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Research Article

MEDICATION ERRORS AND CONSEQUENCES

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Abstract:

Medication therapy is becoming increasingly more complex as new drugs are developed and more therapeutic targets are elucidated. In addition, polypharmacy (≥5 scheduled medications) has become exceedingly common in geriatric patients and in patients with chronic disease states. As the complexity of drug therapy and the number of medications increase, patients are at a high risk for medication errors and adverse drug events (ADEs), or injuries resulting from medication. The type of adverse events may be associated with professional practices, healthcare products, procedures, and systems including prescription, communication through instructions, drug labeling, packaging and nomenclature, reformulation, dissolution, distribution, administration, education, monitoring, and use. Classification and evaluation of medication errors according to their importance may constitute an important factor for process improvement in order to render the administration of medicines as safe as possible. In hospitals, medication errors occur at a rate of about one per patient per day. A dispensing error is one made by pharmacy staff when distributing medications to nursing units or directly to patients in an ambulatory-care pharmacy; the error rates for doses dispensed via the cart-filling process range from 0.87% to 2.9%. Technology has grown to be a constituent part of medicine these days. A few advantages that technology can supply are categorized as follows: the assisting of communication between clinicians; enhancing medication safety; decreasing potential medical errors and adverse events; rising access to medical information and encouraging patient-centered healthcare. The aim of this article is to provide a compendious literature review regarding Medication errors.

Keywords: nursing error(s), medication error(s), adverse drug reaction(s) – adverse drug event(s), electronic medical record(s), patient safety

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INTRODUCTION:

Drug use is a complex process and there are many drugs related challenges at various levels, involving doctors, pharmacists, nurses and patients. Medication misadventure can occur anywhere in the health care system and many errors are preventable and pharmacists have an active role in the appropriate use of drugs [1]. Medication errors are a common cause for iatrogenic adverse events. They can lead to severe morbidity, prolonged hospital stay, unnecessary diagnostic tests, unnecessary treatments and death [1,2]. A medication error is an episode associated with the use of medication that should be preventable through effective control systems [1,2]. Adverse events and medical errors are an inevitable reality of health care. They are the serious problems in pediatrics as well as in adult medicine [3,4]. In 1999, IOM report on quality of health care, *To Err Is Human: Building a Safer Health System* called for a more systematic approach to medical errors and outlined the importance of identifying and learning from errors through mandatory and voluntary reporting system [4]. Medication errors have a huge impact on health care system, patients and payers alike. It compromises the confidence of patients on health care system [5]. Recent developments on medication error include the Global Patient Safety Challenge on Medication Safety from the World Health Organization (WHO). This initiative serves universally in reducing avoidable medication by 50% that causes harm to people [6]. And targeted to achieve this in the duration of next 5 years.[6] Medication error (ME) continues to pose a great challenge to health care systems across the world. Studies have evidenced that MEs cause at least one death every day and injure about 1.3 million people in a year United States (US) alone [6]. In low and middle-income countries, the exact scale of the problem is much more elusive due to the limited number of studies assessing the rate of MEs and factors associated with MEs in developing countries. The current study has observed MEs in developing countries is almost equal to or greater than that of US [6]. There are limited studies on assessment of medication error and its associated factors in developing countries; which lead to difficulty in accurately measure the exact problem [7]. The frequency and the associated factors to MEs also differ across geographic locations and hospital settings [7]. The frequency and the associated factors to MEs also differ across geographic locations and hospital settings [7]. Medication errors not only increase the risk of death to a patient, but they also result in significant cost to society consuming at least 1% of overall global income, which is approximately \$42 billion annually. The definition is given by 'The

