World Health Organization

Patient Safety

A World Alliance for Safer Health Care

Patient Safety Curriculum Guide
Multi-professional Edition

Topic 11
Improving medication safety

Inappropriate medications for a child with nausea

While on holiday, Heather's 8-year-old daughter, Jane, was unwell and started vomiting. Heather took her to the local health clinic and saw a doctor who said her daughter as suffering from asthma and required a nebulizer. The doctor diagnosed nausea secondary to an ear infection and prescribed an antibiotic. He injected chlorpromazine, metoclopramide, and atropine to treat the nausea.

Jane later suffered diminished consciousness and was admitted to the small local hospital. She was subsequently transferred to a larger hospital because of her respiratory symptoms.

The clinic doctor thought he was doing the right thing, having learnt about this cocktail of medications while training as an intern. However, the drugs weren't appropriate for nausea in children because of the potential for adverse reactions and the difficulty in monitoring the child's subsequent condition. The doctor also didn't give adequate information about the drugs to Heather.

Source: Walton M. *Well being: how to get the best treatment from your doctor*. Sydney, New South Wales, Australia, Pluto Press, 2002:51.

Methadone overdose

When Matthew presented himself at the methadone clinic, there were three nurses on duty. Two of the nurses failed to identify Matthew properly and administered methadone without paying proper attention to the dose.

The dose of methadone given was 150 mg when it should have been 40 mg. The nurses also failed to notify the treating doctor when they became aware of the excessive dose. They then instructed the third nurse to give Matthew a take-home dose of 20 mg, despite being aware of the excessive dosage and without the authorization of the medical practitioner. Matthew died in the early hours of the following morning of methadone poisoning.

Source: Case studies. *Health Care Complaints Commission Annual Report* 1995–1996:38. Sydney, New South Wales, Australia.

Introduction–Why focus on medications?

Medicines have proven to be very beneficial for treating illness and preventing disease. This success has resulted in a dramatic increase in the use of medication. Unfortunately, this increase in use has brought with it an increase in hazards, errors and adverse events associated with medication use.

For a number of reasons, the use of medication has also become increasingly complex. There has been a massive increase in the number and variety of medications available. These medications have different routes of delivery and variable actions (long-acting, short-acting). Sometimes the same formulation of a particular drug is sold under more than one trade name, and this can cause confusion.

Although improved treatments for chronic disease are now available, more patients are now taking multiple medications and there are more patients with multiple co-morbidities. This increases the likelihood of drug interactions, side-effects and mistakes in administration.

The process of delivering medications to patients often involves a range of health-care professionals. Communication failures can lead to gaps in the continuity of the process. Health professionals are prescribing a larger range of medications, so there are more medicines they need to be familiar with. There is just too much information for a health professional to be able to remember in a reliable way without the help of reference materials. Nurses, pharmacists, dentists and doctors look after patients who are taking medications often prescribed by other clinicians (often specialists) and, hence, they may not be familiar with the effects of all the medications a patient is taking.

In addition to pharmacists, professionals who prescribe play a major role in the use of medicine. Their role includes prescribing and administering medications, monitoring for side-effects and working in a team. Health professionals play potentially fulfilling leadership roles in the workplace, in relation to medication use and improving patient care.

As future health-care professionals, students need to understand the nature of medication error, learn what hazards are associated with their use and learn what can be done to make medication use safer. Pharmacists, doctors and nurses play a leading role in reducing medication errors,

but everyone involved in the use of medication has a responsibility to work together to minimize the harm caused to patients by medications.

Keywords

Side-effect, adverse reaction, error, adverse event, adverse drug event, medication error, prescribing, administration and monitoring.

Learning objective

This topic provides an overview of medication safety. It is designed to encourage students to continue to learn and practise ways to improve the safety of medication use.

Learning outcomes: knowledge and performance

Knowledge requirements

Students should know:
- the scale of medication error;
- that the use of medications is associated with risks;
- common sources of error;
- where in the process errors can occur;
- the responsibilities associated with prescribing and administering medication;
- how to recognize common hazardous situations;
- ways to make medication use safer;
- the benefits of a multidisciplinary approach to medication safety.

Performance requirements

Medication safety is a vast topic. A health professional who understands the issues and risks involved in the use of medication will:
- use generic names;
- tailor prescribing for each patient;
- practise taking thorough medication histories;
- know which medications are high-risk;
- be very familiar with the medications he/she prescribes and/or dispenses;
- use memory aids;
- communicate clearly;
- develop checking habits;
- encourage patients to be actively involved in the medication process;
- report and learn from errors;
- understand and practise drug calculations, including adjustments based on clinical parameters (e.g. renal clearance);
- detect potential/actual drug–drug and drug–food interactions.

Definitions 6 7

Side-effect

A side-effect is a known effect, other than that primarily intended, relating to the pharmacological properties of a medication [1]. For example, a common side-effect of opiate analgesics is nausea.

Adverse reaction

An adverse reaction occurs when unexpected harm results from a justified action, when the correct process was followed for the context in which the medication was used [1]. An example of this would be an unexpected allergic reaction in a patient taking a medication for the first time.

Error

An error is a failure to carry out a planned action as intended or the application of an incorrect plan [1].

Adverse event

An incident in which a patient is harmed [1].

Adverse drug event

An adverse event involving medication (an adverse drug event) may be preventable (e.g. the result of an error) or may not be preventable (e.g. an unexpected allergic reaction in a patient taking a medication for the first time, as described above).

Adverse drug reaction

Any response to a medication that is noxious and unintended. This WHO definition includes injuries that are judged to be caused by the drug and excludes injuries due to drugs that are caused by error.

Medication error

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 [2]. Such events may be related to professional practice, health-care products, procedures and systems, including: prescribing; order communication; product labelling, packaging and nomenclature; compounding; dispensing; distribution; administration; education; monitoring; and use.

Prescribing

A *prescription* is an order to take certain medications. In many countries, the prescriber has legal responsibility for the clinical care of the patient, as well as a role in monitoring the safety and efficacy of the drug(s). The prescribing of a medication requires the health professional to make a decision about the drug, the drug regimen, the documentation of the drug in the health-care records, and ordering. Health professionals are assisted in medication prescribing by evidenced-based practices that ensure the right drug is given appropriately to the right patient. But in addition, health professionals are also required to take into account the patient's preferences, values and economic circumstances. In some settings, there may be also limited resources and restrictions on what can and cannot be supplied to patients.

