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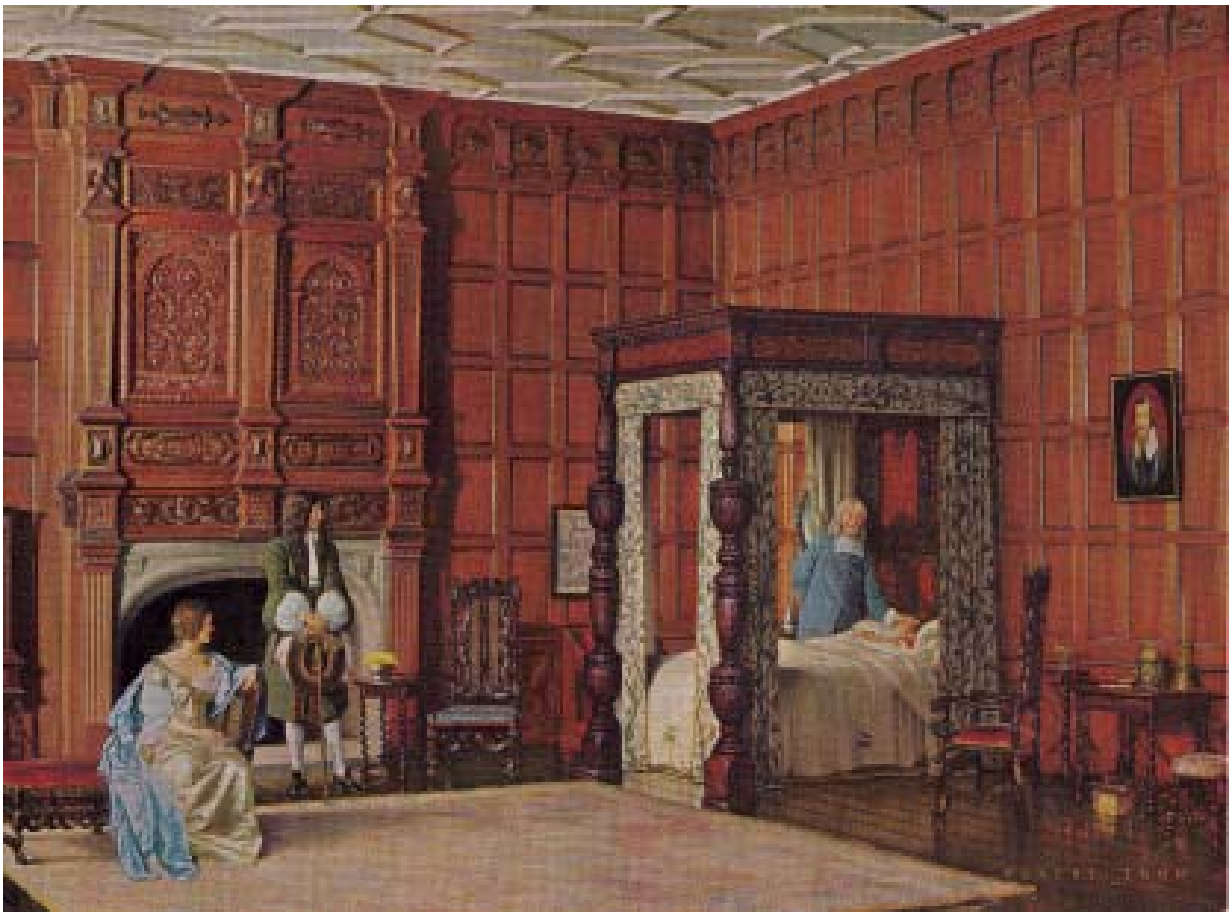

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Cover picture

SYDENHAM:
PROPONENT OF CLINICAL MEDICINE

Thomas Sydenham (1624-1689), seventeenth-century London physician, at the bedside of a patient – the only place, he believed, where doctors could learn about disease. Sydenham's plain Puritan costume contrasts markedly with high fashion raiment worn by his lifelong friend, John Locke, physician-philosopher, who frequently accompanied him on his rounds of patients. Sydenham's honest and straightforward observations, accepted and published in many countries, earned him such posthumous titles as that of the "English Hippocrates," and also the "Father of Clinical Medicine in Britain."

The importance of medication reconciliation for patients and practitioners

Summary

Medication errors are common and often occur when patients move between healthcare settings.

