcare market, which the general public seems to use on a frequent basis to treat their health complications, has rapidly increased the chances of medication errors. Furthermore, the medication chain has several steps that require different people, and errors can occur at different stages in patient care, from ordering the medication to the time the patient is administered the drug. So each stage of the medication chain is exposed to risks that could result in medication errors. Thereby, medication errors prompt patient harm, preclude immediate discharges, and enhance healthcare costs. As a result, it is important to set up a medication safety culture that can light up in the context of effectively putting strategies into action, and everyone's collaboration and participation to adhering to medication safety strategy can improve patient safety. This review of the literature aims to provide a concept of medication errors, explore the pattern of errors, causes and consequences of errors, and error-related adverse events in all types of healthcare settings, risk factors for medication errors, and strategies to avoid and minimize medication errors.

**Keywords:** medication errors, healthcare services, public health, over-the-counter and prescribed medications

## 1. Introduction

As long as patients have had access to medications, there have been significant safety concerns regarding medication errors. They are a common worry that could lead to significant adverse drug events and rank among the most easily avoided patient injury causes. [1] Medication error is defined by the National Coordinating Council for Medication Error Reporting and Prevention (NCC MERP) as "any preventable event that may cause or lead to improper use of medication or patient harm while the medication is in the control of the health care professional, patient, or consumer." Such occurrences could have to do with systems, procedures, and products used in the health care industry, such as ordering, compounding, dispensing, administration, monitoring, and usage, as well as product labeling, packaging, and nomenclature." [2] This definition is wide and implies that there are several levels at which errors can be avoided. Another definition of medication error is a decrease in the likelihood that a patient will receive timely and effective care, or a rise in the risk of medication-related harm when compared to standard practice. [3]

There are several distinct approaches for 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 is to consider the types of errors occurring, such as wrong medication, dose, frequency, administration route or patient. A further 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"). [4]

An estimated 3.5 million doctor visits and one million emergency department visits are attributed to medication errors, which affect seven million patients annually. Every day, about 500,000 medication errors happen in the US, according to the Florida Health Care Coalition. It is the third leading cause of outpatient visits, after cardiovascular disease and cancer. Medication errors are key determinant to destroy lives in the United States of America than traffic accidents, auto-immunodeficiency syndrome, or breast cancer. Medication-related errors account for 5 to 41.3% of all hospital admissions and 22% of readmissions after discharge worldwide. Several studies on prescription therapy in outpatients and hospitalized patients found that medication errors accounted for 5.4 to 66% of errors. [5] The variation in medication errors between studies is due to patient characteristics, study environment, study settings, methods used for assessing and classifying errors, and prescribing practice. With an increase in the number of drugs, comorbidities, multiple prescribers, and older age, the risk of medication errors (having an unnecessary drug, a non-optimal drug, or a non-optimal dose) increases. [6] Some elderly patients are frail, have multiple disorders, and may use multiple medications (polypharmacy). They may also be exposed to a range of risk factors, including memory issues, diminished medication tolerance, and social and economic issues. Therefore, highly individualized medication treatment and highly individualized care that takes into account individual risk factors and care goals in addition to age-specific approaches should be used to specifically protect older patients from adverse drug outcomes. [7] Medication-related admissions were nearly double in older patients (65 years or older) when compared to younger patients. [8]

Errors may also be classified according to their level of severity. Few literatures search in different countries revealed variation in severity of errors of medication dispensed. According to a study conducted in the United Kingdom, 12% of primary care patients may experience a prescribing or monitoring error over the course of a year. This number rises to 38% for patients 75 years of age and older and 30% for patients who receive five or more medications in a year. Prescription errors were found in 5% of prescriptions as a whole. [9] A study conducted in Sweden discovered a 42% rate of medication errors. Just 1% of errors resulted in an incorrect dose, while two-thirds were related to prescriptions failing to specify the treatment's purpose. [10] A study from Saudi Arabia reported that just under one-fifth of primary care prescriptions contained errors, but only a small minority were considered serious. [11] Another study in Mexico observed that 58% of prescriptions contained errors, with dosage regimen accounting for most cases (27.6%). [12] These examples showed evidence that medication errors are a global issue.

