Medication Errors in Clinical Practice

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Introduction

Many new psychopharmacologic agents have been developed and found to be effective in the treatment of psychiatric disorders. However, while these new agents have better tolerability profiles than many of the older drugs, the potential for prescription errors and adverse drug events continues to be an important problem in psychiatric practice.

The issue of medication errors received little attention until 1962, when Barker and McConnell in the United States of America (USA) first demonstrated that medication errors occur more frequently than suspected. They estimated a rate of 16 errors per 100 doses and suggested that the apparent increasing rate of prescribing errors was proportionate to the increasing number of drugs available. As the awareness about the potential implications of prescription errors grew, dedicated systems for reporting medication errors were set up in the USA and Europe. Health care professionals who encounter actual or potential medication errors were encouraged to report them confidentially or anonymously if preferred. In 1995, a multidisciplinary group of 17 national organizations formed the National Coordinating Council for Medication Error Reporting and Prevention. In 1999, the groundbreaking report of the Institute of Medicine (IOM) brought widespread attention to the problem of preventable adverse events including many due to medications.4

The Institute of Medicine’s (IOM) first Quality Chasm report, To Err Is Human: Building a Safer Health System, stated that medication-related errors (a subset of medical error) were a significant cause of morbidity and mortality; they accounted “for one out of every 131 outpatient deaths, and one out of 854 inpatient deaths”5 Medication errors were estimated to account for more than 7,000 deaths annually.6 Building on this work and previous IOM reports, the IOM put forth a report in 2007 on medication safety, Preventing Medication Errors.6 This report emphasized the importance of severely reducing medication errors, improving communication with patients, continually monitoring for errors, providing clinicians with decision-support and information tools, and improving and standardizing medication labeling and drug-related information.

Defining Medication Errors

The National Coordinating Council for Medication Error Reporting and Prevention defines a medication error as 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.3

Adverse Drug events and Adverse Drug Reactions

Adverse drug events are defined as injuries that result from medication use, although the causality of this relationship may not be proven.7 Some ADEs are caused by preventable errors. ADEs that are not preventable are often the result of adverse drug reactions (ADRs), which are defined as “any response to a drug which is noxious and unintended and which occurs at doses normally used for prophylaxis, diagnosis or therapy of disease, or the modification of physiological function, given that this noxious response is not due to medication error.”8

An adverse drug reaction is defined as “an undesirable response associated with use of a drug
that either compromises therapeutic efficacy, enhances toxicity, or both."

According to Bates and colleagues, more attention needs to be directed to ADEs—including both ADRs and preventable ADEs—which range in severity from insignificant to fatal.10

**Black box warnings and high-alert Medications**

In 1995, the FDA established the black box warning (BBW) system to alert prescribers to drugs with increased risks for patients. These warnings are intended to be the strongest labeling requirement for drugs or drug products that can have serious adverse reactions or potential safety hazards, especially those that may result in death or serious injury.11

According to the Institute for Safe Medication Practices (ISMP), “High-alert medications are those likely to cause significant harm when used in error.” ISMP’s list of high-alert medications is available at: www.ismp.org/tools/highalertmedications.pdf.12

**Studies on Medication Errors Worldwide**

In a study by Beso et al13, one or more dispensing errors were identified at the final check stage in 2.1% of 4849 dispensed items, and outside of the pharmacy department in 0.02% of 194,584 items. The majority of those identified at the final check stage involved slips in picking products, or mistakes in making assumptions about the products concerned. Another study from UK determined the incidence and type of medication errors in a large UK pediatric hospital over a five year period. The study found that medication errors occurred in 0.15% of admissions (195 errors; one per 662 admissions). While the highest rate occurred in neonatal intensive care (0.98%), most errors occurred in medical wards. Errors involving the intravenous route were commonest (56%), with antibiotics being the most frequent drug involved (44%).14 In a study by Pote et al15, the medication errors were analyzed in a prospective observational study conducted in 3 medical wards of a public teaching hospital in India. 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%). The medication classes involved most were antimicrobial agents (29.4%), cardiovascular agents (15.4%), GI agents (8.6%) and CNS agents (8.2%). The moderate errors contributed maximum (61.8%) to the total errors when compared to the major (25.5%) and minor (12.7%) errors. The results showed that the number of errors increases with age and number of medicines prescribed.