Errors are known to occur in the prescribing stage and are often associated with a health professional's inexperience and lack of knowledge about the medication, failure to follow an agreed upon protocol, or other factors such as tiredness and lapse of memory.

In addition to prescription drugs, consumers self-prescribe and take drugs they buy over the counter. Sometimes these drugs can cause adverse events particularly when taken with other medications. Consumers should always seek advice from pharmacists when they intend to mix over-the-counter drugs with their prescription medications.

Medication error

A medication error may result in:
- an adverse event, in which a patient is harmed;
- a near miss, in which a patient is nearly harmed;
- neither harm nor potential for harm.

Medication error is a common cause of preventable patient harm. The IOM estimates that in the USA there is one medication error per hospitalized patient per day [3], 1.5 million preventable adverse drug events per year [3], and 7000 deaths per year from medication errors in hospitals in that country [4].

Researchers in other countries around the world in which the incidence of medication error and adverse drug events have been investigated have reported similarly worrying statistics [5]. Only 15% of the prescribing errors that are made reach patients; the others are caught in time by pharmacists and other health-care workers. This fact underscores the importance of teamwork. By working together, health-care providers can prevent many adverse events.

Manufacturing, distribution and marketing
Before drugs can be used on humans, they must be tested to make sure they are safe. The development and manufacturing of drugs is highly regulated in most countries.

Steps in using medication `8`

There are a number of discrete steps in using medication: prescribing, dispensing, administering and monitoring are the main four. Doctors, pharmacists, patients and other health-care professionals all play major roles in this process. For example, some patients may self-prescribe over-the-counter medication, administer this medication on their own and self-monitor to see if there has been any therapeutic effect. Alternatively, for example, in the hospital setting, when a doctor prescribes a medication, a pharmacist will then dispense the medication, a nurse will administer the medication and a nurse and a different doctor may end up monitoring the patient's progress and making decisions about the ongoing drug regimen. In a collaborative practice, a pharmacist may adjust the dose.

The main components of each of the four steps mentioned above are outlined below.

Prescribing `9`
The prescribing health-care professional must choose an appropriate medication for a given clinical situation, taking individual patient factors into account, such as allergies. The prescriber also needs to select the most appropriate administration route, dose, time and regimen. This plan must be communicated to whoever will administer the medication (this communication may be written, verbal or both) and the full plan must be properly documented.

Dispensing
A pharmacist will transcribe the prescription written by the prescribing health professional and check the transcription. The pharmacist will then pick the medication, checking it against the prescription, and document his/her work.

Administering
Administering a medication may include obtaining the medication and having it in a ready-to-use form. This may involve counting, calculating, mixing, labelling or preparing the drug in some way. Anyone administering medication must always check for allergies and check that they are giving the correct dose of the correct medication to the correct patient via the correct route at the correct time. The person who administers the medication must document what he/she has done.

Monitoring
Monitoring involves observing the patient to determine whether the medication is working, being used correctly and not causing harm. Monitoring activities must also be documented, just like all the other steps in the medication process.

There is potential for error at every step of the process. There are a variety of ways that errors can occur at each step.

The use of medication carries risks `10` `11` `12` `13`

The use of medication involves certain risks. Different risks and opportunities for error are associated with different steps in the medication process.

Prescribing
Inadequate knowledge about drug indications, contraindications and drug interactions can lead to prescribing errors. This has become an increasing problem as the number of medicines in use has increased. It is not possible for an individual health-care professional to remember all the relevant details necessary for safe prescribing, without referring to reference materials. Alternative ways of accessing drug information are required. Failure to consider physical, cognitive, emotional and social factors that might alter prescribing, such as allergies, pregnancy, co-morbidities, health literacy and other medications the patient may be taking is another source of errors.

Errors may involve prescribing for the wrong patient, prescribing the wrong dose, prescribing the wrong drug, prescribing the wrong route or the wrong time for drug administration. These errors can sometimes occur due to lack of knowledge, but more commonly are a result of a "silly mistake" or "simple mistake", referred to as a slip or a lapse. These are the sorts of errors that are more likely to occur at 04:00, or if the prescribing clinician is rushing, bored or tired, and not fully concentrating on the task at hand.

Inadequate communication is another source of prescribing errors. Communication that is ambiguous can be misinterpreted (e.g. certain abbreviations). Errors may result from illegible writing or a simple misunderstanding in verbal communication.

Mathematical errors made in calculating doses can cause medication errors. These errors can be a result of carelessness or fatigue,

but can also be the result of a lack of training and unfamiliarity with how to manipulate volumes, amounts, concentrations and units and/or a lack of access to updated parameters. Calculation errors involving medications with narrow therapeutic windows can cause major adverse events. Not uncommonly, a calculation error can occur when transposing units (e.g. from micrograms to milligrams). This type of miscalculation may result in a 1000 times error. Competence with dose calculations is particularly important in paediatrics, where most doses are determined according to the weight of the child.

Dispensing

A 2007 study showed that higher pharmacy workload, defined as the number of prescriptions dispensed per pharmacist work hour, led to increased risk of dispensing a potentially unsafe medication. The following steps [6] can be taken by pharmacists to decrease the risk of a dispensing error:
- ensure correct entry of the prescription;
- confirm that the prescription is correct and complete;
- beware of look-alike, sound-alike drugs (similar drug names account for one-third of medication errors);
- be careful with zeros and abbreviations;
- organize the workplace;
- reduce distraction when possible;
- focus on reducing stress and balancing heavy workloads;
- take the time to store drugs properly;
- thoroughly check all prescriptions;
- always provide thorough patient counseling.

Administering | 14 | | 15 | | 16 | | 17 |

Classic administration errors are the wrong dose of a drug being given to the wrong patient, by the wrong route, at the wrong time, or the wrong drug being used. Not administering a prescribed drug is another form of administration error. These errors can result from inadequate communication, slips or lapses, lack of checking procedures, lack of vigilance and calculation errors, as well as suboptimal workplace and medication packaging design. In these cases, there is often a combination of contributory factors.

Inadequate documentation can also lead to administration errors. For example, if a medication is administered, but has not been recorded as being given, another staff member may also give the patient the medication thinking that it had not yet been administered.

Calculation mistakes for IV drugs (e.g. drops/h or drops/min, ml/h or ml/min) are another type of administration error.