Commonly types of dispensing errors in prescription are: wrong drug dispensed; wrong strength dispensed; wrong form dispensed; wrong quantity dispensed; failure to supply drug; labelling error; wrong drug name on label; wrong strength on label; wrong directions & warnings on label; wrong quantity on label; wrong patient name on label and completely wrong label. [2] Adverse drug reactions, drug-drug interactions, ineffectiveness, inadequate patient adherence, and a poor quality of life and patient experience are signs of undesirable outcomes. Consequently, there could be noteworthy health and financial ramifications, such as heightened utilization of medical services, avoidable medication-associated hospitalizations, and fatalities. [13] It has been estimated that in some countries approximately 6-7% of hospital admissions appear to be medication related, with over two-thirds of these considered avoidable and thus, potentially due to errors. The problem is likely more pronounced in the elderly, because of multiple risk factors, one of which is polypharmacy. [4]

## 2. Statistic of Medication Error

Medication errors can occur at any stage in the medication-use system, including when a drug is prescribed, entered into a computer system, prepared or dispensed, or given to or taken by a patient. [14] Medication errors are mostly common during the ordering or prescribing stage. Typical errors would include healthcare provider writing the incorrect medication, the inappropriate route or dose, or the invalid frequency. Nearly half of all medication errors are occurred due to the ordering errors. [15] For example, the anticoagulant heparin (administered by intravenous route) is considered as one of the highest-risk medications used in the inpatient setting. In order to ensure the safe use of heparin requires weight-based dosing and frequent monitoring of tests of the blood's clotting ability, which may be useful to counteract bleeding complications (if the dose is too high) or clotting risks (if the dose is inadequate). Prescription of heparin with incorrect dosing by a clinician even if a pharmacist detected the mistake before the dose was dispensed, it would be considered a medication error. A potential adverse drug event would occur if the incorrect dose was dispensed and administered but the patient experienced no clinical consequences. If an excessively large dose was administered and the overdose was encountered by aberrant laboratory results, but the patient struggled a bleeding complication as a result of clinicians' failure to intervene accurately, that would be presumed an ameliorable adverse drug event (that is, earlier detection could have reduced the level of harm the patient experienced). [16]

According to statistics, nurses and pharmacists detect 30% to 70% of medication-ordering errors. Medication errors are obviously a widespread problem, but they are mostly avoidable. [15] Medication errors are a worldwide issue that can have serious consequences for patients, particularly those who have acute complex medical conditions. [17] According to the National Patient Safety Agency, medication errors occurred at each stage of the medication treatment process in the UK, with 16% occurring during prescribing, 18% occurring during dispensing, and 50% occurring during drug administration. [18]

According to an Indonesian study, 84% of patients in two hospitals received antibiotics, 15% of which were inappropriate and 42% were unnecessary. [19] A study of drug prescribing to patients aged 60 and up in Indonesia found that 34.3% of antibiotic prescriptions were inappropriate. [20] In Indonesia, studies on medication error rates discovered 1563 medication errors in 770 drug orders. The most common type of error was administration (59%), followed by transcription errors (15%), dispensing errors (14%), and prescribing errors (7%). [21] A Vietnamese study found an insulin administration error rate of 28.8%, with common errors including incorrect administration timing, insulin preparation or administration, and omissions. [22] A longitudinal ten-month study in Vietnam, similar to the Indonesian studies, identified 67.5% of patients receiving antibiotics; of these, 93.2% were in surgical wards—one-third of prescriptions were identified as inappropriate for the notated indication. [23]

### 3. Types of Medication Errors [24,25]

A medication error is a failure in the treatment process that has the potential to lead to, harm to the patient. How to avoid medication error is to consider their classification, which can be contextual, modal, or psychological. Two types of factors are responsible for medication error: Active and latent factors. Medical errors take on many different forms and can happen anywhere in the healthcare system, including pharmacies, nursing homes, and hospitals.