Lustig et al16 recorded prospectively the frequency of medication order errors in a general hospital in Israel with the objective of assessing the impact of pharmacist intervention in preventing potential harm. Principal types of errors detected were incorrect dosage (27.5%), interactions between drugs (20%), incorrect drug (12.5%), route (11.2%) and frequency (11.2%). Medication error rate by degree of severity was calculated per 100 patient days. The highest rate was found in Hemato-Oncology (2.48 %), followed by Intensive Care (0.82), Surgery (0.48) and Internal Medicine (0.26). Anti-infectives were the most frequently implicated (38.7%) followed by total parenteral nutrition preparations (21.8%), antineoplastics (15.6%) and anticoagulants (11.3%). A study from Thailand determined the incidence and type of medication errors, severity of events, patient outcomes and categories of drugs involved in the largest pediatric hospital in Thailand over a fifteen-month-period. The study found that medication errors occurred in 1 per cent of admissions (322 errors in 32,105 admissions). The most common error type was prescription error (35.40%). The majority of errors were detected and prevented before the drugs were administered (76.71%).17 Lesar et al18 reported the analysis of a 9-year experience with a systematic program of detecting, recording, and evaluating medication-prescribing errors in a teaching hospital. A total of 11,186 confirmed medication prescribing errors with potential for adverse patient consequences were detected and averted during the study period. The annual number of errors detected increased from 522 in the index year 1987 to 2115 in 1995. The rate of errors occurring per order written, per admission, and per patient-day, all increased significantly during the study duration (P < .001). Increased error rates were correlated with the number of admissions (P < .001). Antimicrobials, cardiovascular agents, gastrointestinal agents, and narcotics were the most common medication classes involved in errors. The most common type
of errors were dosing errors, prescribing medications to which the patient was allergic, and prescribing inappropriate dosage forms.

A systematic literature review using several databases was conducted to investigate the incidence and nature of dosing errors in children; 16 studies were found to be relevant. Eleven of the 16 studies found that dosing errors are the most common type of medication error, three of the remaining studies found it to be the second most common type. This review of published research on medication errors therefore suggests that dosing errors are probably the most common type of error in the pediatric population.19

### Incidence and Economic Impact of Medication Errors

The reported incidence of errors in treatment with medication among adults ranges from 1-30% of all hospitalized admissions20 or 5% of orders written (NCCMERP). In studies on child population, however, this number has been reported as high as 1 in 6.4 orders21 Drug errors associated with morbidity and mortality increased inpatient healthcare cost by an estimated $4700 per hospital admission or approximately $2.8 million annually for a 700-bedded teaching hospital.22 The economic burden for all areas of healthcare from drug misadventures exceeds $100 billion annually in the United States (US).23 The data regarding the incidence and economic impact of medication errors is lacking in developing world.

### Classification of Medication Errors

Medication errors can be classified in many ways. Some of the methods of classifying medication errors are listed below.

1. **Based on the onset**

   Medication errors can be classified as active or latent based on the onset. Active errors have an immediate effect. Latent errors have delayed effects, are easily identifiable and thus can be corrected before it recurs.

2. **Based on the underlying cause**

   Based on their cause medication errors can be classified as below:
   - **Omission error:** This error takes place when a patient has not received his or her medication by the time the next dose is due.
   - **Wrong dose error:** This type of error occurs when the patient receives an amount of medicine that is greater than or less than the amount ordered.
   - **An unordered error:** This error occurs when a patient receives a medication for which the physician did not write an order.
   - **Wrong dosage form error:** It involves the administration of a drug in a dosage form different from the one that was ordered.
   - **Wrong time error:** It occurs when the patient does not receive his/her medication within a predefined interval.
   - **Wrong route error:** They occur when the correct dosage form is administered, but in the incorrect site on the patient’s body.
   - **Deteriorated drug error:** It is reported when the physical or chemical integrity of a medication dosage form has been compromised, as with expired drugs or intravenous medications requiring refrigeration that are stored at room temperature.
   - **Wrong rate of administration errors:** These errors can occur with infusions of intravenous fluids or liquid enteral fluids.
   - **Wrong administration technique errors:** It involves the use of an inappropriate procedure during administration of a drug.
   - **Wrong dose preparation error:** It occurs when a product is incorrectly made or manipulated before administration.
   - **Extra dose error:** It occurs when the patient receives one or more dosage units in addition to those authorized, such as the dose administered after the dose was cancelled.

3. **Based on the medication error index**

   Medication errors may also be classified based on their error index (NCERP) as shown in Table 1.