Monitoring | 18 | | 19 | | 20 |

Errors in this area include inadequate monitoring for side-effects, not ceasing medication once the prescribed course has been completed or is clearly not helping the patient and not completing a prescribed course of medication. Monitoring errors occur when drug levels not measured or measured but not checked or acted upon. These errors often involve communication failures.

There is a particular risk of a communication failure when the care provider changes, for example, when a patient moves from a hospital to a community setting or vice versa.

Contributory factors for medication errors

Adverse medication events are frequently multifactorial in nature. Often there is a combination of events that together result in patient harm. This is important to understand for a number of reasons. In trying to understand why an error occurred, it is important to look for all the contributing factors, rather than the most obvious reason or the final step in the process. Strategies to improve medication safety also need to target multiple points in the process.

Patient factors | 21 |

Certain patients are particularly vulnerable to medication errors. These include patients with specific conditions (e.g. pregnancy, renal dysfunction, etc.); patients taking multiple medications, particularly if these medications have been prescribed by more than one health-care provider; patients with a number of health problems; and patients who do not take an active interest in being informed about their own health and medications. Patients with memory issues (e.g. Alzheimer patients) and patients who cannot communicate well, including unconscious patients, babies and young children, and patients who do not speak the same language as the staff, are also particularly vulnerable to medication errors. Children and babies, especially neonates have a heightened risk of exposure to medication errors due to the drug-dose calculations required when treating them.

Staff factors | 22 |

Staff factors that increase the risk of medication errors include inexperienced personnel; rushing, as in emergency situations; multitasking; being interrupted mid-task; and fatigue, boredom

and lack of vigilance. A lack of checking and double-checking habits or checking by different individuals can also lead to medication errors, as do poor teamwork, poor communication between colleagues and reluctance to use memory aids.

Workplace design factors 23
Workplace design factors also contribute to medication errors, including the absence of a safety culture in the workplace. This may be evidenced by a lack of reporting systems and failure to learn from past near misses and adverse events. Other workplace design factors include the absence of readily available memory aids for staff and/or other information on specific medications, poor or no access to diagnostic data for the pharmacy team and inappropriate storage of medications, e.g. different drugs with confusingly similar names kept near one another or medicines not stored in easy-to-use forms or not stored in their usual place. Inadequate staffing is another workplace design issue that can lead to increased medication errors.

Medication design factors 24
Certain medication design factors can also increase the risk of medication errors. Some medications can be easily confused, such as pills that are similar in appearance (e.g. colour, shape). Medications with similar names can also be easily confused. Examples of this problem include celecoxib (an anti-inflammatory), fosphenytoin (an anticonvulsant) and citalopram hydrobromide (an antidepressant), which when their brand names are used might be confusing (Celebrex, Cerebryx and Celexa); as well as ephidrin and epinephrine. Ambiguous labelling is another source of confusion. Different preparations or dosages of similar medication may have similar names or packaging. For example, phytonadione 1 mg and 10 mg are very similar looking. Some slow-release medications may differentiate themselves from the usual release form with a suffix. Unfortunately, there are many different suffixes in use to imply similar properties, such as slow release, delayed release or long-acting (e.g. LA, XL, XR, CC, CD, ER, SA, CR, XT and SR).

Certain medication design problems lend themselves to administration errors, including labelling that is too small to read and difficult-to-read dose information on vials. A lack of measuring instruments (e.g. spoons for syrups) is another problem.

Other technical factors
Other technical factors can also contribute to medication errors. For example, identical connectors for IV lines and intrathecal lines allow for drugs to be given by the wrong route.

Some ways to make medication use safer 25

Use generic names 26
Medications have both trade names (brand names) and generic names (active ingredient). The same drug formulation can be produced by different companies and given several different trade names. Usually the trade name appears in large letters on the box/bottle and the generic name appears in small print. It is difficult enough familiarizing oneself with all the generic medications in use; it can be almost impossible to remember all the related trade names. To minimize confusion and simplify communication, it is helpful if staff use only generic names. However, it is important to be aware that patients will often use trade names as this is what appears in large print on the packaging. This can be confusing for both staff and patients. For example, consider a patient being discharged from hospital with a prescription for their usual medication, but with a different trade name. The patient may not realize that the medication they were prescribed upon discharge is the same as their preadmission medication and hence continue taking that medication as well, since no one has told them to cease it or that it is the same as the "new" medication. It is important for prescribers and pharmacists to explain to patients that some medications may have two names.

Medical doctors and other prescribers should prescribe drugs by their generic names. Patients should be encouraged to keep a list of their medications, including both the trade and generic name of each drug.

Tailor your prescribing for individual patients 27
Before prescribing a medication, always stop and think, "is there anything about this patient that should alter my usual choice of medication?". Factors to consider include allergies, pregnancy, breastfeeding, co-morbidities, other medications the patient may be taking, and the size and weight of the patient.

Learn and practise collecting complete medication histories 28
Medication histories should be taken by both prescribing health professionals and pharmacists. When collecting a medication history, the following guidelines should be followed.

- Include the name, dose, route, frequency and duration of every drug the patient is taking.
- Ask about recently ceased medications.
- Ask about over-the-counter medications, dietary supplements and complementary medicines.
- Ask patients if there are any medications they have been advised to take, but do not actually take.
- Make sure what the patient actually takes matches your list. Be particularly careful about this across transitions of care. Practise medication reconciliation on admission to and discharge from hospital, as these are high-risk times for errors [7] due to misunderstandings, inadequate history taking and poor communication.
- Look up any medications you are unfamiliar with. You can search reliable, evidence-based sources of information and/or contact other health-care professionals (e.g. pharmacists).
- Consider drug–drug and drug–food interactions, medications that can be ceased and medications that may be causing side-effects.
- Always include a thorough allergy history. When collecting an allergy history, remember that if a patient has a potentially serious allergy and a condition for which staff may want to prescribe that medication; this is a high-risk situation. Alert the patient and alert other staff.

Know which medications used in your area are associated with high risks of adverse events 29

Some medications have a reputation for causing adverse drug events. This may be due to a narrow therapeutic window, particular pharmacodynamics or pharmacokinetics, or the complexity of dosing and monitoring. Examples of these medications include insulin, oral anticoagulants, neuromuscular-blocking agents, digoxin, chemotherapeutic agents, IV potassium and aminoglycoside antibiotics. It may be useful to ask a pharmacist or other relevant staff in your area what medications tend to be most often implicated in adverse medication events. (Instructors may want to spend time teaching about these agents.)

