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Research Article

Medication errors in outpatient setting of a tertiary care hospital: classification and root cause analysis

Sunil Basukala*, Sameer Mehrotra, Shiva Devarakonda

Department of Hospital Administration, Armed Forces Medical College, Pune, Maharashtra, India

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***Correspondence to:**
Dr. Sunil Basukala,
Email: anyurysm@gmail.com

ABSTRACT

Background: The goal of drug therapy is the achievement of defined therapeutic outcomes that improve a patient's quality of life while minimizing patient risk. Medication error is an important cause of morbidity and mortality, yet it can be a confusing and under-appreciated concept.
Methods: A total of 3000 prescriptions were selected using Systematic Random Sampling, and prescription errors were stratified according to nuisance they may cause by dispensation followed by identification of Root Causes of the errors.
Results: Out of a total of 3000 prescriptions, 2394 prescriptions (70.61%) were found to have one or more errors. The total number of errors were 3390 as many prescriptions had more than one error. The most common type of errors was Type D and was found in 70.61% prescriptions.
Conclusions: Learning more about medication errors may enhance health care professionals' ability to provide safe care to their patients. Hence, A focus on easy-to-use and inexpensive techniques for medication error reduction should be used to have the greatest impact.

Keywords: Medication errors, Prescription, Root cause analysis

INTRODUCTION

The "average" general practitioner signs 13, 000 prescription items per year of which approximately 5000 are written during consultations and 8000 are repeated. The greater numbers of elderly in the population and new drugs developed are likely to increase both the number and range of prescription items written per doctor per year.[1-3]

In order to cope with this trend much effort has been directed toward rationalizing prescribing. A range of general practice formularies is now available, following research projects to evaluate their impact. Regulation of prescribing, whether by voluntary means such as self-regulation and peer group review or by compulsory means such as an extension of the limited list, will become an important feature of general practice in the 1990s. The changes in quality and quantity of feedback from the prescription pricing authority can be seen as the first step toward regulation.[4-6]

A drug prescription is often the endpoint of a patient's visit to a medical practitioner. As an instruction from a prescriber to a dispenser, it is considered to be a medico-legal document that should be written legibly, accurately, and completely.[7] Prescribing physicians, as well as those involved in the execution of the prescription, hold legal responsibility for the prescription.[8] Although the prescription format may vary slightly from one country to another, most countries agree on the core elements that should be included in the prescription order. These are: prescriber's name, address, telephone number and signature; patient's name, address, age, and weight (important at the extremes of age); prescription date; drug name (preferably generic), formulation, strength, dose, frequency of administration, quantity prescribed, reason for prescribing, and instructions for use.[9]

A prescription is a health care program implemented by a physician or other medical doctors in the form of instructions that govern the plan of care for an individual patient. Prescriptions may include orders to be performed

by a patient, caretaker, nurse, pharmacist, or other therapist.[10] Prescriptions have legal implications, as they may indicate that the prescriber takes responsibility for the clinical care of the patient and in particular for monitoring efficacy and safety. As medications have increasingly become pre-packaged manufactured products and medical practice has become more complex, the scope of meaning of the term "prescription" has broadened to also include clinical assessments, laboratory tests, and imaging studies relevant to optimizing the safety or efficacy of medical treatment.[11]

Proper documentation of prescribing practice allows the identification of acceptable and non-acceptable prescribing habits. Such information is needed to set up continuous medical education programs to encourage rational prescribing among physicians. It also helps in setting up monitoring systems to ensure good prescribing habits and to maintain them. Health professionals may also utilize this information to develop guidelines for safe and cost-effective prescribing. An error can occur at any stage of the prescription process *viz*:

a) Choosing a medicine: there may be selection of irrational, inappropriate, or ineffective (a medicine that is not effective for the indication in general or for a specific patient) medication
   - Under-prescribing: failure to prescribe a medicine that is indicated and appropriate or use of too low a dose of an appropriate medicine
   - Over-prescribing: prescribing a medicine too much, too often, or for too long).[12,13]
b) Prescription writing: omission/mistake in a superscription, dosage form, strength of preparation, improper route and/or illegible handwriting lead to such errors.
c) Formulation used: such errors occur due to wrong strength, contaminants, wrong or misleading packaging of formulations involved.
d) Dispensing of medication: dispensing wrong medicine or wrong formulation to the patient or dispensing medicines with wrong labeling can result in such errors.
e) Administering/taking the medicine: despite the correct selection of medicines, meticulous prescription writing, and careful dispensing, the patient may still take or be administered medicines in the wrong amount, by the wrong route, in wrong frequency or for the wrong duration.
f) Monitoring therapy: medicines need to be prescribed for a defined time period. Even long-term treatments require monitoring and modifications from time to time depending on various factors such as disease progression and changes in patient's physiological parameters. Failing to alter therapy when required or erroneous alteration also account for errors.[14,15]

In this study, prescribing was monitored from three separate sources with the aim of producing a classification of errors based on the potential effects of errors. In an attempt to reduce error rates, feedback about prescription errors was given to a group of doctors.

AIM

Identification and classification of medication errors and conduct Root Cause Analysis.

OBJECTIVES

1. To analyze the prescriptions for completeness of information such as the presence of outpatient department (OPD) number, name, age and sex of patient, diagnosis, name, dose and duration of prescribed drugs
2. To classify the errors in the prescriptions
3. To conduct a root cause analysis.

METHODS

The total of 3000 prescriptions were selected using systematic random sampling, out of all the prescriptions received in 3 months at central hospital dispensary from various OPDs. Prescription errors were stratified according to nuisance they may cause by hampering the dispensing work, a method suggested by Neville et al.[16]

According to this method, prescription errors can be classified as follows:[16]

Type A: errors which are potentially serious to the patient. Such prescription would be dangerous to the patient if dispensed. e.g., (i) if the dose of a cardiac drug *viz*. Digoxin is increased by a factor of 10.

Type B: errors causing a major nuisance by making a pharmacist to contact the prescriber to dispense the medicine. e.g., Strength of formulation (e.g., whether aspirin tablets of 75 mg or 150 mg or 325 mg or Atorvastatin tablets of 10 or 20 mg are to be dispensed) is not mentioned or use of brand name about which the dispensing pharmacist is not aware.

Type C: errors causing minor nuisance which can be managed by involving another pharmacist to take a professional decision at dispensary level before dispensing.

Though such prescription can be correctly dispensed without contacting the prescriber; however, such an error causes hindrance in the functioning of the dispensary and delays dispensing of medication to the patient. e.g., (i) omission of dosing schedules of commonly prescribed medicines such as paracetamol, diclofenac (ii) using brand names of commonly used medicines such as "Natrilix" for indapamide, "Tixylix" for promethazine.

Type D: trivial errors consisting of spelling errors or omissions such as date, age and/or gender of the patient. Such errors do not hamper the execution of prescriptions.

Three pharmacists, who have been working in the hospital dispensary, were asked to screen these randomly selected prescriptions under the supervision of the authors.

The prescription errors were identified and were listed as per the type described by Nivelle et al. If the prescription had more than one error, both the type of errors were identified and included in the analysis.

The selected prescriptions were screened for the following prescription writing errors by authors at the first instance:

1. Strength of preparation not mentioned
2. Use of brand names
3. Incomplete description of dosing schedule and dosing instructions
4. Illegible handwriting
5. Diagnosis not mentioned
6. Age of the patient not mentioned
7. Gender not mentioned.

Subsequently, these prescriptions were also given to the pharmacists to assess the level of difficulty they would face in dispensing these. The screening by pharmacists was done under the supervision of authors. The decisions of pharmacist were recorded by authors and were considered for classifying the errors into various categories. If the prescription had more than one error, both the type of errors were identified and included in the analysis.

RESULTS

Out of the total of 3000 prescriptions, 2394 prescriptions (70.61%) were found to have one or more errors. The total number of errors was 3390 as many prescriptions had more than one error. All types of errors except Type A were observed in this study (Table 1).