Table 1. Different types of medication errors and their outcome/side effects in healthcare system

| Types of error       | Example  | Outcome/ Medication related side effects   |
|----------------------|--|--|
| Prescribing error    | Irrational, inappropriate, and ineffective prescribing, under prescribing, overprescribing.  | Uncleared patients history, Lack of knowing the present status of patient.                                   |
| prescription errors  | Writing error occurred by physician as it is not clearly prescribed and could not be interpreted between as distinguishing between those who relate everything to a single central vision. | Create confusion for patient.  |
| Action based error   | Being distracted, writing right but misunderstood the name of medicine by nurse.   | Loss of effect. Unnecessary risks for patient (side effects of drug which was unintended to be administered) |
| Technical error      | Writing illegibly so that Suxonium is dispensed instead of Sonexa from Pharmacy.   | Harmful side effects. Under or overtreatment; air embolism.  |
| Administrative error | Taking the drug with wrong dose, wrong route, wrong frequency, wrong duration.   | Adverse drug reaction. Even death also.  |

Agency for Healthcare Research and Quality under the US Department of Health & Human Services classified medication errors into nine categories by alphabetic sequence as shown in Table 2, based on the extent and outcome of the medication errors. In this classification, Categories A to D do not require any intervention or medication therapies. It merely requires monitoring. Whereas, categories E to I necessitate medication and interventional managements for potential life-saving efforts. [26]

Table 2. Types of medication errors based on the extent and the outcome of errors

| Categories | Description   |
|------------|---|
| A          | No medication error occurred but had the capacity for one to occur                        |
| B          | Medication error but did not reach the receiving end, the patient                         |
| C          | Medication error that reached the patient but unlikely to cause any harm, omission errors |
| D          | Medication error that reached patient which needed extra monitoring                       |
| E          | Medication error that cause temporary/reversible harm                                     |
| F          | Medication error that caused harm which needed hospitalization                            |
| G          | Medication error that results in permanent harm   |
| H          | Medication error that required life-saving interventions                                  |
| I          | Medication errors that results in death   |

#### 4. Causes and Consequences of Medication Errors

When hospitals, doctors, pharmacists, nurses, and others are disorganized or communicate improperly, medication errors can happen. They can also occur when a doctor has prescribed a prescription incorrectly. A doctor who is not paying enough attention may make an error in a hastily scribbled order. A pharmacist may also misinterpret what a doctor says on the phone and fill a patient's prescription in a way that the doctor did not intend. Some errors happen when pharmacists misread dosages due to decimal point placement. As a result, a patient may receive a much higher dose than was stipulated. [27] When medications are improperly preserved in pharmacies, errors can occur. Some medications appear to be similar to others but produce vastly different results. These types of errors can occur when a pharmacy is disorganized, with poor storage and labeling. [28]

There are only a few causes of medication errors when prescribing medications to patients. The most common causes of medication errors are drug knowledge dissemination, insufficient availability of patient information, unclear communication, lack of concentration, illegible prescription, prescription misinterpretation, use of too many abbreviations, Look alike Sound alike drugs (LASA), incorrect dosage calculations, overload, and so on. [29] Medication errors may or may not have serious consequences. Some medication errors change a patient's outcome, but the change does not result in any harm. Other medication errors have the potential to cause harm, but they do not actually cause harm. Serious medication errors that are not intercepted, however, will actually harm the patient. [30]

Medication error can have a wide range of consequences, from minor side effects to severe injuries or death. As these types of injuries are entirely preventable, it is essential that patients understand their rights and take precautions to avoid medication errors. [31] For example, a person is given an antibiotic to treat an infection. However, the doctor prescribed the wrong dose and offered too little to take. As a result of the antibiotic's inefficacy, the infection is spread. It has now made its way into the bloodstream and is potentially creating sepsis. So by the time it is realized, the person is in septic shock. In the vast majority of cases, septic shock is life threatening. The person is now facing a fatal condition as a result of a minor infection that could have been managed with the proper antibiotic dose because the doctor did not prescribe the correct dosage. [32]