Be very familiar with the medications you prescribe 30

Never prescribe a medication you do not know much about. Encourage students to do homework on medications they are likely to use frequently in their practice. They should be familiar with the pharmacology, indications, contraindications, side-effects, special precautions, dosages and recommended regimens for theses medications. If you need to prescribe a medication you are not familiar with, read up on the medication before

prescribing it. This will require having reference material readily available in the clinical setting. It is better for prescribers to know a few drugs well than many superficially. For example, rather than learning about five different non-steroidal anti-inflammatory drugs, a prescriber might just know one in detail and prescribe that one. Pharmacists, however, should be familiar with many medications.

Use memory aids 31

Perhaps in the past it was possible to remember most of the required knowledge regarding the main medications in use. However, with the rapid growth in the number of available medications and the increasing complexity of prescribing, relying on memory alone is not sufficient.

Students should be encouraged to have a low threshold to look things up. They should become familiar with selecting independent, evidence-based memory aids and using them. Students should view relying on memory aids as a marker of safe practice rather than a sign that their knowledge is inadequate. Examples of memory aids include textbooks, pocket-sized pharmacopoeias and information technology, such as computer software (decision/dispensing support) packages and personal digital assistants. A simple example of a memory aid is a card with all the names and doses of medications that may be needed in a case of cardiac arrest. This card can be kept in the prescriber's pocket and referred to in the event of an emergency, when there may not be time to get to a textbook or computer to check the dosage of a medication. (Note that memory aids are also referred to as cognitive aids).

Remember the 5 Rs when prescribing and administering medication 32

In many parts of the world, training programmes have emphasized the importance of checking the *5 Rs* before dispensing or administering a medication. The 5 Rs are: right drug, right route, right time, right dose and right patient. This guideline is relevant for all health-care professionals who prescribe and administer medication. Two additions to these 5 Rs are right documentation and the right of a staff member, patient or carer to question a medication order.

Communicate clearly 33

It is important to remember that the safe use of medication is a team activity and that the patient is also a member of the team. Clear, unambiguous communication will help to minimize assumptions that can lead to error. A useful maxim to

remember when communicating about medications is to *state the obvious* as often what is obvious to the doctor or pharmacist may not be obvious to the patient or nurse and vice versa.

Bad handwriting can lead to dispensing errors. Health professionals should write clearly and legibly including their name and contact details. Pharmacists who cannot read the writing should contact the person who signed the prescription to check the details.

Remembering the 5 Rs (as described above) is a useful way of remembering the important points about a medication that need to be communicated. For example, in an emergency situation, a doctor may need to give a verbal drug order to a nurse, "can you please give this patient 0.3 ml of 1:1000 epinephrine as soon as possible?" is much better than saying, "quick, get some adrenaline".

Another useful communication strategy is to *close the loop*. This decreases the likelihood of misunderstanding. In our example, the nurse would close the loop by saying, "OK, I will give the patient 0.3 ml of 1:1000 epinephrine as soon as possible".

Develop checking habits `34` `35`
It is helpful to develop checking habits early in one's career. For this to happen, these habits need to be taught at the undergraduate level. An example of a checking habit is to always read the label on the ampoule before drawing up a medication. If checking becomes a habit, then it is more likely to occur even if the clinician is not actively thinking about being vigilant.

Checking should be an important part of prescribing, dispensing and administering drugs. You are responsible for every prescription you write and every drug you dispense or administer. Check the 5 Rs and for allergies. High-risk medications and situations require extra vigilance with checking and double-checking, for example, when very potent emergency drugs are being used to treat a critically ill patient. Double-checking colleagues' actions, as well as your own actions, contributes to effective teamwork and provides an additional safeguard. (However, it is very important that everyone first checks his/her own work, as delegating checking can lead to errors.)

Remember that computerized prescribing does not remove the need for checking. Computerized systems solve some problems (e.g. illegible handwriting, confusion around generic and trade names, recognizing drug interactions), but also present a new set of challenges [8].

Some useful maxims regarding checking:
• unlabelled medications belong in the bin;
• never administer a medication unless you are 100% sure you know what it is.

Encourage patients to be actively `36` involved in their own care and the medication process. Educate your patients about their medication(s) and any associated hazards. Communicate plans clearly with patients. Remember that patients and their families are highly motivated to avoid problems. If they are made aware of the important role they play in the medication process, they can contribute significantly to improving the safety of medication use.
Information can be both verbal and written and should cover the following aspects:
• name of the generic drug;
• purpose and activity of the medication;
• dose, route and administration schedule;
• special instructions, directions and precautions;
• common side-effects and interactions;
• how the effects of the medication (e.g. efficacy, side-effects, etc.) will be monitored.

Encourage patients to keep a written record of the medications that they take and details of any allergies or problems they have had with medications in the past. This list should be presented whenever they interact with the health-care system.

Report and learn from medication errors `37`
Discovering more about how and why medication errors occur is fundamental to improving medication safety. Whenever an adverse drug event or near miss occurs, there is an opportunity for learning and improving care. It will be helpful for students if they understand the importance of talking openly about errors and are aware of what processes are in place in their training programmes or in the facilities in which they are working to maximize learning from errors and progress in medication safety.

The reporting of errors is facilitated when trust and respect have been established between health-care professionals. For example, pharmacists are more likely to report and explain near-miss errors when prescribers are open to listening to their explanations.

Safe practice skills for students 38

Although students are generally not permitted to prescribe or administer medication until after graduation, there are many aspects of medication safety that students can start practising and preparing for. It is hoped that the following list of activities can be expanded upon at multiple stages throughout a student's training. Each task on its own could form the basis of an important educational session (lecture, workshop, tutorial). Thorough coverage of these topics is beyond the scope of an introductory session to medication safety.

An understanding of the inherent hazards of using medicines will affect how a clinician performs many daily tasks. Below are instructions for how a safety-conscious clinician will perform different tasks.

Prescribing

Consider the 5 Rs, know the drugs you prescribe well and tailor your treatment decisions to individual patients. Consider individual patient factors that may affect the choice or dose of medication, avoid unnecessary use of medications and consider risk–benefit relationships.