Around half of hospital medication errors occur on admission, transfer and discharge. Around 30% of these have the potential to cause patient harm.

Advanced age and taking several prescription medicines are associated with an increased risk of medication errors on admission.

At least one in six patients may have a clinically significant medication discrepancy on transfer within a hospital. Discrepancies also often occur at discharge and may cause problems in general practice.

The process of medication reconciliation can significantly decrease errors. It involves obtaining, verifying and documenting a list of the patient's current medicines and comparing this list to the medication orders and the patient's condition to identify and resolve any discrepancies.

Medication reconciliation is an important element of patient safety.

Key words: discharge medication, hospitals, medication errors

(Aust Prescr 2012;35:15-9)

Introduction

A common patient safety problem around the world is the lack of accurate and complete information about patients' medicines when their care is transferred between healthcare settings. In up to two-thirds of patients there are variances between the medicines they take at home and the medicines ordered on admission to hospital.[1] It has been estimated that around half of the medication errors that happen in hospital occur on admission or discharge from a clinical unit or hospital.[2] Around 30% of these errors have the potential to cause patient harm.[3,4] These errors are also an economic burden to health services.[5]

The problem is not confined to hospital. Patients may have several specialist prescribers as well as their general practitioner. If there is not good communication between all the prescribers there is potential for medication errors. Studies in ambulatory care settings report 26-87% of medication records as incomplete or having discrepancies between medicines taken by the patient and those documented in the patient record.[6] In an Australian study only 58% of general practitioners' referrals to a specialist contained the correct dosage and number of prescribed medicines. Complementary and over-the-counter medicines were documented in 26% of letters.[7]

Causes of medication errors at interfaces of care

Errors can occur:

- on admission when determining the medicines the patient is currently taking.
- when recording details of the patient's medicines in the medical record.
- when prescribing medicines for the patient after admission, on transfer to another ward and at discharge.[5]

Drug history on admission

Drug histories are often incomplete with strengths, dose and drug forms missing (see case 1) and nonprescribed medicines, such as over-the-counter or complementary medicines, often omitted. Studies have shown that 10-67% of medication histories contain at least one error.[1]

In hospital the history is used to inform the inpatient medication orders, to make treatment decisions and to identify adverse medicines events. If errors are not corrected they continue throughout the patient's stay. Incomplete medication histories at the time of admission have been cited as the cause of at least 27% of prescribing errors.[8] The most common error is the omission of a regularly used medicine.[4,9,10]

Erroneous drug histories can lead to discontinuity of therapy, recommencement of ceased medicines, inappropriate therapy and failure to detect a drug related problem. These errors can have adverse consequences for the patient during their hospital stay. Perpetuation of these errors on discharge may result in adverse events, from duplication of therapy, drug interactions and discontinuation of an essential medicine (see case 2).

Consequences of medication errors

Case 1

A 67-year-old woman with a regular general practitioner was prescribed several medications, including atenolol 50 mg daily, after a myocardial infarction. Six months later she saw a cardiologist for a review of her treatment. She was asymptomatic, but the cardiologist prescribed metoprolol 50 mg twice daily. The cardiologist did not have a complete list of her medicines. As she was now taking two beta blockers, the patient subsequently developed symptomatic bradycardia.

Case 2

An elderly man was admitted to hospital via the emergency department. The patient had recently started warfarin for atrial fibrillation so his INR was measured. The INR was 4.0 and the decision to 'withhold warfarin until INR is therapeutic' was documented in the patient's notes. No warfarin was ordered during the admission. The discharge prescription and summary were written from the inpatient medication chart so did not include warfarin. There was no reconciliation with the admission history. A medicines list for the patient was prepared by hospital pharmacy staff from the discharge prescription and placed in the bag with a month's supply of discharge medicines. No follow-up appointment was made with the general practitioner. Five days later the patient suffered a stroke.

Recording medicines on admission

The current processes for recording drug histories have been described as inadequate, potentially dangerous and in need of improvement.[4] These histories may be obtained by a number of different practitioners with varying skills and recorded on different forms and in different places in the medical record. In some cases the only history recorded is the medicines ordered on the inpatient medication chart.

Prescribing medicines on admission, transfer and discharge

Errors can be introduced into a patient's medication regimen whenever there is a transfer of care, particularly on:

- admission to hospital
- transfer from the emergency department to other wards, or the intensive care unit
- transfer from intensive care unit or operating theatre to the ward
- transfer from hospital to home or another facility, such as a residential aged-care facility.