In 3000 prescriptions analyzed, Type B errors were found in 16.10% prescriptions. The main reasons for Type B errors were the use of the brand name (2.65% of prescriptions), no mention of strength of preparation (5.89% of prescriptions), incomplete description of dosing schedule and dosing instructions (2.83% prescriptions), and illegible handwriting (4.7% prescriptions). Type C errors were found in 13.39% prescriptions. They resulted due to the use of brand names (8.1% prescriptions) and illegible handwriting (5.2% prescriptions). The most common type of errors was Type D and was found in 70.61% prescriptions. Type D errors were due to no mention of diagnosis (22.1% prescriptions) no mention of age (20.1% prescriptions), illegible handwriting (5.8% prescriptions), and gender not mentioned (22.4% prescriptions) (Figures 1 and 2).

DISCUSSION

Common consequences faced by physicians after medication errors can include loss of patient trust, civil actions, criminal charges, and medical board discipline. Methods to prevent medication errors from occurring (e.g., use of information technology, better drug labeling, and medication reconciliation) have been used with varying success. When an error is discovered, most patients expect disclosure that is timely, given in person, and accompanied with an apology and efforts to prevent future errors.

In our study, an error rate of 70% was observed with most of the errors as trivial, i.e., Type D. Such errors are not likely to hamper the correct execution of the prescriptions. Most of the Type D errors resulted due to the absence of diagnosis in the prescriptions. Mentioning diagnosis in the superscription is a part of correct prescription writing and is mandated by WHO.[10] Mention of a diagnosis may help the pharmacist to correlate and interpret the correct medicine or formulation if the handwriting is not completely understood. Omission of mentioning "age" of the patient was the next contributor for Type D errors. Mentioning patient's age apparently appears superfluous but is vital from patho-physiological view especially for patients in extremes of age. It is also important if two patients of the same name, gender, and diagnosis are attending OPD or dispensary at one time. Type B errors resulted mainly due to Use of brand names such as Tablet "Pangraf," "Lospot," "Natrilam". The strength of preparations not mentioned *viz*.

Table 1: Classification of prescription errors.

Cause of errors	Number of errors				
	Type A errors	Type B errors	Type C errors	Type D errors	Total
Strength of drugs		200			200
Use of brand names		90	276		366
Incomplete description of dosing schedule and dosing and instructions for medications		96			96
Illegible handwriting		160	178	200	538
Diagnosis not mentioned				752	752
Age of the patient not mentioned				682	682
Gender not mentioned				760	760
Total		546	454	2394	3390

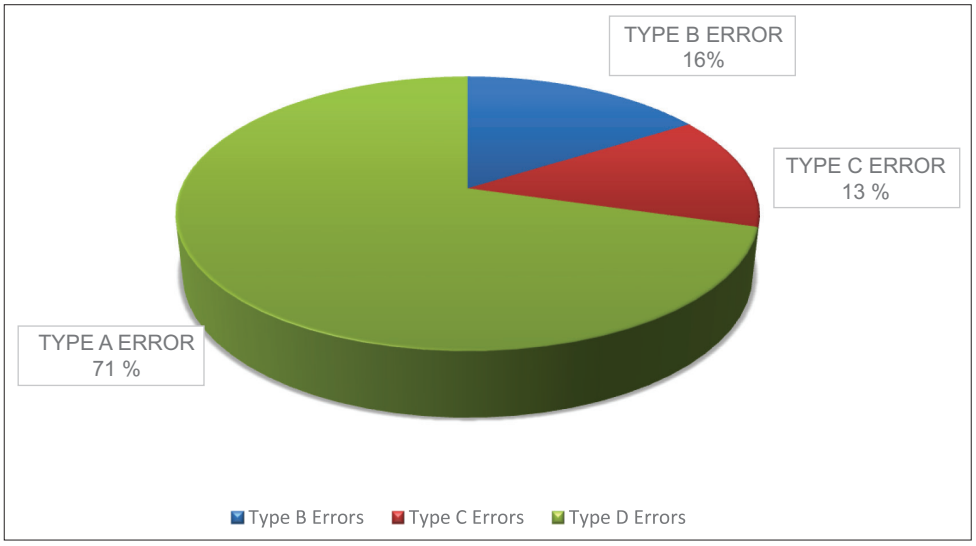

Figure 1: Percentage of medication error.