Documentation

Documentation should be clear, legible and unambiguous. Those who struggle to write neatly should print. Consider the use of electronic prescribing, if available. Include the patient's name, the name of the drug and the dose, route, time and schedule for its administration as part of the documentation. It is also important to include the contact details of the prescribing clinician, in order to facilitate communication between the pharmacist and the prescriber.

Use of memory aids

Have a low threshold to look things up, know how to select memory aids and look for and use effective technological solutions, if available.

Teamwork and communication surrounding the use of medications

Remember that the use of medication is a team activity. Communicate with the other people involved in the process and make sure that false assumptions are not being made. Be on the look out for errors and encourage the rest of the team to be vigilant of their own actions and those of others.

Administering medications

Be familiar with the hazards and safety precautions associated with administering medication by different routes–oral, sublingual, buccal, inhaled, nebulized, transdermal, subcutaneous, intramuscular, intravenous, intrathecal, per rectum and per vagina. Check the 5 Rs whenever you administer medication.

Involving and educating patients about their medications

Look for opportunities and ways to help patients and carers help minimize errors. Listen carefully to what they have to say.

Learning and practising drug calculations

Be familiar with how to manipulate units and adjust volumes, concentrations and doses. Practise calculating adjustments based on clinical parameters. In high-stress and/or high-risk situations, consider ways to decrease the chance of a calculation error, such as using a calculator, avoiding doing arithmetic in your head (use a pen and paper instead), asking a colleague to perform the same calculation to see if you concur and using any other available technology. When dispensing drugs, it is important to always check the calculated dose.

Collecting a medication history

Always take a thorough medication history before prescribing and regularly review patients' medication lists, especially those of patients taking multiple medications. Cease all unnecessary medications. Always consider medication as a possible cause of symptoms during the diagnostic process. When a patient cannot provide his/her medication history (e.g. an unconscious patient), these records may be available from his/her pharmacist or general practitioner. In some situations, a medication history might be collected by a pharmacist before the patient sees a doctor.

Detecting and reducing possible interactions and/or contraindications

Collecting an allergy history

Always ask about allergies before prescribing any medication. If a patient has a serious medication allergy, stop and think whether that patient is at risk of someone wanting to prescribe that medication. For example, if a community doctor sends a patient to hospital with suspected appendicitis and the patient has a serious penicillin allergy, it is possible that there will be some momentum within the hospital to give the patient penicillin. In this situation, it is important to emphasize the allergy in communication with the hospital staff, warn the patient that the usual treatment for appendicitis involves penicillin-based antibiotics and encourage the patient to be alert

to what medication he/she is being given and to speak up if someone tries to give him/her penicillin. The risk of cross-allergy should also be mentioned. It is also important for health-care professionals to ask about allergies before administering medications.

Monitoring patients for side-effects
Be familiar with the side-effects of the medications you prescribe/dispense/administer and be proactive in looking for them. Educate patients about potential side-effects: how to recognize them and appropriate actions should they occur. Always consider medication side-effects as part of the differential diagnosis when assessing patients with undifferentiated clinical problems.

Learning from medication errors and near misses
Learn from errors through investigation and problem-solving. If an error can occur once, it can occur again. Consider strategies to prevent the recurrence of errors at both an individual practitioner level and an organizational level. Be familiar with how to report errors, adverse reactions and adverse events involving medication. Pharmacists might consider running multidisciplinary meetings to discuss common mistakes and identify methods/procedures for avoiding these mistakes (e.g. excluding sound-alike drugs from the hospital formulary).

Summary `39`
Medications can greatly improve health when used wisely and correctly. Nevertheless, medication errors are common and cause preventable human suffering and financial cost. Remember that using medications to help patients is not a risk-free activity. Know your responsibilities and work hard to make medication use safe for your patients.

Teaching strategies and formats `40` `41` `42`
There are a variety of ways to teach students about medication safety and a combination of approaches is likely to be most effective.

Options include: interactive lectures, small group discussions, problem-based learning, practical workshops, tutorials, project work including tasks to be undertaken in the clinical environment and at the bedside, online learning packages, reading and case analyses.

Lecture presentation and/or group discussion
The PowerPoint presentation included in this package is designed for use as an interactive introductory lecture on medication safety or a teacher-led small group discussion. It can be readily adjusted to be more or less interactive and you can adapt it for your clinical setting by including local examples, local issues and local systems. A series of questions are interspersed throughout the presentation to encourage students to actively engage with the topic and also short cases with questions and answers that could be embedded in the lecture or provided for the students as a separate exercise.

Below are listed some other educational methods and ideas to consider using for teaching about medication safety.

Problem-based learning
Use cases that raise issues relevant to medication safety. Students can be asked to respond to reflective questions after reading through a case. Alternatively, students could work through a set of drug-calculation problems.

Additional teaching and learning activities
– Practical workshops
Students can practice their skills under time pressure, mimicking emergency situations. Suggested workshop topics include drug administration, prescribing and drug calculations.

– Project work
Possible projects include the students performing one or all of the following:
- interview pharmacists to find out what errors they commonly see;
- accompany a nurse on a drug round;
- interview nurses or doctors who administer a lot of medication (e.g. anaesthetists) and ask them about their experience and knowledge of medication error and what strategies they use to minimize the chance of a mistake;
- research a medication that has a reputation for being a common cause of adverse events and present your findings to fellow students;
- prepare a personal formulary of medications likely to be commonly prescribed in the early postgraduate years;
- perform a thorough medication history on a patient taking multiple medications. Do some homework to learn more about each of these medications, then consider potential side-effects, drug interactions and if there are any medications that could be ceased. Discuss your thoughts with a pharmacist or doctor

and share what you have learnt with fellow students;

- find out what is meant by the term *medication reconciliation* and talk to hospital staff to find out how this is achieved at your facility. Observe and, if possible, participate in the process during admission and discharge of a patient and consider how the process may prevent errors and also whether there are any gaps or problems with the process.

Role-playing exercises
Role-playing exercises are another valuable educational tool for teaching students about medication safety.

Scenario I: Erroneous administration of drugs

Description of event
During the early hours of the morning shift, the morning shift nurse administered 100 units subcutaneous regular insulin, instead of 10 units as was written in the physician's order. The error stemmed from the physician's illegible handwriting.

The patient, who was suffering from dementia, was uncooperative and seemed to be asleep. During the nurse's regular checking, she discovered the patient to be completely unresponsive. A blood test confirmed that the patient was in a state of hypoglycaemic shock. The on-call physician was called and the error was discovered.

