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Risk Factors, Causes, and Strategies for Reducing Medication Errors: A Narrative Review

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***Abstract*— Medication errors, which refer to any deviation from the prescribed medication regimen, can have seriously affected patient safety and treatment outcomes. It underscores the need for healthcare professionals to follow medication orders precisely and to be vigilant in preventing errors throughout the medication use. This process involves different stakeholders, including specialists, therapists, apothecaries, patients, and their relatives. Medication errors tend to be more prevalent in hospital settings due to various factors related to the complexity of patient care, the fast-paced environment, and the involvement of multiple healthcare professionals in the medication process. The current review was conducted for reporting medication errors, risk factors, causes, and strategies for reducing medication errors in previous articles from 2015 to 2023. The brief review showed that multiple studies have reported a high incidence of medication errors following hospital discharge. These errors can include prescribing errors, incorrect dosing, medicine interactions, and omissions or duplications of medication. Medication errors following hospital discharge can lead to adverse drug events, which can result in patient harm, hospital readmissions, and increased healthcare costs. Also; some studies have evaluated the effectiveness of transitional care interventions and strategies in reducing medication errors and adverse drug events (ADEs). These interventions can include medication reconciliation processes, post-discharge follow-up, patient education programs and electronic medication management system. By addressing these interventions, future studies and interventions can contribute to improving medication safety following hospital discharge and advancing the global safety agenda.**

Keywords*— *Medication errors, prescribing, patient, hospitals

I. INTRODUCTION

Medication errors are usually termed aberrations from the physician's medication order as reported on the patient's blueprint. In hospitals, medication errors occur at a value of around one per patient per day [1- 3]. A dispensing errors occurs by the pharmacy team when dispensing medications to medical units or instantly to patients in an ambulatory-care pharmacy; the errors- values - for doses supplied by the cart-filling procedure compass from nearly 0.85% to 3% [4-9]. Medication errors can lead to various adverse outcomes such as prolonged hospitalization, increased treatment costs, and even fatalities [10-12]. The statistics from the United Kingdom and the United States underscore the magnitude of the problem, with a substantial number of people affected by medication errors annually and a significant number of deaths attributed to these errors [13-15]. Moreover, medication errors can erode patients' trust in healthcare services and impose substantial financial burdens on the healthcare sector. The wide range of costs associated with medication errors, as indicated in previous studies, demonstrates that a significant proportion of medication errors occur during the delivery of medication to the patient [16-18]. This underscores the importance of implementing robust medication management processes and ensuring accuracy and safety at every stage of the medication use process to mitigate the risks associated with medication errors. [19-25]. Medication errors can occur at various stages of the medication use process, involving different stakeholders, including specialists, therapists, apothecaries, patients, and their relatives [26-27]. Specialist's prescriptions; when a patient visits a specialist (e.g., a doctor, they may receive a prescription for medication). Errors can happen at this stage if the specialist makes mistakes in diagnosing the condition, choosing the wrong medication, or prescribing the wrong dosage or instructions. Therapist's application of Drug Plans; if the patient receives treatment from a therapist (e.g., physical therapist, occupational therapist), the therapist may be responsible for administering medications as part of the treatment plan. Errors may occur if the therapist misinterprets the prescription, administers the wrong medication, or fails to monitor the patient's response to the medication [28]. Apothecary's Reading of Instructions in Pharmacies; The apothecary or pharmacist plays a crucial role in dispensing medications to patients. Errors can happen at this stage if the pharmacist misreads the prescription, dispenses the wrong medication or dosage, provides incorrect instructions, or fails to recognize potential drug interactions. Patients Themselves; Patients also have a role in preventing medication errors. They must follow the instructions provided by the healthcare provider or pharmacist carefully. Errors may occur if patients misinterpret instructions, forget to take their medication, take the wrong dosage, or misuse medications. Patients' Relatives;

