

Medical Harm and Patient Safety- II: Medication Errors

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In this second series on Medical harm and patient safety, I will discuss Medication Errors. It is essential to review some definitions before we discuss medication errors.

Medical Error: as defined by the Institute of Medicine (IOM), is “the failure to complete a planned action as intended or the use of a wrong plan to achieve an aim^{1,2}.”

Adverse Event: Medical errors may cause adverse events. An adverse event (AE) is “an injury caused by medical management rather than by the underlying disease or condition of the patient.” Most medical errors do not cause adverse events, a few do. Even these few are not excusable. Medical excellence is demanded by the patients and society³. Rate of adverse events among hospital patients is an important indicator of patient safety. In various countries, hospital chart reviews have revealed that 2.9–16.6% of patients in acute care hospitals experienced one or more AEs. Weighted AE rate was 7.5 per 100 medical or surgical hospital admissions. More than a third of AEs judged to be highly preventable (36.9%). 9% of deaths associated with an AE judged to be highly preventable. Most patients who experienced an AE recovered without permanent disability. However, there is significant morbidity and mortality associated with AEs. 5.2% resulted in permanent disability. 15.9% resulted in death⁴.

Medication Error: Medication use has become increasingly complex in recent times. The National Coordinating Council for Medication Error Reporting and Prevention defines a medication error as “any preventable error that may cause or lead to inappropriate medication use or patient harm while medication is in control of the health care professional, patient or consumer. Such events may be related to professional practice, health care products, procedures, and systems, including prescribing; order communication; product labeling, packaging, nomenclature;

compounding; dispensing, distribution; administration; education and monitoring.” Medication error is the most frequent type of medical error at a rate of 0.5 ADEs per 100 admissions^{5,6,7}. An evaluation of complications associated with medications among patients at 11 primary care sites in Boston. Of 2258 patients who had had drugs prescribed, 18% reported having had a drug related complication, such as gastrointestinal symptoms, sleep disturbance, or fatigue in the previous year.

Adverse drug event (ADE): Adverse drug event is an injury because of a medication. About 1% of medication errors result in ADE⁸. Given a large numbers of medication errors, number of ADEs is very significant.

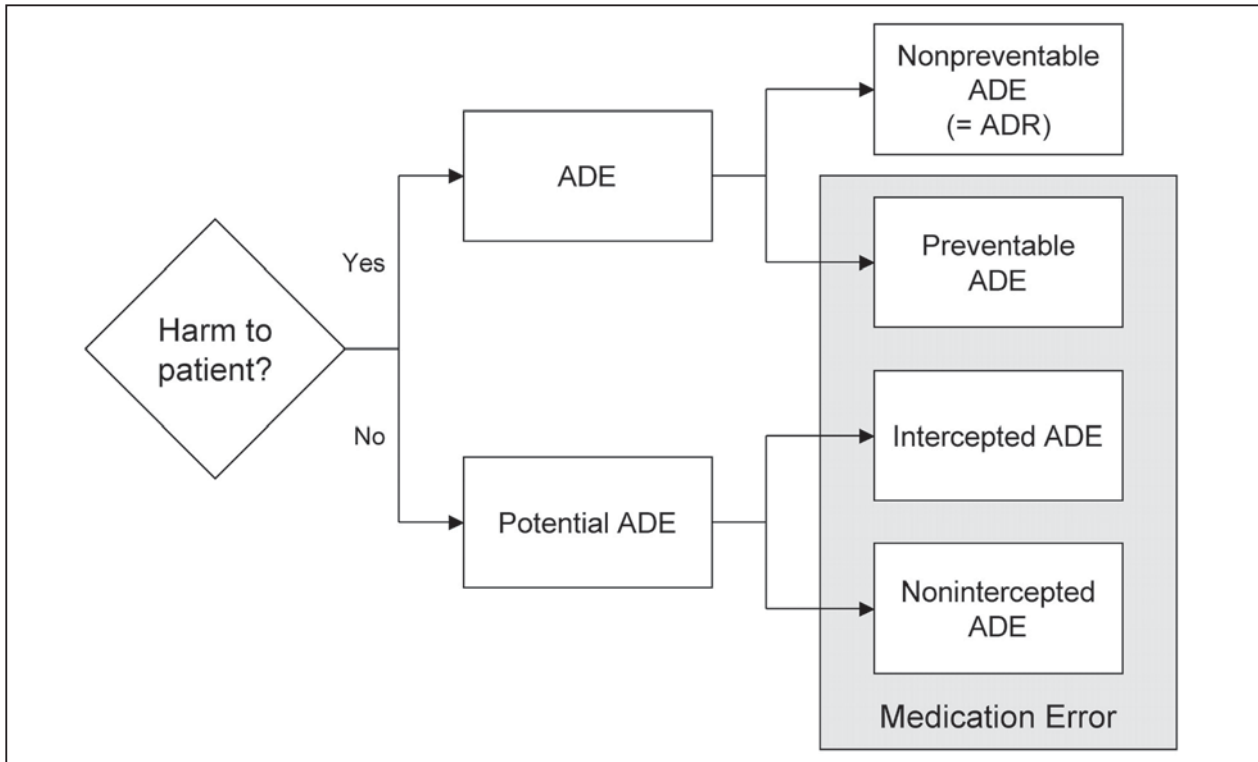
Adverse drug effects can be preventable or unpreventable. Preventable ADEs are due to mistakes in prescribing, administration and monitoring. Unpreventable ADEs are because of inherent side effect of a drug. Unpreventable drug reactions cannot be foreseen,