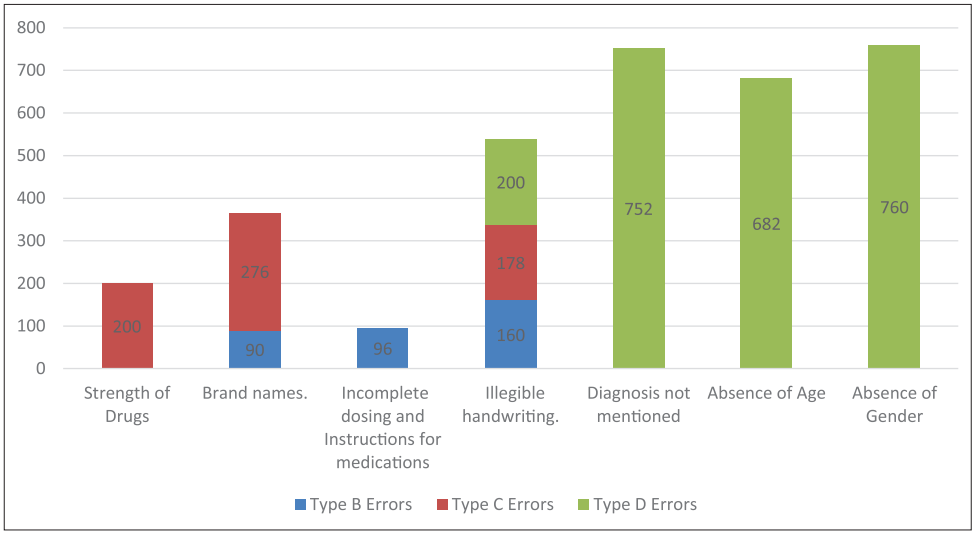

Figure 2: Types and causes of observed prescription errors.

Tablet "Ecosprin" 75 mg or 150 mg, tablet methylcobalamin 500 mcg or 1500 mcg. Medicines must be prescribed only by generic names to maintain uniformity, clarity, ease of understanding, and reduce the cost of medical care. However, the brand names are usually catchy, suggestive, and easy to remember making their use common. In government health care set-ups, usually the procurement is done as per the generic name of the drug. As a result, medicine from the same manufacturer may not be procured every time, and thus the brands of medicines may change with fresh procurement. Hence, it becomes even more important to prescribe using generic names only.

Omitting the strength of the preparation will not have much effect on dispensing medicines which are available in single strength; However, a large number of the medicines are available in multiple strengths such as glimepiride which is available as 1, 2, and 4 mg tablets; warfarin as 1, 2, and 5 mg tablets; atorvastatin as 10, 20, and 40 mg tablets; omeprazole as 20 and 40 mg tablets.

Incomplete dosing schedule/dosing instruction was found in 96 prescriptions leading to Type B errors. While indicating dosage schedules, it is better to avoid Latin words such as BD, TDS. Clear instructions such as 2 times a day for BD, 3 times a day for TDS should be used preferably along with the time of administration.

Poorly legible or illegible handwriting was another cause of prescription errors encountered in a total of 133 prescriptions (15.8% prescriptions), leading to all types of errors (160 Type B, 178 Type C, and 200 Type D) depending on the ability of the pharmacist to understand the prescription correctly. Writing a legible prescription is the legal responsibility of the prescriber, and he is responsible for wrong interpretation of the prescription by the pharmacist.[17]

The use of computers for prescription writing also may reduce prescription errors.[18,19] The computerized system can be integrated with patient details including his/her physiological parameters, known allergies, real-time