The patient was treated with an infusion of glucose 50% IV. A crash cart was brought to the patient's room, to be readily available if necessary. The patient recovered within a few minutes, woke up and began behaving normally.

Role play
Later that morning, the patient's son, a lawyer, came to visit his father. Looking agitated, he turned to the nurse asking, "What happened to my father?" His father's roommate had told him that there had been a problem and that there had been many people at his father's bedside early in the morning. The nurse who administered the insulin was called to speak with the patient's son.

If the nurse explains the chain of events, takes responsibility for and admits her error, the patient's son will not placated and will reply: "Is that the level of care my father has been receiving?"; "What kind of nurses work in this ward?"; "I won't have it. I will take action!"; "I demand to speak to the head physician

immediately!"; "I demand to see this event's report!" If the nurse does not explain the error in detail, the patient's son will be upset and unwilling to accept any subsequent explanation.

A physician passing by overhears the conversation. The physician will enter the room if the actor asks him to. If the actor does not request the physician, the physician will enter the room after approximately 8 minutes (12-minute scenario). The physician will enter the room and ask about the events being discussed. The nurse will update him as to the morning's events and her conversation with the patient's son (either in his presence or not, depending on the physician and nurse).

Character description
The son, 45-years-old, is a well-dressed lawyer. He visits his father whenever possible. He is interested in everything going on around him, but is having difficulty accepting his father's new medical state. He feels confused, neglected and a bit sad. He really wants to help but does not know how. A conversation with the social worker reveals that previously there was never a need for him to care for his father, but ever since his mother fell and broke her leg and his father's situation began to deteriorate, the burden of their care has rested on his shoulders alone.

Actor tips
The actor must complain to the head physician of a cover-up and omission of facts and threaten negative publicity (going to the press) (i.e. "You almost killed him! You're lucky it didn't end that way!")

Scenario II: Death due to erroneous medical care

Description of event
Sarah, a 42-year-old woman, was admitted for the resection of a localized, non-metastatic malignant duodenal tumour.

Sarah was otherwise healthy, without any family history of malignancy. She had consented to surgery and any other treatment deemed necessary afterward based on the pathology results.

On the morning of the surgery, the patient said goodbye to her husband and two young children (aged 13 and 8). A small localized mass was resected in its entirety. The mass was sent to pathology for diagnosis. Two hours into surgery, the patient showed signs of decreased saturation,

tachycardia and hypotension. The patient received IV fluids, while the surgeon rechecked the resection site for signs of haemorrhage, tearing or an embolism. After finding nothing, the surgeon sutured the site according to protocol.

Upon her return to the ward, the patient quickly developed a high fever, which remained unchanged for a week. A prescription for antibiotics was written:

IV. Gentamicin 80 MGR X 3 P/D

The nurse copied the following order:
IV. Gentamicin 80 MGR X 3 P/DOSE

The nurse who copied the order mistook the letter "D" to mean "dose", while the physician who wrote the order actually meant "day". Over the next 10 days, the patient received 240 mg of gentamicin, three times daily.

During that time, the patient began showing signs of renal failure and hearing impairment. On the tenth day of treatment, as the nurse manager was taking stock of the drugs administered, the error was discovered. The treatment was stopped, but the patient's general status deteriorated due to acute renal failure. Ten days later, the patient died of generalized organ failure.

The patient's family was critical of the nursing staff throughout her hospitalization, blaming them for malpractice. They expressed their anger to the nurse manager and the department chief.

After the patient died, her husband asked to speak to the head nurse. He blamed the nurses for the error and malpractice that culminated in his wife's death. He claimed to have already discovered which nurse copied the order and threatened to sue her.

Character description
The patient's husband is a hardworking man who works in a store. He has difficulty providing for his family and is struggling to make ends meet. He is an angry and restless man who has not yet come to terms with his wife's cancer diagnosis. He is angry with everyone and especially with the nursing staff, after his wife told him she received "too many antibiotics because the nurse couldn't do math". He wants to know what killed his wife, who is at fault and who is going to pay for it. He wants top hospital management involved and wants help for his children. He is very upset and shouts a lot.

Scenario III: Patient–health-care worker communication

Description of event
Kirk, 54-years-old, has been admitted due to transient chest pain complaints. He has been previously hospitalized in the ICU due to acute coronary events. This time, preliminary test results were inconclusive and his pain is not as severe. The physician has ordered complete rest and continuous 48-hour cardiac monitoring. Kirk is a heavy smoker and is overweight. He has not been taking the medications prescribed to help with his high blood pressure and high cholesterol.

The patient demands to be released immediately. He is afraid his hospitalization may cause him to lose his job at an automobile factory.

His anger is directed at the nurse-in-charge of the evening shift. He claims he was promised that he would be discharged and that there is no need for him to be monitored or for complete rest. He is uncooperative. He has already convinced another nurse to let him leave the ward for a short period. Now, he demands to leave the ward again and refuses to remain in his room. He demands to smoke and wants to be discharged. He is angry and shouting by the nurses' station.

Assuming the nurse-in-charge insists he stay in the ward, the patient will accuse her of being insensitive and will claim the other nurse was nicer and more empathetic and understanding.

The on-call physician is in the vicinity but does not intervene and continues caring for other patients (some of whom are near the nurses' station where the event is taking place).

Character description
Kirk is overweight and a heavy smoker. He enjoys getting attention by shouting. He is very concerned that he will not be able to work as much as he has been and may be fired. He is very afraid of surgery, as his best friend died on the operating table two years ago at the same hospital.

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Case studies

A prescribing error
`43` `44` `45` `46`

This case study illustrates the importance of collecting complete and accurate medication histories.

A 74-year-old man saw a community doctor for treatment of new onset stable angina. The doctor had not met this patient before and took a full history and medication history. He discovered that the patient has been healthy and only takes medication for headaches. The patient could not recall the name of the headache medication. The doctor assumed it was an analgesic that the patient takes whenever he develops a headache. But the medication was actually a beta-blocker that the patient took every day for migraine. A different doctor had prescribed this medication. The doctor commenced the patient on aspirin and another beta-blocker for the angina. After commencing the new medication, the patient developed bradycardia and postural hypotension. Unfortunately, the patient fell three days later due to dizziness on standing and fractured his hip in the fall.