Potential ADE: is a medication error that places the patient at significant risk of injury but does not cause any harm. These are near misses. The potential error can be intercepted or non- intercepted. Again potential serious harm/death can sometimes be averted by treatment of the harm at right time.

Errors of Omission and Commission: Medication errors can also be classified as errors of commission or omission. An error of commission occurs when an incorrect action is taken, such as giving potassium chloride as IV bolus. An error of omission results when a correct action is not taken, such as not checking patient's chart before doing an imputation.

I am giving some examples of Adverse Drug Events, which I encountered during my practice over three decades. The effects of the events ranged from innocuous to serious.

The following figure shows the relationship among medication errors, ADEs, and harm.



1. Allergic rash due to Carbamazepine- Non preventable ADE (side effect of medication).
2. A 2-year old child starts to vomit, when given zinc tablets for treatment of viral diarrhoea-unpreventable ADE (side effect).
3. A patient is prescribed high dose of Ranitidine, pharmacist detects the error and refers him back to the physician-intercepted (before the event) ADE.
4. Patient of a cancer receives Metoclopramide before chemotherapy and develops oculo-gyric crisis-Non preventable ADE, easily reverted.
5. Administration of 10 mg of Morphine sulfate IM to the baby, instead of the mother for whom it was prescribed for pain (preventable ADE). The baby stopped breathing; the nurse realized the problem in time and with help from pediatrician on duty was resuscitated successfully by respiratory support and administration of Naloxan-Preventable ADE, intercepted after the event.
6. A one year old boy weighing 10 Kg receives 1ml (10 mg) of morphine, instead of 0.1 mg prescribed. Baby was again resuscitated-Preventable ADE-calculation error, intercepted after the event.
7. Baby dies of anaphylaxis after administration of measles vaccine at a sub health post. This is unpreventable ADE, because it was not known that patient will be allergic to a constituent of Measles

8. Five ml of KCL was injected directly intravenous, when it was ordered to be added in IV fluid bottle. Patient has a cardiac arrest and is resuscitated successfully but later had convulsions and diminished cognition (preventable, ADE) resulting in serious medical harm.
9. A patient, who was doing well on high dose ionotrope in PICU goes back into shock because extravasation of intravenous fluids with drug was detected late (Preventable ADE).

The first three ADEs are of innocuous nature, the fourth caused lot of worry to patient's family, though could be resolved easily; while last five are of severe nature. Even innocuous AED may take a serious form, if not intercepted in time, for example if patient was not instructed to report any rash while starting treatment and carbamazepine, and medication was not stopped in time, it could have taken a severe form of Steven Johnson Syndrome. All five of severe ADEs in the list above are potentially life threatening. National Quality Forum described 28 events as Never Events. These never events are serious, unambiguous, reportable and usually preventable. These should never occur in a hospital and generally indicate a system failure⁹.

Children are recognized to as high risk population for medication errors and ADEs. The risk from an ADE is estimated to be three times higher in admitted children than in admitted adults^{10,11}. This is because of following reasons:

1. Dosing of children has to be calculated according to weight. There may be error in taking the weight or in calculating the drug dose.
2. The children may be treated in an adult facility, where nursing staff is not proficient in looking after children.
3. Most drugs are packaged for adult patients. A mistake may be made in its dilution for a young child (error of commission).
4. In neonatal care units, where patient may stay for a long time, fluctuations in weight (increase or decrease) may be very significant and requires recalculation with these changes, which may be missed (error of omission).

Patients on multiple medications, patients with another condition, e.g. renal impairment, pregnancy, patients who cannot communicate well, patients who have more than one doctor, patients who do not take an active role in their own medication use; are also at increased risk of medication errors.

Certain circumstances such as inexperience, rushing, doing two things at once, interruptions, fatigue, boredom, being on "automatic pilot" leading to failure to check and double-check, lack of checking and double checking habits, poor teamwork and/or communication between colleagues and reluctance to use memory aids; place a patient to be on high risk of having an adverse drug reaction.

Steps in using medication: The three steps in using medication are prescribing, administering and monitoring. These steps may be carried out by the health workers or the patient himself; e.g. self prescribing over the counter medication and self medication of prescribed medication at home.