National Coordinating Council for Medication Error Reporting and Prevention' a medication error is "any preventable event that may cause or lead to inappropriate medication use or patient harm while the medication is in the control of the health care professional, patient or consumer." previous studies have revealed that the related aspects of professional practice, up keeping health products, procedures, and methods, prescribing medicine, ways of communication, ways of labeling, and packaging products, language, compounding, dispensing, distribution, administration, education, monitoring, and use." [8,9] Undesirable outcomes include adverse drug reactions, drug-drug interactions, lack of efficacy, suboptimal patient adherence and poor quality of life and patient experience. In turn, these may have significant health and economic consequences, including the increased use of health services, preventable medication-related hospital admissions and death [10]. The problem is likely more pronounced in the elderly, because of multiple risk factors, one of which is polypharmacy [11]. Error in medication can occur at different stages of the prescription process, which are ordering transcription, preparation, dispensing, administering, and monitoring. The medication error in the above-mentioned stages can occur as an omission error, unauthorized drug error, the dose error, dosage form error, and drug preparation error, route of administration error, administration time error, administration technique error, reconciliation error, and compliance error. There is increased awareness globally on safe medication practices, which has resulted in the implementation of practices to minimize the rate of medication errors in hospitals. A number of studies evidence that the primary, secondary, and tertiary healthcare settings to assess the prevalence, types, severity of MEs, and factors associated with MEs. [12,13,14] Furthermore, several review articles have been published on factors associated with or contributing to the occurrence of MEs in and outside of the hospital setting. [15,16] Additionally, other published reviews have reported the prevalence of MEs in different hospital settings and the interventions implemented to reduce the rate of MEs. [17,18]

TYPES OF MEDICATION ERRORS:

A prescribing error can arise from the choice of the wrong drug, the wrong dose, the wrong route of administration, and the wrong frequency or duration of treatment, but also from inappropriate or erroneous prescribing in relation to the characteristics of the individual patient or co-existing treatments; it may also depend on inadequate evaluation of potential harm deriving from a given treatment. [19,20] Errors in

prescribing can be divided into irrational prescribing, inappropriate prescribing, ineffective prescribing, under prescribing and overprescribing, and errors in writing the prescription. The inadequacy of the term 'error' to describe all of these is obvious. Failing to prescribe an anticoagulant for a patient in whom it is indicated (under prescribing) or prescribing one when it is not indicated (overprescribing) are different types of error from errors that are made when writing a prescription. [21]. The prescription errors are mainly of two types, errors of omission and errors of commission. Errors of omission mean prescription missing essential information, while errors of commission mean wrongly written information in the prescription. [22]. The prescribing error is an avoidable medication error common in hospitals worldwide. The study revealed errors in 1.5% of medications ordered in hospital stays in the UK and up to 6.2% in the USA. [23]. For example, writing a dose that is orders of magnitude higher or lower than the correct one because of erroneous calculation, or erroneous prescription due to similarities in drug brand names or pharmaceutical names. [24]. The National Coordinating Council for Medication Error reporting and prevention reported 15% of the medication errors are because of handwriting problem, abbreviations problem and incomplete medication orders. [25]. Poor communication between patients and prescribers, self-medication and unethical medicine promotion has been reported to increase irrational prescribing. [26]. In a US study of about 900 medication errors in children, ~30% were prescription errors, 25% were dispensing errors and 40% were administration errors. [27]. Opioid medicines include diamorphine, morphine, codeine, fentanyl, oxycodone and methadone. More than 450 patients died after being prescribed opioid medicines unsafely at Gosport War Memorial Hospital (18) and opioid analgesics are associated with the development of tolerance and, in some cases, dependence. [28]. The drug-drug interactions were the most frequently (68.2%) occurring type of error, which was followed by incorrect dosing interval (12%) and dosing errors (9.5%) [29]

EXAMPLES OF MEDICATION ERRORS:

- i. Omitted or delayed medicines in prescribing:** A patient was discharged following an ischemic stroke. Unfortunately, they had not been prescribed clopidogrel on discharge. This was not noticed by the prescribing doctor, the pharmacist dispensing the medication, or the nurse handing over the prescription. [30].
- ii. Opioid analgesics:** A patient was prescribed MST (morphine) 60mg twice per day for arthritic pain as an initial dose. Prior to this, the patient was using tramadol 50mg three times per

day for analgesia. After taking four doses of MST, the patient was confused, hallucinating and drowsy. The patient was admitted to hospital and stayed for six days after receiving naloxone. [31].