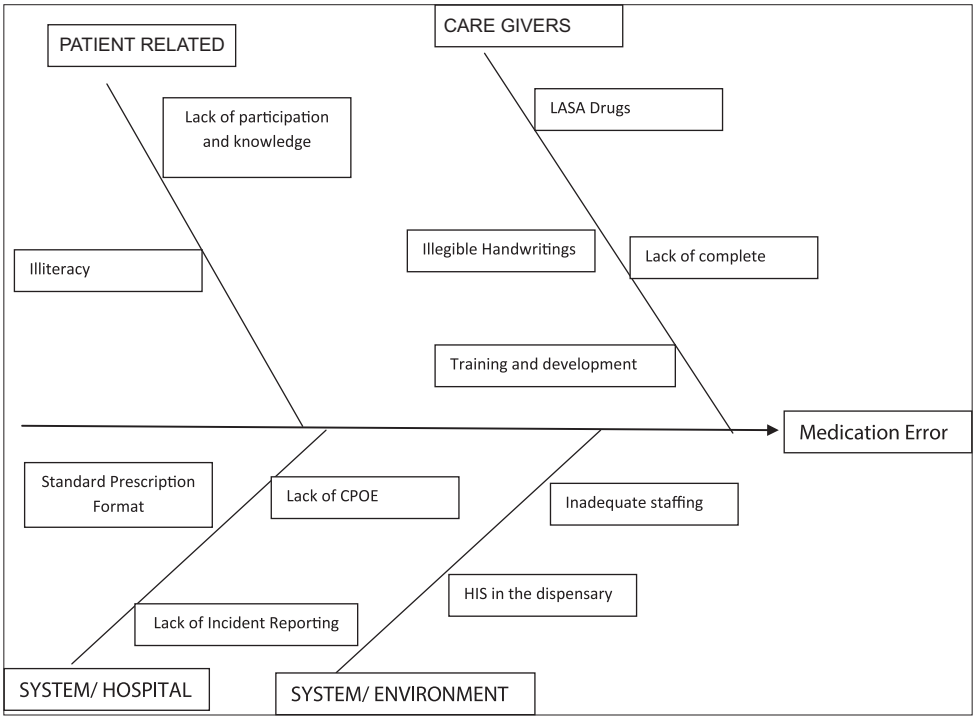

Figure 3: Cause and effect diagram of medication error.

information regarding the availability of medicines, and the system can be tailor-made to offer best possible therapy. Such prescription, once generated, can be sent electronically to the dispensary where dispensing packages can be prepared before the patient reaches the dispensary, thus reducing waiting time. However, evolving and applying such technology across a large number of hospitals and training of manpower remain major impediments in such an endeavor. Once implemented, updating the database in light of emerging evidence, data protection, maintaining confidentiality and routine troubleshooting will be major challenges in ensuring routine use of such a technology.

ROOT CAUSE ANALYSIS

Analysis of each event served to identify the root cause, which was defined as the event that precipitated the error. Each medication error was reviewed, and the decision was reached about the primary cause of the error (Figure 3)

More about medication errors may enhance health care professionals' ability to provide safe care to their patients. Future research should focus on identifying the errors that most commonly lead to patient harm. In addition, a better understanding of how information technology, labeling, medication reconciliation, and improved care transitions reduce medication errors is needed.

A focus on easy-to-use and inexpensive techniques for medication error reduction will likely have the greatest impact failures) that, if eliminated, would have either prevented the occurrence or reduced its severity.

CONCLUSION

Medication error is an important cause of morbidity and mortality, yet it can be a confusing and under-appreciated concept. A medication error is any error that occurs in the medication use process. It has been estimated by the IOM that mediation errors cause 1 of 131 outpatient and 1 of 854 inpatient deaths. Medication factors (e.g., similar sounding names, low therapeutic index), patient factors (e.g., poor renal or hepatic function, impaired cognition, polypharmacy), and health care professional factors (e.g., use of abbreviations, cognitive biases) can precipitate medication errors.

Learning more about medication errors may enhance health care professionals' ability to provide safe care to their patients. Future research should focus on identifying the errors that most commonly lead to patient harm. In addition, a better understanding of how information technology, labeling, medication reconciliation, and improved care transitions reduce medication errors is needed. A focus on easy-to-use and inexpensive techniques for medication error reduction will likely have the greatest impact.

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