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Family members or caregivers who are involved in the patient's medication management can also contribute to errors. If they misunderstand instructions, give the wrong medication, or mix up dosages, it can lead to adverse effects [29- 30]. Medication errors tend to be more prevalent in hospital settings due to various factors related to the complexity of patient care, the fast-paced environment, and the involvement of multiple healthcare professionals in the medication process [31- 33]. Moreover, inexperience can lead to errors in medication administration, also, Supervision: Nursing students typically administer medications under the supervision of registered nurses or clinical instructors. The presence of multiple individuals involved in medication administration can sometimes lead to communication or coordination issues. Also, Stress and Pressure: Clinical training can be stressful for nursing students as they try to apply their theoretical knowledge in real-life situations. Stress and pressure can increase the likelihood of errors. Also, Learning Environment: Clinical settings can be busy and fast-paced, making it challenging for nursing students to focus entirely on medication administration, potentially leading to errors [34 - 36]. When nurses identify errors in medication orders or medicine therapy, they are responsible for taking appropriate actions to address the situation and ensure patient safety [37]. Some of the most common analysis and care interventions supplied by nurses in response to medication errors include: first, Error Documentation: Nurses are required to document any medication errors or near-miss incidents accurately. This documentation is essential for reporting and analysis purposes and helps identify patterns and potential areas for improvement. Second, Immediate Patient Assessment: If a medication error is discovered before administration, nurses will conduct an immediate patient assessment to determine if any adverse effects have occurred or if any actions are needed to mitigate harm [38]. Third, Announcement of medicine wellness program group: assistant attendant advertise the medication error to the pertinent medicine wellness program group, such as the doctor, pharmacist, and assistant attendant manager, to establish a communal method to settle point of departure. Fourth, Appeasement and extra verification: assistant attendant may need to extra review the medication methodize against the new prescription to discover inception of the error. Additionally, they may sharing in medication Appeasement method to secure precise medication types and prevent strong drug interactions [39]. Fifth, restorative Assess assessment: regarding to the type of the error and its strong effects on the person, the assistant attendant may apply restorative assessment, such as accustoming the quantity. Sixth, Monitoring and Observation: After a medication error, nurses closely monitor the patient for any adverse reactions or changes in their condition. They may also observe the patient's response to the correct medication to ensure it is well-tolerated [40]. Other healthcare professionals often face heavy workloads, long hours, and demanding schedules, which can increase the risk of errors in medication administration, they are significant contributing factors to various issues and adverse events in healthcare settings, including medication errors. The impact of these factors goes beyond medication errors and can affect overall patient safety and the well-being of healthcare professionals [41]. The beliefs of nurses regarding the main causes of medication errors align with various factors that have been identified in research and literature. Some of these factors in more detail: 1- Use of Abbreviations: The use of abbreviations in medication orders, prescriptions, and documentation can lead to misunderstandings and errors. Misinterpretation of abbreviations can result in the wrong medication being administered or incorrect dosages given. 2- Similarity in Drug Names: Drugs with names that sound alike or look similar can lead to confusion, especially during medication administration. This similarity increases the risk of medication errors, as nurses may accidentally administer one medicine instead of another. 3- Carelessness of Nurses: Human error is an inherent risk in any profession, including nursing. Carelessness, distraction, or lapses in attention during medication administration can contribute to errors. 4- High Work Pressure and Workload: Nurses often work in demanding environments with heavy workloads, especially in emergencies. The pressure to provide timely and efficient care can lead to errors, particularly if there is inadequate time to double-check or if multitasking is necessary [14, 42]. A systematic review study documented that the prevalence of medication errors in the countries of the Middle East region remains a significant challenge despite positive measures taken to prevent and control such errors [43]. Precise characterization of the types of medication errors is indeed a crucial step to preventing their recurrence and improving patient safety. By understanding the specific types of errors that occur, healthcare organizations can implement targeted interventions and strategies to address the root causes and minimize the risk of future incidents. The review of the literature in Iran that primarily focuses on the opinions and experiences of nurses regarding medication errors highlights an important perspective, as nurses are frontline healthcare providers. These stakeholders work collaboratively to promote medication safety, optimize patient outcomes, and provide high-quality care [44]. Aim: the current review was conducted for reporting about medication errors, risk factors, causes, and strategies for reducing medication errors in previous articles from 2015 to 2023. The method of the review was by collection and reporting the articles that talk about Medication errors from 2015 to 2023 and searching for solutions to reduce them.

II. RISK FACTORS ASSOCIATED WITH MEDICATION ERROR

Several factors are associated with a higher risk of medication errors [45]. These risk factors include: first, Older age: Elderly patients may have multiple medications prescribed for various health conditions, which can increase the complexity of their drug regimens, leading to a higher risk of errors [46 - 49]. Second, Overburdened healthcare system: Healthcare settings with a high patient load, such as having to attend to 20 or more patients in one hour, can lead to rushed decision-making and an increased likelihood of errors [50 - 52]. Third, Higher number of medicines in a prescription: Prescribing medications in a single prescription may increase the chance of confusion or mistakes in interpreting and administering the drugs [53]. Fourth, Comorbidities: Patients with multiple medical conditions often require multiple medications, increasing the complexity of their treatment and the risk of errors [54]. Fifth, Multiple prescribers for one patient: When a patient

receives prescriptions from multiple healthcare providers, there is a higher chance of drug interactions, duplications, or conflicting recommendations [55-56]. Sixth, Trainee practitioner: Inexperienced healthcare practitioners, such as medical students or residents, may have a higher risk of making medication errors due to their limited clinical experience [57-59]. On the other hand, the statement also suggests that certain factors were not significantly associated with a higher risk of medication errors. These factors include:
Patient's gender: The risk of medication errors does not appear to be influenced by the gender of the patient.