Furthermore, a patient must bring a complete list of all medications to the doctor's office or the hospital. In addition to any prescription medications, the list of medications includes over-the-counter drugs, vitamins, supplements, and herbs. It is necessary to confirm whether the doctor or nurse reviewed it properly and included it in the medical chart. If there is a history of allergic reactions, this should also be disclosed. During the prescription process, the patient should inquire about the proper dosage regimen, the potential benefit of the drug, its side effects, risk complications, and so on. During a pharmacy store visit, it is essential to verify the information on the prescription bottle to ensure that the medication is the correct drug and dose. [31] If a patient is seriously injured as a result of a prescription error, the patient should also be aware of his or her legal rights. The patient may be able to seek compensation by filing a medical malpractice claim. [31,32]

#### 5. Factors that May Influence Medication Errors

Despite widespread adoption of electronic medication delivery systems, increased skill and competency of doctors and nurses, and a standardized approach to medication administration, errors continue to occur that negatively impacting patients. [33] Several factors may directly or indirectly influence to happen medication errors. (Table-3) [30]

Table 3. Direct or indirect factors influencing to happen medication errors.

| Factors  | Outcome   |
|--|---|
| Factors associated with health care professionals        | <ul style="list-style-type: none"> <li>➤ Lack of therapeutic training</li> <li>➤ Inadequate drug knowledge and experience</li> <li>➤ Inadequate knowledge of the patient</li> <li>➤ Inadequate perception of risk</li> <li>➤ Overworked or fatigued health care professionals</li> <li>➤ Physical and emotional health issues</li> <li>➤ Poor communication between health care professional and with patients</li> </ul> |
| Factors associated with patients                         | <ul style="list-style-type: none"> <li>➤ Patient characteristics (e.g., personality, literacy and language barriers)</li> <li>➤ Complexity of clinical case, including multiple health conditions, polypharmacy and high-risk medications</li> </ul>  |
| Factors associated with the work environment             | <ul style="list-style-type: none"> <li>➤ Workload and time pressures</li> <li>➤ Distractions and interruptions (by both primary care staff and patients)</li> <li>➤ Lack of standardized protocols and procedures</li> <li>➤ Insufficient resources</li> <li>➤ Issues with the physical work environment (e.g., lighting, temperature and ventilation)</li> </ul>   |
| Factors associated with medicines                        | <ul style="list-style-type: none"> <li>➤ Naming of medicines</li> <li>➤ Labelling and packaging</li> </ul>  |
| Factors associated with tasks                            | <ul style="list-style-type: none"> <li>➤ Repetitive systems for ordering, processing and authorization</li> <li>➤ Patient monitoring (dependent on practice, patient, other health care settings, prescriber)</li> </ul>  |
| Factors associated with computerized information systems | <ul style="list-style-type: none"> <li>➤ Difficult processes for generating first prescriptions (e.g. drug pick lists, default dose regimens and missed alerts)</li> <li>➤ Difficult processes for generating correct repeat prescriptions</li> <li>➤ Lack of accuracy of patient records</li> <li>➤ Inadequate design that allows for human error</li> </ul>   |
| Primary-secondary care interface                         | <ul style="list-style-type: none"> <li>➤ Limited quality of communication with secondary care</li> <li>➤ Little justification of secondary care recommendations</li> </ul>  |

## 6. Risk factors for medication errors

There are patient-specific, drug-specific, and clinician-specific risk factors for medication errors. (Table-4) Polypharmacy, or taking more medications than are clinically necessary, is most likely the most significant risk factor for medication errors. It is important to note that in ambulatory care, patient-level risk factors are most likely an underexplored source of medication errors. Several studies have found that both caregivers (including parents of sick children) and patients themselves make medication administration mistakes at alarmingly high rates. [16]

The Institute for Safe Medication Practices keeps a list of high-alert medications having similar names and physical appearances but completely different pharmaceutical properties — can cause significant patient harm if used incorrectly. [34] Traditionally, medication safety has been assessed using the Beers criteria, which define certain classes of medications as potentially inappropriate for geriatric patients. However, the newer STOPP criteria (Screening Tool of Older Person's Inappropriate Prescriptions) have been shown to predict medication errors more accurately than the Beers criteria, making them a better measure of prescribing safety in elderly patients. [16]

Though there are some commonly used medications where the harm outweighs the benefits, such as benzodiazepine sedatives in the elderly- have risks but offer significant benefits when used properly. Other common examples include diabetes medications (such as insulin), anticoagulants (such as warfarin), antiplatelet agents (such as aspirin and clopidogrel), and opioid pain relievers. These four medications account for more than half of all emergency department visits for medication errors in Medicare patients. [16,35]