- iii. Known allergy to medicine, including antibiotics:** The patient was prescribed trimethoprim. They collapsed and arrested shortly afterwards. The arrest included entering into a ventricular fibrillation rhythm, which required defibrillation. The prescription stated that the patient was allergic to Septrin® (Aspen) and penicillin. Anaphylactic shock was given as a probable. [32].
- iv. Drug interactions:** Drug interactions can reduce the efficacy of a drug or increase the adverse effects of a drug. Pharmacists and healthcare professionals need to recognize and understand which drug interactions can result in significant patient harm. [33].
- v. Incident:** The patient had a cardiac arrest with unclear etiology, leading to admission to intensive care. A digoxin blood level was taken as the patient was on a high dose while on clarithromycin. Results showed digoxin toxicity. A review of past prescriptions show that the patient has been receiving in total the equivalent of several loading doses of digoxin, which ultimately led to this toxic level. In addition, the patient was on antibiotics known to change digoxin levels. [30].
- vi. Illegible writing:** Illegible writing has plagued both nurses and pharmacists for decades. Physicians are often in a hurry and frequently scribble down orders that are not legible; this often results in major medication mistakes. Taking shortcuts in writing drug orders is a prescription for a lawsuit. Often the practitioner or the pharmacist is not able to read the order and makes their best guess. If the drug required is a dire emergency, this also adds more risk to the patient. To eliminate such errors, most hospitals have rules that practitioners and pharmacists have to follow; if the drug order is illegible, the physician must be called and asked to rewrite the order clearly. The practitioner or the pharmacist should never guess what the drug/dose is. The bad writing by physicians has become such a major problem that the Institute of Safe Medication Practices has recommended the complete elimination of handwritten orders and prescriptions. This problem has been resolved using electronic records where everything is typed, and poor writing is no longer an issue; however, errors still can occur

from writing the wrong drug, dose, or frequency. [34,35].

vii. Loading doses: Loading doses are complex to prescribe because they require multiple-step calculations using information about the patient, their medicine and any frequent changes of dose, or frequency of administration. Loading doses may be miscalculated, additional doses may be prescribed in error, maintenance and loading doses prescribed at the same time, or loading or maintenance doses may not be prescribed. [36].

viii. Consequences: Inaccuracy in writing and poor legibility of handwriting, the use of abbreviations or incomplete writing of a prescription, for example by omitting the total volume of solvent and duration of a drug infusion, can lead to misinterpretation by healthcare personnel. This can result in errors in drug dispensing and administration. Unintended omission or changes in the dosing regimen are frequent, and account for 15–59% of medication errors. [37] Excessive and inappropriate prescribing results in severe consequences such as wastage of the public economy, increased risk of toxicity, increased adverse drug reaction, increased antimicrobial resistance and decreased faith in the medical profession [38]

DISPENSING ERROR:

A dispensing error is defined as the discrepancy between the written order in a medical prescription and the following of this order. These errors are made by the pharmacy staff (including the pharmacist) when dispensing to hospital units [39,40,41]. Dispensation is one of the most sensitive phases of the process. Safe, organized and effective dispensing systems are therefore, fundamental to ensure that the drugs will be properly dispensed according to the prescription order forms and to reduce the possibility of errors. In a study which was carried out in 1994 in the US, it was demonstrated that the transcription and administration of drugs could be responsible for 50% of the medication errors, considering that 39% of the errors involved prescription errors and 11% involved dispensing errors. [42]. It has been observed that the rates of drug dispensing errors in work environments with high levels of interruption, distraction, noise and overload are higher (3.23%) as compared to environments with lower levels of these aspects (1.23%). [43]. Dispensing plays an integral role in maintaining the quality use of medications. The different types of dispensing errors that were observed during the study were drug omission, wrong quantity, wrong drug, wrong strength and wrong dosage form. [44]

STUDY. 1

A study was done to measure dispensing accuracy rates in 50 pharmacies located in 6 cities across the United States and describe the nature and frequency of the errors detected. Observation was done by pharmacist in each pharmacy for 1 day, with a goal of inspecting 100 prescriptions for dispensing errors (defined as any deviation from the prescriber's order).[45]. Data were collected between July 2000 and April 2001. The overall dispensing accuracy rate was 98.3% (77 errors among 4,481 prescriptions; range, 87.2%-100.0%; 95.0% confidence interval, +/- 0.4%). Accuracy rates did not differ significantly by pharmacy type or city. Of the 77 identified errors, 5 (6.5%) were judged to be clinically important.[45]. Dispensing errors are a problem on a national level, at a rate of about 4 errors per day in a pharmacy filling 250 prescriptions daily. An estimated 51.5 million errors occur during the filling of 3 billion prescriptions each year. [45]. In a study which was conducted by Dominica MG [46] et al. on the analysis of the prescription, transcription and the dispensing quality through the information which was gathered at a pharmacy service, the types of transcription errors which were found were drug omission (6.4%) and wrong dosage form (1.2%). This study was found to be consistent for wrong dosage form. [47].