Prescription by a specialist: Prescriptions issued by specialists were not found to have a higher risk of medication errors compared to those issued by other healthcare providers [60-61] Also, presence of previous medical records: The availability of previous medical records did not seem to significantly affect the risk of medication errors. As well as, the involvement of a clinical pharmacist in reviewing the prescription did not appear to significantly reduce the risk of medication errors [62 - 64]. It is essential to recognize these risk factors to implement strategies and protocols that can help mitigate medication errors and improve patient safety in healthcare settings. For example, healthcare organizations may consider implementing medication reconciliation processes, interdisciplinary communication, and technology-based solutions to reduce errors and ensure patient well-being [65- 67].

III. THE MOST COMMON CAUSES OF MEDICATION ERRORS

Different classes of high-level error-producing conditions were identified: the director, persons, staff, working setting, the chore, the electronic system [68-69].The causes of medication errors can be depending on the healthcare setting, the specific processes involved and the individuals responsible for medication administration [70]. However, several common causes of medication errors are consistently reported in the literature and practice. These include: 1- Communication Breakdown: Inadequate or unclear communication between healthcare professionals, such as physicians, nurses, and pharmacists, can lead to errors in prescribing, dispensing, or administering medications [71]. 2- Drug Name Confusion: Medications with similar names or look-alike packaging can be easily confused, leading to medication errors when the wrong drug is selected. 3- Incorrect Dosage or Administration Route: Errors may occur when healthcare professionals prescribe, dispense, or administer the wrong dosage or use the incorrect route of administration for a medication [72]. 4- Missing the extra verification: fault to extra verification medication before determining medications can induce errors. 5- Perturbation and disturbances: A diligent and boisterous medical management setting with Persisten to Diversion and disturbances can enlarge the likelihood of medication errors. 6- Insufficient medication appeasement: Errors can be originated when medication lists are unreliable accommodated during development of care [73]. 7- Exhaust and High line of duty: medicine wellness programs that program who is tired -- or working under high workload conditions may be more susceptible to errors. 8- Loss of Drug Awareness and Improvement. [74]. 9- Look-Alike or Sound-Alike Medications: Medications with the same titles or boxing may be wrongly given it to others, leading to errors. 10- Incomplete writing done by hand: writing done by hand prescriptions can be misinterpreted, leading to medication errors [75].

III. MEDICATION ERRORS IN PEDIATRIC PATIENTS

Medication errors in pediatric patients are a considerable concern due to their exposure, variation in medicine dosage. Pediatric patients have clear anatomical identifies and different advancing planes, which can lead to errors if medications are not administered correctly. It noted that medications such as cloxacillin, ampicillin, metronidazole, gentamicin, and ceftriaxone are commonly encountered medications in medication management errors. The five commonest drugs, which contributed for the MAEs, are ampicillin, ceftriaxone, gentamicin, cloxacilline and metronidazole, with a magnitude of 263(33.76%), 190 (24.39%), 166 (21.31%), 73 (9.37%) and 34 (4.36%), respectively [76]. It is essential to understand which drugs are most frequently involved in medication errors as part of medication safety initiatives. Identifying high-risk medications can help healthcare organizations and professionals implement targeted strategies to reduce the occurrence of errors related to these specific drugs. Improving education, enhancing protocols, and implementing safety checks can all contribute to minimizing medication errors and ensuring patient safety [77- 79]. Some factors contributing to medication errors in pediatric patients include: 1- Weight-Based Dosing: Many pediatric medications are dosed based on the child's weight, and errors can occur if the wrong weight is used for calculation or if the dosing is not adjusted correctly. 2- Liquid Formulations: Young children often receive medications in liquid form, and errors can happen if the wrong concentration or volume is administered [80]. 3- Drug Preparation: Incorrect preparation of medications can lead to errors, especially with the use of compounded drugs or the mixing of medications. 4- Medication Calculation: Dosing calculations for pediatric patients can be complex, and mistakes in calculating the correct dosage can occur [81]. 5- Labeling and Packaging: Similarities in drug names, confusing labeling, and packaging can lead to medication mix-ups. 6- Lack of Pediatric-Specific Information: Pediatric patients may have limited data on drug safety and efficacy, making it challenging to determine appropriate dosing and potential adverse effects [82]. 7- Communication and Handoffs: Inadequate communication during transitions of care can lead to errors in medication orders or omissions. 8- Lack of Pediatric Training: Healthcare professionals may have limited exposure to pediatric patients during their training, leading to less familiarity with pediatric drug dosing and administration [83,84] .