Discrepancies commonly occur between the drugs a patient is taking on admission and those ordered on the medication chart. Literature reviews report unintentional discrepancies of 30-70% between the medicines patients were taking before admission and their prescriptions on admission.[5] In a recent study, 26.6% of these discrepancies were attributable to inadequate or incorrect information in primary care medicines lists including general practitioner referrals and printouts of medicines.[11]

Patients over the age of 65 years and those taking several prescription medicines have a significantly increased risk of medication errors.[12] Internal hospital transfer of care also carries considerable risks. At least one in six patients have one or more clinically significant medication discrepancies on transfer, for example when a patient is transferred from intensive care to a general ward.[13-15] Patients at high risk for these discrepancies include those for whom a comprehensive medication history has not been taken by the time of transfer, those with a greater number of medicines taken before admission, and those prescribed multiple medicines at the time of transfer.[14] Omission of a medicine with a valid indication is the most common unintentional discrepancy[14] and around half of these errors may not be detected before they affect the patient.[15]

Discrepancies also commonly occur at discharge when prescriptions are written and discharge summaries prepared. One Australian study has reported 15% of drugs intended to be continued were omitted on the discharge prescription.[16] Another found 12% of patients had one or more errors in their discharge prescription, including unintentional omissions and continuation of drugs which had been ceased.[17] Patients with one or more drugs omitted from their discharge summary have 2.31 times the usual risk of re-admission to hospital.[18]

What is medication reconciliation?

Medication reconciliation is a process designed to improve communication and promote teamwork. This has the objectives of preventing medication errors associated with the handover of care[19] and maintaining continuity of care. It is described as the formal process of obtaining, verifying and documenting an accurate list of a patient's current medicines on admission and comparing this list to the admission, transfer and discharge orders, to identify and resolve discre-

pancies.[13,20,21] At the end of each episode of care the verified information is transferred to the next care provider and provided to the patient or carer.[21] This information includes changes made to the medicines during the episode of care. There are a number of discrete steps (Fig. 1). The process is based on the safety principle of independent redundancies – having independent checks, generally by different providers, for key steps in the process.[13] The process aligns with the principles recommended to achieve continuity of medication management in Australia.[22]

The best possible medication history

A 'best possible medication history' is the cornerstone of the medication reconciliation process. It is described as a comprehensive drug history obtained by a clinician that includes a thorough history of all regular medicines used, including non-prescription and complementary medicines, and is verified by more than one source. A structured process for taking the history, that involves the patient or carer or family, using a checklist to guide the interview, and that verifies the history with information from a number of different sources, provides the best assessment of the drugs a patient takes at home.[4]

Sources used to obtain a comprehensive history are listed in Fig. 1 (step 2). Patients being admitted to hospital should be advised to take their medicines containers and current medicines list.