STUDY. 2

Upon restocking opioids, changing from Dipidolor™ (a trade name of Piritramide from the Janssen-Cilag GmbH, Germany) to the generic brand Piritramide (Hameln pharma, Germany), with Dipidolor being a commonly used opioid for post-operative pain in Germany, opioids were ordered as a 1 ml vial containing 7.5 mg/ml of Piritramide, instead of the usually ordered and used 2 ml vials containing 15 mg/2 ml of Piritramide, still from the same manufacturer (see the figure of medication boxes (Figure 1)). However, these stocks were falsely registered as 2 ml vials in the drug cupboard logbook on the ward. In some cases, prescriptions were made as "... administer half a vial of Piritramide..." by physicians. A CIRS was filed anonymously, however, at this point no conclusion could be drawn as how many patients had been involved and which patient had received what dosage. Assumably "half an vial" of Piritramide has led to some patients receiving 3.75 mg of Piritramide instead of 7.5 mg. [48].

Some of the common Dispensing errors are:

- A) **Medicines with similar names or packaging:**
It's an easy mistake to make. When working in a busy dispensary, medicines with similar names or almost identical packaging are easily confused. This is perhaps why incidents such as these

account for more than 70% of the error reports received by the NPA.

- B) **Out-of-date medicines:** It is relatively common for patients to receive out-of-date medicines and this mistake isn't easily forgiven. For example, antibiotics could be rendered ineffective if dispensed past their sell-by date.
- C) **Incorrect calculations:** Complex calculations are fertile ground for an error. Medicines that need to be diluted - such as ranitidine are commonly cited in errors.
- D) **Misreading prescriptions:** illegible handwriting as most of the time it's fathomable, but sometimes it can require guesswork. And this is where problems tend to creep in. Pharmacists can misread the drug name, Latin abbreviations or units of measurement. Clearly, this leaves scope for some serious errors.[49].

In 1999, an American cardiologist caused the death of a 42-year-old patient when his prescription of 20 mg Isordil, an antianginal drug, was misread by the pharmacist as 20 mg Plendil, an antihypertensive drug. [50]. High risk medicines may cause serious patient harm if dispensed incorrectly like Narrow therapeutic range, Serious adverse effects if dose or administration incorrect. Examples: Lithium, Opioid medicines, Methotrexate, Insulin, Oral anti-cancer medicines, Anticoagulants. [51].

DOCUMENTING ERROR OR CHARTING ERROR:

Documented details include form, dose, route, frequency, and duration of drug administration. On a time scale, the applied dose and frequency for each day is expressed using figures and lines. Documentation errors (errors in the documentation of the actual drug dispensation on the medication list by nursing staff) [52]. Nursing activity also includes documenting the care given to the patient and communication between other healthcare professionals. Due to enormous patient related workload, nurses perceive documenting these activities less important. As a result, quality of document is compromised and errors are inevitable.

The eight most common types of documentation errors made by nurses are [53].

- A) Not recording patient care activities or drug related information.
- B) Failure to record nursing activities
- C) Failure to record medication given to patient
- D) Not recording a drug reaction or any change in patient condition
- E) Illegible hand writing and incomplete records
- F) Documenting prior to care given

- G) Leaving space between entries to record delayed entries
- H) Not documenting date, time and sign of nursing staff