Table 4. Risk factors related to medication errors

| <b>Patient-specific</b>                |  |
|--|--|
| Age related [16]                       | Elderly patients are especially vulnerable to medication errors because they take more medications and are more vulnerable to specific medication side effects than younger patients.<br>Pediatric patients are also at increased risk, particularly when hospitalized, because many medications for children must be dosed based on their weight.   |
| Health literacy and numeracy [36]      | Parents with low levels of health literacy were more likely to make medication errors than those with adequate levels of health literacy. Parents with low health literacy levels were unable to comprehend the treatment steps and prescribed medications, resulting in medication errors (such as wrong time and wrong dose).<br>It is known that the risk of being affected by medication errors is more in children compared to adults. In the 0-1 age group, immaturity continues in all systems and the health literacy of parents can be directly correlated with the health status of their children.        |
| <b>Drug-specific</b>                   |  |
| Higher number of prescribed drugs      | The World Health Organization recommends a maximum of three drugs in a prescription as optimal therapy. [37] A large number of patients were given more than five medications. It is a known risk factor for medication error. The risk of error increased from 17 to 66% as the number of drugs in a prescription increased from two to sixteen. [5]  |
| Comorbidities                          | Comorbidities were linked to a higher risk of medication errors. Comorbidities increase patient interaction with healthcare professionals, and patients use more medicines for a longer period of time. [5]  |
| <b>Clinician-specific risk factors</b> |  |
| Complex work environment               | Workload was also found to be significantly related to an increase in the risk of medication errors. Overburdening and fatigue can have an impact on the effectiveness of health professionals and lead to a failure of a medication step e.g. checking-rechecking method. [5,38] Institutional policies and protocols, fear of lawsuits or disciplinary actions, blame culture, a lack of knowledge about the utility of reporting medication errors, and a lack of information on how to report medication errors are all factors that contribute to health care providers under-reporting medication errors. [39] |
| Emergency admissions                   | Risk of an adverse event increases by approximately 6% per day [40]  |
| Multiple care providers                | Challenges the integration of different care plans [40]  |

**7. Prevention of Medication Errors**

Medical errors and drug-administration errors cause substantial patient risks, contributing to avoidable patient deaths in the hospital setting. To ensure patient safety and avoid medication errors, pharmacists, nurses, and other healthcare professionals must follow the "five rights" of medication use: the right patient, drug, dose, time, and route. [41] Preventing medication errors necessitates specific steps to ensure safety at each stage of the pathway. (Table-5).

Table 5. Strategies to Prevent medication errors [16]

| <b>Stage</b> | <b>Safety Strategy</b>   |
|--------------|--|
| Prescribing  | <ul style="list-style-type: none"> <li>• Avoid unnecessary medications by adhering to conservative prescribing Principles.</li> <li>• Computerized provider order entry, especially when paired with clinical decision support systems.</li> <li>• Medication reconciliation at times of transitions in care.</li> </ul> |
| Transcribing | <ul style="list-style-type: none"> <li>• Computerized provider order entry to eliminate handwriting errors</li> </ul>  |
| Dispensing   | <ul style="list-style-type: none"> <li>• Clinical pharmacists to oversee medication dispensing process</li> <li>• Use of "tall man" lettering and other strategies to minimize confusion between look-alike, sound-alike medications</li> </ul>  |

|                |   |
|----------------|---|
|                | <ul style="list-style-type: none"> <li>Automated dispensing cabinets for high-risk medications.</li> </ul>  |
| Administration | <ul style="list-style-type: none"> <li>Adherence to the "Five Rights" of medication safety (administering the Right Medication, in the Right Dose, at the Right Time, by the Right Route, to the Right Patient)</li> <li>Barcode medication administration to ensure medications are given to the correct patient</li> <li>Minimize interruptions to allow nurses to administer medications safely</li> <li>Smart infusion pumps for intravenous infusions</li> <li>Multicompartment medication devices for patients taking multiple medications in ambulatory or long-term care settings</li> <li>Patient education and revised medication labels to improve patient comprehension of administration instructions</li> </ul> |

## 8. Conclusion

The majority of morbidity and mortality occur from medication errors, which are the most common adverse events in hospitals. This is especially true in developing nations where a shortage of medical professionals affects the proper prescription, dispensing, administering, and monitoring of medication. Developing strategies to enhance medication safety can be aided by knowing the locations and contributing factors of medication errors. Government, healthcare providers, patients, researchers, and health services will all need to make a sustained commitment and concerted effort to address this problem.