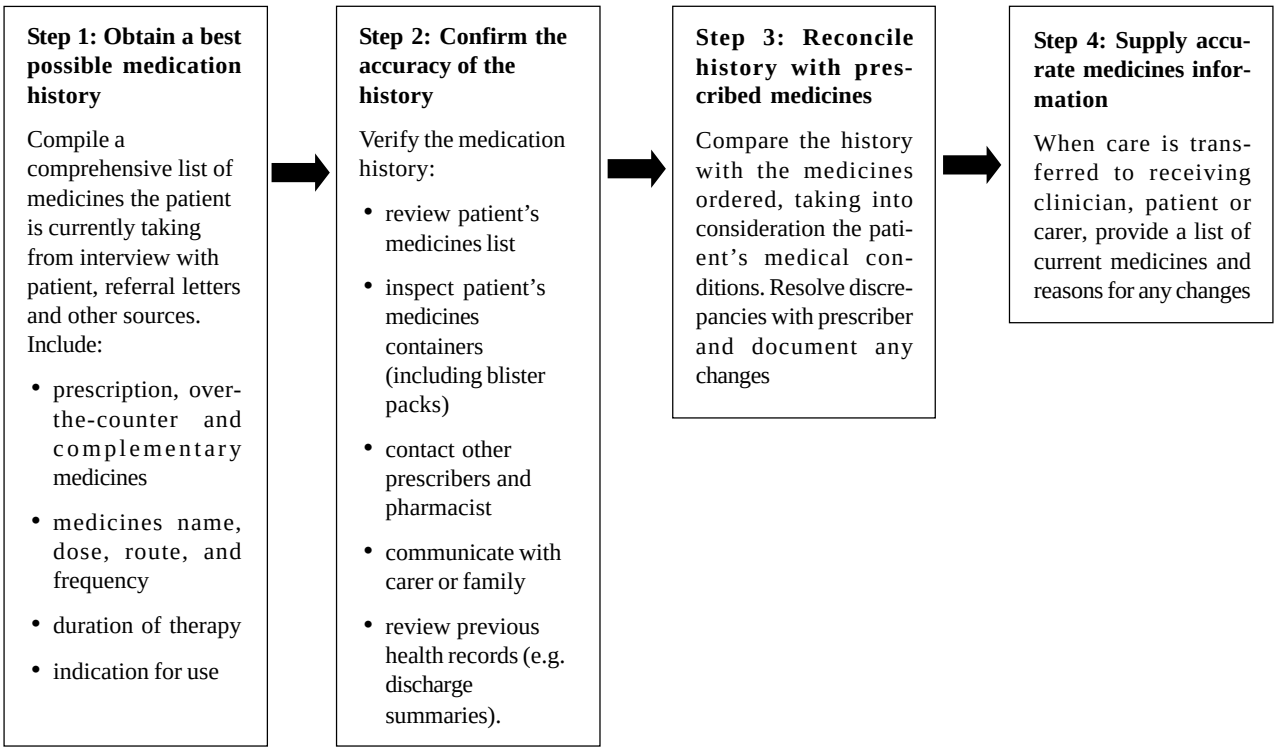
Ideally the best possible medication history is completed before any drugs are ordered and is used when the medication chart is written up. For unplanned admissions the history is usually completed after the initial medication orders have been written and is used to reconcile the orders.

In the community the general practitioner can refer to the community pharmacy for a list of dispensed medicines or request a Home Medicines Review to determine the medicines currently taken. This best possible medication history should be reconciled with the current medication list in the patient's record and their condition.

Standardised reconciling form

A standardised form for recording the best possible medication history and reconciling any discrepancies is essential for effective medication reconciliation. Whether electronic or paper based, the form should be kept in a consistent, highly visible position in the patient's notes and be easily accessible by all clinicians when writing medication orders and reviewing the patient.[19]

Figure 1. Steps in the medication reconciliation process on hospital admission



In Australia the National Medication Management Plan can be used to record the history and reconcile medication orders in patients admitted to hospital. (www.safetyandquality.gov.au/internet/safety/publishing.nsf/Content/PriorityProgram-06_MedRecon)

Electronic solutions

Computerised systems (e-prescribing) may prevent many of the medication errors that occur at transfers of care but these systems are not without their problems. They still require someone to enter an accurate list of drugs and allergies. Medication lists in electronic records can lag behind prescription changes and be incomplete.[12] For example, they may only contain the medicines prescribed in a particular system, and not include non-prescription products or medicines prescribed by other practitioners. Outdated, unverified or inaccurate information may be transferred indefinitely when using copy-and-paste facilities, so reconciliation is still required.[13]

Reconciling medicines

Medicines should be reconciled as soon as possible,[5] at least within 24 hours of a patient's admission to hospital or earlier for high risk drugs.[19] This involves a clinician comparing the history against the medication orders at admission, transfer or discharge to identify any variances and bring them to the attention of the prescriber, taking into consideration the patient's clinical condition. Any changes to orders are documented. Whoever performs the task should be trained and competent in the process.

In the community, medication reconciliation should occur on receipt of information about the discharge medication. The general practitioner can compare the medication history in the patient's notes with the discharge medicines list provided by the hospital, reconciling any differences and updating the patient's record. Similarly when changes are made to a patient's medicines such as dosage alterations, medicines ceased or new medicines prescribed, the current medication list in the patient's record should be reviewed and updated. This reduces the risk of inaccurate medication information being transferred to other care providers in referrals. Providing patients or carers with an updated list when medicines are changed and encouraging them to maintain their own medicines list is an important component of the medication reconciliation process. A medicines list is available from NPS (www.nps.org.au/consumers/tools_and_tips/medicines_list [also available as a mobile phone application)

Involving patients in medication reconciliation

Engaging the patient is one of the best strategies to prevent reconciliation errors and a patient centred approach to medication reconciliation is recommended. When patients present a list of their medicines, or the medicines themselves, on admission to hospital the risk of medication errors and harm is reduced.[12] Any discrepancies should be discussed with the patient, and enquiries made about medicines prescribed by other prescribers and any over-the counter or complementary medicines they are taking.