A. Prescribing:

Prescribing involves

- i. Choosing an appropriate medication for a given clinical situation.
- ii. Taking individual patient factors into account such as allergies
- iii. Selecting the administration route, dose, time and regimen, communicating details of the plan with:

- a. whoever will administer the medication (written-transcribing and/or verbal)
- b. and the patient

iv. Documentation

Prescribing can go wrong in following circumstances:

- i. Inadequate knowledge about drug indications and contraindications.
- ii. Not considering individual patient factors such as allergies, pregnancy, co-morbidities, and other medications.
- iii. Wrong patient, wrong dose, wrong time, wrong drug, and wrong route.
- iv. Inadequate communication (written, verbal). This is a very important step. Prescribing should always be in written form and time must be taken for explaining to the patient.
- v. Documentation - illegible, incomplete, ambiguous.
- vi. Mathematical error when calculating dosage.
- vii. Look alike and sound alike medicines.
- viii. Incorrect data entry when using computerized prescribing e.g. duplication, omission, wrong number

B. Administration of a drug involves:

- i. Obtaining the medication in a ready-to-use form; may involve counting, calculating
- ii. Mixing, labeling or preparing
- iii. Checking for allergies
- iv. Giving the right medication to the right patient, in the right dose, via the right route at the right time (5Rs)
- v. Documentation

Drug administration can go wrong if any of above is omitted or not performed correctly.

C. Monitoring

Monitoring involves observing the patient to determine if the medication is working, being used appropriately and not harming the patient. All these must be documented.

Monitoring can go wrong in following circumstances:

- i. Lack of monitoring for side-effects
- ii. Drug not ceased if not working or course complete.

- iii. Drug ceased before course completed
- iv. Drug levels not measured, or not followed up on, when indicated and feasible, communication failure

It is absolutely essential to have safe work place design. Safety culture must be present at all facilities. This should include mandatory reporting of adverse events. Lessons must be learnt from past near misses and adverse events. There should be adequate staff members recruited.

Prevention of Medical Errors

A. Primary prevention

Following precautions, if taken will greatly reduce number of medication errors:

- i. Use generic names where appropriate
- ii. Tailor your prescribing for individual patients
- iii. Obtain a thorough list of patient's current medication
- iv. Obtain an accurate list of patient's allergies and adverse reaction
- v. Know which medications are high risk and take precautions
- vi. Know the medication you prescribe well
- vii. Weigh your patient accurately
- viii. Write legibly.
- ix. Avoid use of unsafe abbreviations
- x. Mind decimals. Weight based calculators can be used.
- xi. Remember the 5 Rs (right drug, right route, right time, right dose, right patient), when prescribing and administering.
- xii. Communicate clearly
- xiii. Develop checking habits.
- xiv. Encourage patients to be actively involved in the process. Educate patients and their families.
- xv. report and learn from medication errors

B. Secondary Prevention: involves rapid detection and removal of errors introduced in management system, intercepting them before they become preventable errors as in example no.3, where pharmacist detected the high dose of prescribed ranitidine. Computerized weight based calculations and information on drug interactions at pharmacy is found to be most helpful, where possible. Computerized Physician Order Entry (CPOE)¹²

systems are electronic prescribing systems that incept errors, which most commonly occur-at the time medications are ordered. With CPOE, physicians enter orders into a computer rather than on paper. Orders are integrated with patient information, including laboratory and prescription data. The order is then automatically checked for potential errors or problems.

C. Tertiary prevention: aims at taking quick action and minimizing the harm as in examples 5, 6 and 8. In example 8. Because of quick action, the patient lived but was left with handicap. This indicates that primary prevention is the best prevention.

Matthew Grissinger, a medication safety analyst, identified 10 drugs most commonly implicated in adverse events requiring treatment in a hospital emergency department¹³. These in order of frequency include- Insulin, Anticoagulants, Amoxicillin, Aspirin, Trimethoprim-sulfamethoxazole, hydrocodon-acetamenophen, Ibuprofen, Acetamenophen, Cephalexin and Penicillin.

A somewhat different top 10 list identifies medications that are most commonly misused or mishandled in some way by healthcare professionals¹⁴. This list is based on information from the United States Pharmacopoeia (USP), which maintains a database of medication errors that are reported anonymously. In the year 2005, these drugs in order of frequency were: Insulin, Morphine, Potassium chloride, Albuterol, Heparin, Vancomycin, Cefazolin, Acetaminophen, Warfarin and Furosemide.

Conclusion

It is evident that the status quo is no longer acceptable. Furthermore, we now know much more about what to do about reducing the consequences of error than we did before, although it is still not nearly enough. The next painstaking task will be routinely measuring what we do, making the results available, and then going through the systems of medicine, one at a time, and bringing them forward to the 21st century.

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How to cite this article ?

Adhikari N. Medical Harm and Patient Safety- II: Medication Errors. *J Nepal Paedtr Soc* 2011;31(1):75-79.