## References

- [1] Lopes, J., Joaquim, J., Matos, C., & Pires, T. (2015). Medication errors in Community Pharmacy: Potencial Causes and strategies for Prevention. *Clinical Therapeutics*, 37(8), e119. <https://doi.org/10.1016/j.clinthera.2015.05.341>
- [2] *Medication error definition*. Nccmerp.org. Retrieved from <https://www.nccmerp.org/about-medication-errors>
- [3] Dean, B., Barber, N., & Schachter, M. (2000). What is a prescribing error? *Qual Health Care*.2000;9:232-7. *Qual Health Care*, 9, 232-237.
- [4] Technical series on safer primary care medication errors: Technical series on safer primary care. Who.int. Retrieved from <https://apps.who.int/iris/rest/bitstreams/1070139/retrieve>
- [5] Rasool, M. F., Rehman, A. ur, Imran, I., Abbas, S., Shah, S., Abbas, G., Khan, I., Shakeel, S., Ahmad Hassali, M. A., & Hayat, K. (2020). Risk factors associated with medication errors among patients suffering from chronic disorders. *Frontiers in Public Health*, 8. <https://doi.org/10.3389/fpubh.2020.531038>
- [6] Kovačević, M., Vezmar Kovačević, S., Miljković, B., Radovanović, S., & Stevanović, P. (2017). The prevalence and preventability of potentially relevant drug-drug interactions in patients admitted for cardiovascular diseases: A cross-sectional study. *International Journal of Clinical Practice*, 71(10), e13005. <https://doi.org/10.1111/ijcp.13005>
- [7] Fialová, D., Kummer, I., Držaić, M., & Leppee, M. (2018). Ageism in medication use in older patients. In *International Perspectives on Aging* (pp. 213-240). Springer International Publishing.
- [8] Leone, R., Magro, L., Moretti, U., Cutroneo, P., Moschini, M., Motola, D., Tuccori, M., & Conforti, A. (2010). Identifying adverse drug reactions associated with drug-drug interactions: Data mining of a spontaneous reporting database in Italy. *Drug Safety: An International Journal of Medical Toxicology and Drug Experience*, 33(8), 667-675. <https://doi.org/10.2165/11534400-000000000-00000>
- [9] Avery, A. A., Barber, N., Ghaleb, M., Franklin, D., & Crowe, A. S. (2012). Investigating the Prevalence and Causes of Prescribing Errors in General Practice: the Practice Study. *General Medical Council*.
- [10] Claesson, C. B., Burman, K., Nilsson, J. L. G., & Vinge, E. (2011). Prescription errors detected by Swedish pharmacists. *The International Journal of Pharmacy Practice*, 3(3), 151-156. <https://doi.org/10.1111/j.2042-7174.1995.tb00809.x>
- [11] Khoja, T., Neyaz, Y., Qureshi, N. A., Magzoub, M. A., Haycox, A., & Walley, T. (2011). Medication errors in primary care in Riyadh City, Saudi Arabia. *La Revue de Sante de La Mediterranee Orientale [Eastern Mediterranean Health Journal]*, 17(2), 156-159. <https://doi.org/10.26719/2011.17.2.156>
- [12] Zavaleta-Bustos, M., Castro-Pastrana, L. I., Reyes-Hernández, I., López-Luna, M. A., & Bermúdez-Camps, I. B. (2008). Prescription errors in a primary care university unit: urgency of pharmaceutical care in Mexico. *Revista Brasileira de Ciências Farmacológicas*, 44(1), 115-125. <https://doi.org/10.1590/s1516->