Evidence for effectiveness of medication reconciliation

Individual hospital studies and a number of large scale initiatives in the USA and Canada have shown that medication reconciliation significantly reduces medication errors and adverse events. Errors prevented by medication reconciliation include inadvertent omission of therapy, prescribing a previously ceased medicine, the wrong drug, dose or frequency, failure to recommence withheld medicines and duplication of therapy after discharge. Implementing formalised medication reconciliation at admission, transfer and discharge reduces medication errors by 50-94%[3,13,15,20] and reduces those with the potential to cause harm by over 50%.[3,23] The process is also associated with improved patient outcomes and a tendency for reduced readmissions.[18]

Efficiency

A standardised process for medication reconciliation reduces the work associated with the management of medication orders. Time savings for nurses of 20 minutes per patient at admission and pharmacists of 40 minutes per patient at discharge have been reported.[20] Recognising the importance of medication reconciliation A formalised system of medication reconciliation could have prevented the events described in the cases. In case 2 if the doctor's plan to recommence the warfarin had been documented in the patient's medication management plan, the error would have been identified if the plan had been used to reconcile the drugs ordered on discharge.

Conclusion

The process of medication reconciliation, using a formalised structured approach involving patients and carers and conducted in an environment of shared accountability, can reduce the morbidity and mortality of medication errors that occur at interfaces of care. Medication reconciliation is a cost-effective use of the health dollar and an important element of patient safety.

Conflict of interest: none declared

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Avoiding medication errors in the hospital: the way forward

Medication errors and its impact on patient safety

Medication errors are a threat to patient safety. They are defined as a 'failure in the treatment process that leads to or has the potential to lead to harm to patients'. The treatment process includes all the processes carried out after the decision for treatment has been made by the doctor, includes prescribing, compounding, dispensing, drug administration, and monitoring. The inability to attain a specified standard during these processes may result in a failure in the treatment process.

Medication errors can affect patient safety and cause an extra burden to healthcare costs. At least 1.5 million preventable adverse drug events (ADEs) occur in the USA every year. Preventable ADEs increase the length of hospital stay.

It is important to know where and what type of medication errors occur in a healthcare system before implementing strategies to avoid them. Errors may occur at every stage of the treatment process. Prescribing errors are the most frequently occurring type, followed by drug administration errors, and dispensing errors. However, errors that occur earlier in the treatment process are more likely to be detected when compared to those that occur later. Drug administration errors are more at risk of harming the patient than prescribing errors. Some examples of medication errors that took place in a tertiary care hospital in Hong Kong in 2013 are shown in Table 1. Although comparative studies are not available in Sri Lanka, a similar pattern is expected.

Approaches to avoiding medication errors

Medication errors may be due to active or latent failures. These two types of failures could be clearly distinguished by the 'length of time taken for a bad outcome to occur' and by the 'place in the organisational hierarchy where the error originates'. In a healthcare system, active failures take place at the 'sharp end' where health professionals are in direct

Table 1. Some examples of medication errors that took place in a tertiary care hospital in Hong Kong (*International Journal of Clinical Pharmacy,* 2013)