After auditing nursing records of three hospitals in Jamaica emphasised weakness in the nursing documentation and suggested to monitor and train nurses on documentation [54]. A total of 105 errors were detected in 65 of the 1934 prescribed agents (3.5%). At least one error was found in the medication documentation of 71 of the 165 patients (43%), while in 94 cases no errors were found in the medication documentation (on both, the prescription sheets and medication lists). The median number of documentation errors per patient was 1 (range 0-9). [1]. The maximum number of 9 irregularities was detected in the drug documentation of an 86-year-old female patient who received 25 different agents during a 10-day stay. A detailed listing of the medication documentation errors found is depicted in Table 1. Prescribing errors occurred in 39 prescribed agents. Wrong or missing details about date and time were identified in 29 prescriptions (27.6%), which may have had a direct impact on the start time of a medication. In four cases (3.8%), the prescriptions were lacking dose information. Ambiguous orders, potentially leading to an overdose, were found three times (2.9%). One of these could potentially have resulted in an overdose with 18 mg of phenprocoumon (coumarine derivative) per day. [52]. In a study Observers detected 300 of 457 pharmacist-confirmed errors made on 2556 doses (11.7% error rate) compared with 17 errors detected by chart reviewers (0.7% error rate), and 1 error detected by incident report review (0.04% error rate) [55]. Documentation errors include charting procedures or medications before they were completed. Such a documentation error can cause a patient to miss a dose of medication or a treatment and can confuse, misrepresent, or mask a patient's true condition. Lack of charting of observations of the patient causes serious harm when a nurse fails to chart signs of patient deterioration, pain, or agitation or particular signs of complications related to the illness or therapies. [56].

MEDICATION TRANSCRIPTION ERROR:

MTE can be defined as "any discrepancy between the physician medication order and the medication order transcribed onto any document related to the patient concerned as the medical record, medication chart, medication request sheet, discharge medication chart or any other similar document" [57].

Medication transcription errors (MTEs) are of particular importance because the different phases of prescription, transcription, dispensing, and administration occur in chain and, therefore, it is highly likely that if a medication was transcribed incorrectly, this error would go without interception and would most probably reach the patient and cause harm [57]. Previous studies conducted in Switzerland, Pakistan, and Iran and showed that errors occurred at the medication transcription phase [58, 59, 60]. In a previous study conducted in Pakistan, MTEs occurred in 16.9 and 13.8% of the 6583 and 5329 medications transcribed onto inpatient profiles and discharge charts, respectively [58]. Pichon et al. conducted a study in Switzerland in which the nurses transcribed chemotherapy and non-chemotherapy related prescribed medications onto different sheets twice [59]. In the first transcription stage, 11.8 and 20.7% of the transcribed chemotherapy and non-chemotherapy medications, respectively, were incorrect. Fahimi et al. reviewed MTEs in a teaching hospital in Iran and MTEs occurred in about 30% of the 558 opportunities for errors [60]. It is noteworthy mentioning that in large hospitals where larger volumes of medications are prescribed which subsequently need to be transcribed before being dispensed and administered to patients, even lower error rates are of paramount importance given the increasing opportunities for errors and potential harms to the patients [61].

1. PREVENTION OF TRANSCRIPTION ERROR:

Previous studies have suggested a need for a unified medication system to eliminate errors at the ordering and transcription stage. This medication chart, paper or electronic, should clearly state the components needed to fulfil requirements for unambiguous prescription—especially drug form and route, as these were the most frequent types of error in our study. The high frequency of discrepancies in drug form between medical records and medication charts were caused by nurses' interpretation of drug prescriptions, and lack of drug formulation in the medical record. Often, these interpretations are correct and improve the quality of the drug prescription, but these actions are beyond nurse authority and could, ultimately, result in fatal consequences for the patients. [62,63,64].

2. ADMINISTRATIVE ERRORS:

Medication administration error (MAE) is defined as “any difference between what the patient received or was supposed to receive and what the prescriber intended in the original order” [65]. Existing studies