IV. EXPLORING THE CAUSES OF MEDICATION ERRORS IN SELF-ADMINISTERED MEDICATION: AN IN-DEPTH ANALYSIS

The reported statistically significant correlation between the number of medications taken and medication errors highlights an important association in healthcare [85, 86, and 87]. The implications of this finding: 1- the Concomitant use of numerous drugs by a person. As the

quantity of medications increases, so does the complexity of medication management. [88-89] 2-Medication Appeasement: With an elevated number of drugs, drug Adjustment come to develop into more difficult [90]. 3-Elevated responsibilities for medical practitioners. 4- Patient Teaching and adhesiveness: As the quantity of drugs moves up, teaching and adhesiveness become more complicated. [91-95]. 5- Danger of Drug-Related Obstacles: With numerous drugs, there is an elevated danger of Drug-Related Obstacles. 6- Complexity in Medication Management: For patients with a high number of medications, healthcare professionals must carefully manage drug schedules, potential interactions, and patient-specific factors, which can lead to a higher risk of errors [96- 98]. The importance of interprofessional collaboration among physicians, pharmacists, and nurses to address medication errors and reduce the contributing factors [100].

VI. OUTCOMES OF TOXICITY OF PHYNTOIN AS A MEDICATION ERROR

Metabolism of phenytoin plays a key part in detecting its toxicity, principally when phenytoin is taken in overlying than normal doses, resulting in enlargement in the body [101- 102]. At therapeutic doses of phenytoin, the hydroxylating enzyme is not saturated, and the metabolism follows first-order kinetics. This means the rate of metabolism is directly proportional to the concentration of phenytoin in the body [103]. However, when phenytoin is taken in excessive amounts, the hydroxylating enzyme becomes saturated, and the metabolism changes to zero-order kinetics. In zero-order kinetics, the rate of metabolism is constant regardless of the drug concentration. This leads to a significant increase in the plasma half-life of phenytoin, especially at higher concentrations. Toxic effects of phenytoin start to manifest at concentrations around 20 µg/mL, which can cause symptoms like nystagmus (involuntary eye movements) [104]. It is important to adhere to the prescribed dosage of phenytoin and to have regular monitoring of drug levels in the blood to ensure the drug is within the therapeutic range and to avoid potential toxicity. [105- 106].

VII. EFFICTIVE STRATEGIES FOR PREVENTING MEDICATION ERRORs I SELF-MANAGEMENT

Amplitudes that can aid in lessening medication errors involve: 1- Comprehensible drug instruction from professionals. 2- Appropriate instruction and coaching for analyst and medicine wellness program distributors on medication supervision [107-112]. 3- Sound programs in drugstores to identify orders and avoid errors. 4- Patient education and guidance by pharmacists about medication use, adverse effects, and strong drug interface. 5-Emboldening patients to query challenges, attempt simplification, and share in their medication treatment [113-116]. Double-Check Procedures: Establishing double-check procedures for high-risk medications can add layer of safety [117-120]. General strategies for reducing medication errors: Computerized entry of the prescription order; identical format for writing the prescription; permanent education to the health team; effective human resource in care; collaboration of the pharmacist; involvement of family/caregivers in the medication reconciliation process in hospital. Reduction of the nursing team's workload and implementation of permanent education programs for the health team [121-123].

VIII. CONCLUSION

The brief review showed that multiple studies have reported a high incidence of medication errors following hospital discharge. These errors can include prescribing errors, incorrect dosing, drug interactions, and omissions or duplications of medications and these errors can lead to adverse medicine events, which can result in patient harm, hospital readmissions, and increased healthcare costs. Furthermore; some studies have evaluated the effectiveness of transitional care interventions and strategies in reducing medication errors and ADEs. These interventions can include medication reconciliation processes, post-discharge follow-up, patient education programs, and electronic medication management systems. By addressing these interventions, future studies and interventions can contribute to improving medication safety following hospital discharge and advancing the global safety agenda.

CONFLICT OF INTEREST

Authors declare that they have no conflict of interest.

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