Questions
– How common are medication errors?

– How could one prevent these errors from occurring?

– Is there a role for patients in preventing errors?
_____

Source: WHO Patient Safety Curriculum Guide for Medical Schools. Geneva, World Health Organization, 2009:242-243.

An administration error
`47` `48` `49` `50`

This case history illustrates the importance of checking procedures when administering drugs, as well as the importance of good communication between team members. It also demonstrates the importance of keeping all materials in accurately labelled containers.

A 38-year-old woman came to the hospital with 20 minutes of itchy red rash and facial swelling. She had a history of serious allergic reactions. A nurse drew up 10 ml of 1:10 000 adrenaline (epinephrine) into a 10 ml syringe (1 mg in total) and left it at the bedside ready to use, just in case the doctor would request it. Meanwhile, the doctor inserted an IV cannula. The doctor saw the 10 ml syringe of clear fluid that the nurse had drawn up and assumed it was normal saline.

There was no communication between the doctor and the nurse at this time.

The doctor administered all 10 ml of adrenaline (epinephrine) through the IV cannula, thinking he was using saline to flush the line. The patient suddenly began to feel terrible and anxious. She became tachycardic and then unconscious with no pulse. She was discovered to be in ventricular tachycardia, was resuscitated and, fortunately, made a good recovery. The recommended dose of adrenaline (epinephrine) in anaphylaxis is 0.3–0.5 mg IM. This woman received 1 mg IV.

Discussion
– What factors might be associated with this adverse event?

– Outline how the team could have functioned better?
_____

Source: WHO Patient Safety Curriculum Guide for Medical Schools. Geneva, World Health Organization, 2009:242-243.

Monitoring error
`51` `52` `53` `54` `55`

This case study illustrates the importance of communicating with patients about their medications. Patients should always be advised as to how long to continue to take prescribed medications. This case study also illustrates the importance of collecting accurate and thorough medication histories, in order to avoid negative outcomes.

A patient was started on oral anticoagulants in hospital for treatment of a deep venous thrombosis following an ankle fracture. The intended treatment course was three to six months. However, neither the patient nor the community doctor were aware of the planned duration of treatment. The patient continued to take this medication for several years, being unnecessarily exposed to the increased risk of bleeding associated with this medication. At some point, the patient was prescribed a course of antibiotics for a dental infection. Nine days after he started taking the antibiotic, the patient became unwell with back pain and hypotension, as a result of a spontaneous retroperitoneal haemorrhage, and required hospitalization and a blood transfusion. A blood coagulation test revealed grossly elevated results; the antibiotic had potentiated the therapeutic anticoagulant effect.

Questions
– What are the main factors associated with this adverse event?

– How might the adverse event been prevented?

Prescribing error leading to adverse effects
In this case, a dentist underestimated the systemic immunodeficient status of the patient and, in doing so, failed to take appropriate measures to prevent adverse effects of systemic antibiotics.

An HIV-positive, 42-year-old man saw a dentist for a dental treatment consisting of a root canal treatment, treatment of gum disease and extraction of a tooth due to severe decay.

After taking a medical and dental history, the dentist decided that the patient's medical status was stable and prescribed a course of prophylactic antibiotics before performing any dental treatment. In the second visit, during intraoral examination, the dentist noticed that the patient had developed oral lesions resembling fungal (*Candida*) infection.

When he considered the patient's systemic condition, he realized that he had failed to focus on the increased risk of fungal infections in people with HIV/AIDS when taking systemic antibiotics and had forgotten to prescribe the appropriate antifungal drugs together with antibiotics to prevent such lesions. He further realized that he had considered the patient's systemic condition to be stable without consulting the patient's physician.

Thus, he had underestimated the immunodeficient status of the patient. He referred the patient to his physician for treatment of the oral fungal lesions and the patient received the necessary treatment. The patient's dental treatment was postponed until the state of his systemic and oral health was appropriate.

Questions
– What factors may have been present that influenced the dentist's initial treatment plan in isolation from the treating doctors?

– What factors might have existed that led the dentist to underestimate the immunodeficient status of the patient?

– What factors may have prevented the dentist from prescribing antifungal drugs with systemic antibiotics for this HIV-positive patient?

Communication is essential between health professionals and patients
In this case, a pharmacist, realizing that a patient does not understand how medications interact, spent some time explaining to the patient each of the medications the patient was taking and their appropriate use.

Mary is an 81-year-old woman in chronic pain, caused by serious back pain including osteoporosis; coronary heart disease and depression, caused by her constant pain and lack of confidence in the medications she has been prescribed. Her medications include prescriptions by her neurologist, endocrinologist, two general practitioners and a rheumatologist. She was prescribed a total of 18 different drugs. Many of the medications were for pain. Because of the frequency of her taking medications (NSAIDS) for her pain, she suffered from gastritis (inflammation of the lining of the stomach). This made her very wary of the analgesics, which she took from time to time. Mary visited different pharmacies to buy different pain killers (paracetamol, ibuprofen etc).

Mary is concerned about the pain killers she is taking because of their gastro-toxicity; some-times she uses all of them, while also taking 'over the counter' (OTC) drugs bought in pharmacies. Despite this, Mary does not feel any better. Mary is afraid of the adverse drug reactions of tramadol and is not using it regularly. For strong pain relief she uses paracetamol, but the pain killer has little effect. Similarly, she sees no improvement with the antidepressant citalopram, even after a week of regular use; sub-sequently she uses the medication occasionally. Box B.11.1 lists all medications Mary was taking.

A pharmacist, realizing that Mary does not understand how her medications interact, spent some time explaining to her each of the medications and their appropriate use. He discussed with her the inappropriate use of combinations of NSAIDs, and in particular:
• the appropriate use of metamizol with higher doses of paracetamol if she has no liver problems;
• plans to evaluate the effects of citalopram one month after initiation of course;
• the importance of informing physicians about her medications and her medical history;
• the need to evaluate drug interactions in order to minimize the risks of adverse drug reactions;

Box B.11.1. List of drugs for patient

Neurologist:
Gabapentin
tramadol + paracetamol (for pain relief)
thiaprofenic acid (for pain relief)

OTC drugs with paracetamol (for pain relief)

Endocrinologist:
levothyroxine
omeprazole
colecalciferol+ Ca+Zn+Mn
colecalciferol
atorvastatin
strontium ranelate
diclofenac (for pain relief)

General practitioners:
citalopram
bromazepam (for phobia)
nimesulide (for pain relief)
tramadol (for pain relief)
metamizol (for pain relief)
metoprolol
indobufen

Rheumatologist:
Meloxicam (for pain relief)

• the need to review contraindications and use OTC drugs appropriately.