93322008000100013

- [13] Masotti, P., McColl, M. A., & Green, M. (2010). Adverse events experienced by homecare patients: a scoping review of the literature. *International Journal for Quality in Health Care*, 22(2), 115-125. <https://doi.org/10.1093/intqhc/mzq003>
- [14] Medication errors statistics 2023. (2021, May 2). The Checkup. Retrieved from <https://www.singlecare.com/blog/news/medication-errors-statistics/>
- [15] Tariq, R. A., Vashisht, R., Sinha, A., & Scherbak, Y. (2023). *Medication dispensing errors and prevention*. StatPearls Publishing.
- [16] Larrea Urtaran, X., Pérez Plasencia, A., Coma Punset, M., Dordà Benito, A., Ortí Juan, C., Nogue Pujadas, E., López Noguera, Q., Gratacos Santanach, L., Subirana Batlle, C., & Sacrest Güell, R. (2022). 5PSQ-104 Voluntary electronic reporting of medication errors and adverse drugs events during the first year of the COVID-19 pandemic. *Section 5: Patient Safety and Quality Assurance*.
- [17] Alsulami, Z., Conroy, S., & Choonara, I. (2013). Medication errors in the Middle East countries: A systematic review of the literature. *European Journal of Clinical Pharmacology*, 69(4), 995-1008. <https://doi.org/10.1007/s00228-012-1435-y>
- [18] Safety in Doses: Improving the Use of Medicines in the NHS. London: NPSA (2006). *National Patient Safety Agency. The Report from the Patient Safety Observatory*.
- [19] Marjadi, B., & McLaws, M. L. (2010). Rural Indonesian health care workers' constructs of infection prevention and control knowledge. *American Journal of Infection Control*, 38(5), 399-403. <https://doi.org/10.1016/j.ajic.2009.11.010>
- [20] Navoa-Ng, J. A., Berba, R., Galapia, Y. A., Rosenthal, V. D., Villanueva, V. D., Tolentino, M. C. V., Genuino, G. A. S., Consunji, R. J., & Mantaring, J. B. V., 3rd. (2011). Device-associated infections rates in adult, pediatric, and neonatal intensive care units of hospitals in the Philippines: International Nosocomial Infection Control Consortium (INICC) findings. *American Journal of Infection Control*, 39(7), 548-554. <https://doi.org/10.1016/j.ajic.2010.10.018>
- [21] Ernawati, D., Lee, Y. P., & Hughes, J. (2014). Nature and frequency of medication errors in a geriatric ward: an Indonesian experience. *Therapeutics and Clinical Risk Management*, 413. <https://doi.org/10.2147/term.s61687>
- [22] Nguyen, H.-T., Nguyen, T.-D., Haaijer-Ruskamp, F. M., & Taxis, K. (2014). Errors in preparation and administration of insulin in two urban Vietnamese hospitals: an observational study: An observational study. *Nursing Research*, 63(1), 68-72. <https://doi.org/10.1097/NNR.0000000000000010>
- [23] Thu, T. A., Rahman, M., Coffin, S., Harun-Or-Rashid, M., Sakamoto, J., & Hung, N. V. (2012). Antibiotic use in Vietnamese hospitals: a multicenter point-prevalence study. *American Journal of Infection Control*, 40(9), 840-844. <https://doi.org/10.1016/j.ajic.2011.10.020>
- [24] Cohen, M. R. (2023). Medication errors. *Nursing*, 53(9), 64. <https://doi.org/10.1097/01.NURSE.0000946872.45300.63>
- [25] Aronson, J. K. (2009). Medication errors: what they are, how they happen, and how to avoid them. *QJM: Monthly Journal of the Association of Physicians*, 102(8), 513-521. <https://doi.org/10.1093/qjmed/hcp052>
- [26] Jessurun, J. G., Hunfeld, N. G. M., de Roo, M., van Onzenoort, H. A. W., van Rosmalen, J., van Dijk, M., & van den Bemt, P. M. L. A. (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. <https://doi.org/10.1111/jocn.16215>
- [27] Medication mistakes can have serious consequences. (2022, April 13). *Raynes & Lawn Trial Lawyers*. <https://rayneslaw.com/medication-mistakes-can-have-serious-consequences/>
- [28] Hughes, R. G., & Ortiz, E. (2005). Medication errors: why they happen, and how they can be prevented. *Journal of Infusion Nursing: The Official Publication of the Infusion Nurses Society*, 28(2 Suppl), 14-24. <https://doi.org/10.1097/00129804-200503001-00005>
- [29] American society of hospital pharmacists. ASHP guidelines for preventing medication errors in hospitals. (1993). *Am J Hosp Pharm*, 50, 305-314.
- [30] Rogers, E., Griffin, E., Carnie, W., Melucci, J., & Weber, R. J. (2017). A Just Culture approach to managing