revealed that medication errors most frequently occur during the administration phase [66, 67, 68]. Most of the medications are administered by nurses [69]. The frequently perpetrated types of MAEs include wrong dose, wrong time, wrong drug, wrong route, omission of doses, wrong patient, lack of documentation, and technical errors [70,71,72,73]. The problem of MAEs is real incurring a serious threat to patient safety. Several studies and systematic reviews around the world showed the magnitude of MAE being still high [67, 68, 73, 74]. Identifying and intervening the contributing factors of MAEs is one of the best strategies proposed to improve patient safety by reducing the magnitude of MAEs. The factors are commonly identified through medication error reporting. However, studies showed that nurses are reluctant to report MAEs [70, 72, 75]. Generally, there are only a few relevant data on MAEs in developing and transitional countries, especially in Africa. In developing countries like Ethiopia with educational, economic, and trained labor problems, the issue is one of the least investigated and neglected health problems. Therefore the main aim of this study was to assess the occurrence of medication administration errors among nurses working in Addis Ababa Tertiary hospitals. The findings of both types of study showed that MAEs were a common health problem in the hospitals under study. The magnitude of MAE in self-reported study and observational study was 68.1 and 96% respectively. This result indicated that some participants made MAE but not report in the self-reported questionnaire. Similarly in this self-reported study 83.4% of nurses were not report medication errors to the concerned body. Furthermore, different literatures also showed that majority of the medication errors were not reported [73, 76, 77]. Wrong time error (58.7%) was the most frequent type of MAE detected in this study. This finding indicates that more than half of the medications were not administered at ordered time. When medications are not administered at the regularly scheduled time the patient may develop toxicities or resistance to the drugs. The finding of this study was similar to a study done in two southern Ethiopia hospitals (58.5%) [73]. However, it was much lower than a study conducted in France (72.6%) [78]. The difference likely to be due to the difference in the study setting (the previous study was conducted in a specified ward, while this study was conducted in all clinical departments of three hospitals). Additionally, there was a difference in data collection method. (The study in France used a direct observational method only. Whereas; this study used both a direct observational and self-reporting method). [78] On our study interruption during medication administration, lack of work experience

and unavailability of a guideline for medication administration were significantly associated with MAEs. These findings were supported by studies conducted in Ethiopia Felege Hiwot Referral hospital and two public hospitals in southern Ethiopia [71, 73]. A similar study conducted in Turkey indicated that interruption by telephone and questions being asked during medication administration were found to have contributed to MAEs [76]. Medication preparation and administration need concentration. Interruption occurs when a nurse is preparing and administering a medication, which could lead to an error. Interruption of these activities may lead to cognitive failure in relation to working memory and attentiveness. Moreover making the environment conducive for nurses prior to preparation and administrations of medication may reduce medication errors. The finding of this study showed that work experiences of nurses were significantly associated with MAEs. Studies conducted in Felege Hiwot Referral hospital and emergency department of southern Iran hospital indicated that there is a significant association between work experience and MAEs [71, 79]. Medication administration is one of the nursing practices and improved through experience. When nurses with experience can improve their skill and gain greater knowledge on safe medication administration practice. Moreover experienced nurses are familiar with different medications and procedures.[79]. Lack of training and unavailability of guideline for safe medication administration practice were also significantly associated with medication administration errors. This finding is supported by WHO 2017 medication without harm strategies. In 2017 WHO develops strategies to improve patient safety through reductions of medication error up to 50% in the next 5 years from 2017 to 2022 [80]. From these strategies provide a guideline and strengthen health professional's capacity through skill building are the major ones. On the other hand, a study done in Egypt showed that MAEs was highly prevalent and all nurses had not taken training courses on safe medication administration practices and they haven't policies and procedures for medication administration [81].

CONCLUSION:

Introduction of interventions will lower the risk of harm caused to the patient to a minimal level, thereby improving patient's safety, sanitizing the work environment and reduce the rate of MEs due to prescribing, administering, preparation, dispensing, monitoring and transcribing errors in hospital settings. Our study also clearly indicates the use of the CPOE and computerized medication chart

without proper adherence to the system and prolong training of the staff may not show a significant result in reducing the rate in ME. Therefore, a prolong personnel training on the use of new systems employed is highly recommended for the effective functioning of the system, thereby improving patient's safety. A review of literature reveals several proposed solutions to the medical error problem. One solution is to change the system for reporting medical errors. This would allow for the tracking of errors and provide information on potential problematic areas. Another solution involves implementing a culture of safety among healthcare organizations. The Technical Series on Safer Primary Care addresses selected priority areas that WHO Member States could prioritize, according to local needs.

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