By the second visit to the pharmacist, Mary was satisfied with her pain management.

Questions
– What communication errors may have occurred to result in Mary misusing her medications?

– What are some of the problems associated with inadequate and incomplete information sharing between health professionals?

– Should all patients be educated about their medications?

– What mechanisms could be put in place to ensure that every attending health professional is aware of the medications being prescribed and taken by patients?
– What is the responsibility of a health professional who prescribes or provides medications to patients?

– What is the responsibility of pharmacists in providing advice regarding the use of OTC drugs? What would the algorithm have to be to maximize the beneficial effect of OTC drugs and minimize potential risks?

Source: Jiri Vlcek, Professor of Clinical Pharmacy and Pharmaceutical Care.
Clinical phartmacists on internal department in teaching hospital in Hradec Kralove Charles University, Prague, Faculty of Pharmacy, Department of Social & Clinical Pharmacy.

Tools and resource material

WHO patient safety solutions
These are summary documents detailing solutions for patient safety problems. A number of them concern medication issues.

Solution 1 – Look-alike, sound-alike medication names.
Solution 5 – Control of concentrated electrolyte solution.
Solution 6 – Assuring medication accuracy at transitions in care.
Solution 7 – Avoiding catheter and tubing misconnections.
Solution 8 – Single use of injection devices.
These documents are available on the Internet (http://www.who.int/patientsafety/solutions/en/; accessed 21 February 2011).
Other internet references
The Agency for Healthcare Research and Quality (United States Department of Health and Human Services, Rockville, MD) maintains an online case archive that can be used as a source of case studies that may be helpful in your teaching (http://www.webmm.ahrq.gov). Other useful online references include the sites maintained by the Institute for Safe Medication Practices (Horsham, PA) (http://www.ismp.org) and the National Patient Safety Agency (http://www.npsa.nhs.uk).

Educational DVDs
Beyond Blame documentary. This DVD runs for 10 minutes and is a powerful way to engage students in the issue of medication safety. It consists of a doctor, a nurse and a pharmacist

talking about serious medication errors they have been involved in. This DVD is available for purchase through the Institute for Safe Medication Practices (http://www.ismp.org; accessed 21 February 2011).

The WHO *Learning from Error* Workshop includes a DVD depiction of a medication error–the administration of intrathecal vincristine. The DVD illustrates the multifactorial nature of error.

Books

Vicente K. *The human factor*. London, Routledge, 2004:195–229.

Cooper N, Forrest K, Cramp P. *Essential guide to generic skills*. Oxford, Blackwell Publishing Ltd, 2008.

Institute of Medicine. *Preventing medication errors: quality chasm series*. Washington, DC, National Academies Press, 2006 (http://www.iom.edu/?id=35961; accessed 21 February 2011).

Assessing knowledge of this topic

A variety of assessment methods can be used to assess knowledge of medication safety and performance in this area, including:
- MCQ;
- drug calculation quizzes;
- short-answer questions;
- written reflection on a case study involving a medication error, identifying the contributing factors, and considering strategies to prevent recurrence;
- project work with accompanying reflection on learning outcomes of the activity;
- OSCE stations.

OSCE stations might include prescribing/dispensing/administration exercises. These stations can be used to: evaluate students' ability to collect a medication and allergy history; administer a medication, checking the 5 Rs and for allergies; and educate a patient about a new medication.

Note that several of these potential assessment topics are not covered in detail in the accompanying PowerPoint presentation. They are included here as ideas for assessment in the area of medication safety on the assumption that students would have received additional instruction on these particular aspects of medication safety.

Evaluating the teaching of this topic

Evaluation is important in reviewing how a teaching session went and how improvements can be made. See the Teacher's Guide (Part A) for a summary of important evaluation principles.

References

1. *The conceptual framework for the international classification for patient safety*. Geneva, World Health Organization Patient Safety Programme, 2009 (http://www.who.int/patientsafety/en/; accessed 21 February 2011).

2. Cousins DD. Developing a uniform reporting system for preventable adverse drug events. *Clin Therap* 1998; 20 (suppl C): C45-C59.

3. Institute of Medicine. *Preventing medication errors. Report brief*. Washington, DC, National Academies Press, 2006.

4. Kohn LT, Corrigan JM, Donaldson MS, eds. *To err is human: building a safer health system*. Washington, DC, Committee on Quality of Health Care in America, Institute of Medicine, National Academies Press, 1999.

5. Runciman WB et al. Adverse drug events and medication errors in Australia. *International Journal for Quality in Health Care*, 2003, 15 (Suppl. 1):S49–S59.

6. Nair RP, Kappil D, Woods TM. 10 strategies for minimizing dispensing errors. *Pharmacy Times,* 20 January 2010 (http://www.pharmacytimes.com/issue/pharmacy/2010/January2010/P2PDispensingErrors-0110; accessed 21 February 2011).

7. Vira T, Colquhoun M, Etchells E. Reconcilable differences: correcting medication errors at hospital admission and discharge. *Quality & Safety in Health Care*, 2006, 15:122–126.

8. Koppel R, Metlay JP, Cohen A. Role of computerized physician order entry systems in facilitating medication errors. *Journal of the American Medical Association*, 2005, 293:1197–1203.

Slides for Topic 11: Improving medication safety

Didactic lectures are not usually the best way to teach students about patient safety. If a lecture is being considered, it is a good idea to plan for student interaction and discussion during the lecture. Using a case study is one way to generate group discussion. Another way is to ask the students questions about different aspects of health care that will bring out the issues contained in this topic such as the blame culture, the nature of error and how errors are managed in other industries.

The slides for Topic 11 are designed to help the instructor deliver the content of this topic. The slides can be adapted for the local environment and culture. Instructors do not have to use all of the slides and it is best to tailor the slides to the areas being covered in the teaching session.

All drug names used are according to the *WHO International Nonproprietary Names for Pharmaceutical Substances* (http://www.who.int/medicines/services/inn/en/; accessed 24 March 2011).

Annexes

**Patient Safety
Curriculum Guide:
Multi-professional
Edition**