- medication errors. *Hospital Pharmacy*, 52(4), 308-315. <https://doi.org/10.1310/hpj5204-308>
- [31] Mulac, A., Taxis, K., Hagesaether, E., & Gerd Granas, A. (2021). Severe and fatal medication errors in hospitals: findings from the Norwegian Incident Reporting System. *European Journal of Hospital Pharmacy. Science and Practice*, 28(e1), e56–e61. <https://doi.org/10.1136/ejhpharm-2020-002298>
- [32] Gladstein, S. (2019, September 22). *Consequences of medication errors - gladstein law firm, PLLC*. Gladstein Law Firm; Gladstein Law Firm, PLLC. <https://gladsteinlawfirm.com/blog/what-are-the-consequences-of-medication-errors/>
- [33] Morelock, S. (2016, August 2). Factors influencing nurse medication errors. *RN Journal*. <https://rn-journal.com/journal-of-nursing/factors-influencing-nurse-medication-errors>
- [34] Michalek, C., Paparella, S., & Mandrack, M. (2022) *High-alert medications heparin, concentrated electrolytes and magnesium: Practical strategies in pursuit of safety*. Ismp.org. Retrieved from <https://www.ismp.org/sites/default/files/attachments/2022-01/Baxter%20High%20Alert%20Part%202%20handouts.pdf>
- [35] Rankin, A., Cadogan, C. A., Patterson, S. M., Kerse, N., Cardwell, C. R., Bradley, M. C., Ryan, C., & Hughes, C. (2018). Interventions to improve the appropriate use of polypharmacy for older people. *The Cochrane Library*, 2018(9). <https://doi.org/10.1002/14651858.cd008165.pub4>
- [36] Tek, S., & Topuz, A. (n.d.). *The effect of the health literacy levels of parents on medication errors*. Internationaljournalofcaringsciences.org. Retrieved December 27, 2023, from [http://www.internationaljournalofcaringsciences.org/docs/64\\_tek\\_original\\_14-2.pdf](http://www.internationaljournalofcaringsciences.org/docs/64_tek_original_14-2.pdf)
- [37] Promoting rational use of medicines. WHO.int. Retrieved from [http://www.who.int/medicines/areas/rational\\_use/en/](http://www.who.int/medicines/areas/rational_use/en/)
- [38] Efstratios, A. (2014). An inside look into the factors contributing to medication errors in the clinical nursing practice. *ICUS and Nursing Web Journal*, 8(1), 0-0. Retrieved from <https://www.itmedicalteam.pl/articles/an-inside-look-into-the-factors-contributing-to-medication-errors-in-the-clinical-nursing-practice-105510.html>
- [39] Damin Abukhalil, A., Amer, N. M., Musallam, L. Y., & Al-Shami, N. (2022). *Medication error awareness among health care providers in Palestine: A questionnaire-based cross-sectional observational study*. *Saudi Pharmaceutical Journal: SPJ: The Official Publication of the Saudi Pharmaceutical Society*, 30(4), 470-477. <https://doi.org/10.1016/j.jsps.2022.01.014>
- [40] Moyen, E., Camiré, E., & Stelfox, H. (2008). Clinical review: Medication errors in critical care. *Critical Care (London, England)*, 12(2), 208. <https://doi.org/10.1186/cc6813>
- [41] Saljoughian, M., & PhD Department of Pharmacy Alta Bates Summit Medical Center Berkeley. (2020, June 18). *Avoiding medication errors*. Uspharmacist.com. Retrieved from <https://www.uspharmacist.com/article/avoiding-medication-errors>

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