4. **Based on the severity**

   Based on their severity medication errors may be classified as A, B and C.(Table 2)

### Causes of Medication Errors

There are five stages of the medication process: (a) ordering/prescribing, (b) transcribing and verifying, (c) dispensing and delivering, (d) administering, and (e) monitoring and reporting.6

Medication errors can occur at any of these stages. Most medication errors occur as a result of
Table 1: Medication error categorization index

<table>
<thead>
<tr>
<th>Error Category</th>
<th>Result</th>
</tr>
</thead>
<tbody>
<tr>
<td>Category A</td>
<td>Circumstances or events that have the capacity to cause error.</td>
</tr>
<tr>
<td>Category B</td>
<td>An error occurred, but the medication did not reach the patient.</td>
</tr>
<tr>
<td>Category C</td>
<td>An error occurred that reached the patient but did not cause patient harm.</td>
</tr>
<tr>
<td>Category D</td>
<td>An error occurred that resulted in the need for increased patient monitoring, but no patient harm.</td>
</tr>
<tr>
<td>Category E</td>
<td>An error occurred that resulted in the need for treatment or intervention and caused temporary patient harm.</td>
</tr>
<tr>
<td>Category F</td>
<td>An error occurred that resulted in initial or prolonged hospitalization and caused temporary patient harm.</td>
</tr>
<tr>
<td>Category G</td>
<td>An error occurred that resulted in permanent patient harm.</td>
</tr>
<tr>
<td>Category H</td>
<td>An error occurred that resulted in near-death event.</td>
</tr>
<tr>
<td>Category I</td>
<td>An error occurred that resulted in patient death.</td>
</tr>
</tbody>
</table>

Table 2: Classification of medication errors based on the severity

<table>
<thead>
<tr>
<th>Degree of Severity</th>
<th>Definition</th>
<th>Examples</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Potentially serious error that can cause permanent harm to patient, may increase hospitalization or need of additional treatment</td>
<td>Overdose of potassium chloride in total parenteral nutrition, order of doxorubicin instead of daunorubicin</td>
</tr>
<tr>
<td>B</td>
<td>Clinically significant error can increase need for patient monitoring</td>
<td>Tazobactum 4 gm twice daily to an obese septic patient</td>
</tr>
<tr>
<td>C</td>
<td>Clinically non-significant error that does not harm the patient</td>
<td>Pantoprazole IV to a patient who can swallow</td>
</tr>
</tbody>
</table>

Methods to Detect Medication Error

To prevent the further occurrence of medication errors, it is essential to detect them. Many methods are employed to detect the occurrence of medication errors. Some of them are described below.

- **Anonymous self reports**: The person committing the error (or witnessing one) reports the mistake without being associated with it.
- **Incident reports**: This involves the official written legal report of a medication error as documented by hospital staff.
- **Critical incident technique**: This event-sampling technique involves in-depth analysis of a large number of individual errors to identify common causal factors.
- **Disguised-observation technique**: An observer accompanies the person giving the medications, witnesses the administration of each dose, writes down exactly what the subject does while administering drugs and notes consumption of the medication by the patient.
- **Dispensing error detection techniques**: To study the errors that occurred before the medication is prepared for administration to the patient, such as pharmacy dispensing errors, various techniques like participant observer technique, critical incident method are employed.

Prevention of Medication Errors

Healthcare professionals need to develop and maintain an ongoing process that uncovers potential risk while promoting ways to eradicate vulnerability to error. In order to accomplish these tasks, the system needs to provide resources to monitor and
evaluate errors and to implement methods to reduce them. This process is referred to as a system approach to medication error reduction. A system is defined as “an interdependent group of items, people, or process with a common purpose.” Some system approaches are relatively inexpensive and easily implemented such as the pharmacy computer system. The ISMP suggest a number of error prevention tools ranging from forcing functions to independent double check systems. These include software programs with forcing functions that require the entry of additional pertinent patient information before the order is completed and the medication is dispensed. These programs also trigger other alerts such as look alike and sound alike medications. A number of agencies like United States Food and Drug Administration (US FDA), ISMP and USP keep track of medication errors and publish guidelines to avoid medication errors. In India, there are around thirty Pharmacovigilance centres operating as regional and peripheral centers situated at medical colleges in several states and are scanning instances of adverse drug reaction since January 2005.

**Conclusion**

Prescription errors are a source of considerable mortality, morbidity, and health-care costs in the world today but the important thing is that they can be prevented. Educational intervention programs and computer aided prescription order entry can substantially contribute in the lowering of such errors.

A combined approach of regulatory, managerial and educational interventions may be an ideal way to minimize the occurrence of prescription errors. Prospective observational studies of are needed to more accurately determine the frequency of prescription errors in psychiatry. The healthcare providers using electronic system to write prescriptions (e-prescribing) were seven times less likely to make errors than those writing their prescriptions by hand. E-prescribing promises to be useful innovation but its exact potential in reducing prescription error needs to be explored by comprehensive research.

**References**