Type of error	% (N=1268)	Examples
		Prescribing errors
Wrong strength	28.6	Metformin 75 mg was prescribed instead of 750 mg to be given twice a day
Wrong frequency	5.4	Methotrexate 20 mg was prescribed to be given once a day, instead of every Friday
Known drug allergy	4.7	Co-amoxiclav 375 mg was prescribed to a patient with a known drug allergy to penicillin
Wrong drug	4.3	Carbamazepine 5 mg was prescribed instead of carbimazole 5 mg to be given once a day
Wrong patient	3.7	A wrong-patient identification label was fixed on to the medication record on which drugs were prescribed on
Wrong dosage form	3.5	Gliclazide 120 mg normal tablet form was prescribed to be given once orally instead of the modified release form.
Other	3.2	Ciprofloxacin 500 mg twice a day was prescribed for a patient with G6PD deficiency
		Dispensing errors
Wrong drug	8.0	Spironolactone 25 mg tablet was dispensed instead of methyldopa 250 mg tablet
Wrong strength	4.2	Enoxaparin 60 mg was dispensed instead of enoxaparin 40 mg prescribed to be given daily
Wrong dosage form	2.4	Morphine sulphate 10 mg syrup was dispensed instead of the slow release tablet
Wrong or missing label information	1.8	A bottle of frusemide 1 mg/ml solution was labeled as folic acid 50 microgram/ml solution
Other	1.2	Paclitaxel was prepared in 500 ml of dextrose 50% solution instead 5% solution
		Drug administration errors
Dose omission	6.1	The administration of one dose of prednisolone 10 mg and allopurinol 50 mg were missed
Extra dose	3.8	An extra dose of hydrocortisone 150 mg IV was administered because the drug was given 8 hourly instead of 12 hourly
Wrong drug	3.8	Noradrenaline infusion was prescribed but adrenaline infusion was administered instead
Wrong-patient	3.3	One dose of calcium folinate IV 15 mg was given to the wrong patient
Wrong strength	2.8	Glibenclamide 5 mg was administered instead of 2.5 mg
Wrong time	2.0	Vancomycin 500 mg IV that was prescribed to be given 8 hourly was administered 4 hours earlier
Wrong flow rate	1.9	Intravenous fluid ½:½ solution (83 ml/hr) and dopamine in normal saline (10 ml/hr) was prescribed but the infusion rates were switched when administered
Known drug allergy	1.5	Ampicillin was administered to a patient with a known allergy to co-amoxiclav
Other	3.8	A date expired normal saline infusion was administered to a patient

contact with patients. It includes unsafe acts committed by humans such as mistakes, or lapses made by prescribers, pharmacists and nurses. Active failures result in bad outcomes immediately. In contrast, latent failures occur due to weaknesses in the system. They are failures in the strategic decision making process higher up in the organisational structure. Latent failures may lie dormant for a long time before they produce a bad outcome. Medication error happens due to an active or latent failure, or due to both. So medication errors may be avoided by eliminating active or latent failures.

In the past, the human approach was used as a strategy to reduce medication errors. That is, to blame, shame and punish health professionals who were involved in medication errors. Psychologists argue that an error could occur due to 'human error', 'at risk behaviour', or 'reckless behaviour' in humans. 'Human errors' are usually unintentional. 'At risk behaviour' includes intentional behaviour that increases the risk of error. It is mostly observed when health professionals tend to drift away from rules and take short cuts 'Reckless behaviour' is when there is conscious disregard of patient safety when performing a task. Of the three types of behaviour, 'human errors' are unavoidable, difficult to eliminate, and are not blameworthy. Furthermore, 'blame and shame' may discourage honest health professionals from reporting medication errors, hindering hinder the opportunity of preventing similar errors from happening again. Hence, blaming and punishing human errors is unsuccessful. Stopping latent failures; a systems approach, is a more sensible and proactive approach. Presently, the most accepted approach is the 'just culture'. In this approach all health professionals value the importance of the threats to patient safety, and use safe methods to perform tasks, whereas hospital administrators ensure that the system is designed to minimise risk. The 'just culture' holds the hospital administrators accountable for system-level failures and healthcare staff (prescribers, pharmacists and nurses) accountable for their negligent behaviour.

Establishing a 'just culture' in the hospital

Improving the system and establishing a 'safety culture' among the hospital work force are two integral components of avoiding medication errors. Figure 1 shows some of the key strategies that may be used by hospital administrators to improve the system in a hospital. Educating health professionals on the importance of patient safety and advising them to be more careful is important, but has less power as an error-reduction strategy. On the other hand, establishing rules and procedures, constant reminders, use of checklists, simplifying and standardising the process are more effective. There is evidence that use of technology in the treatment process has greatly reduced the rate of medication errors as it provides a relatively error-free system that detects human errors. The use of computers for prescribing, computerised decision support systems to aid prescribers make therapeutic decisions and pharmacists to evaluate the appropriateness of prescriptions, bar-code assisted medication dispensing systems, medication administration systems, automated dispensing machines, and the use of 'smart pumps' for parenteral drug administration procedures are some widely used technologies. We encourage Sri Lankan health administrators to invest on selected technologies such as computerised prescribing and bar-code assisted drug dispensing and drug administration to improve patient safety in our country. Forcing functions and introducing constraints have shown to be the most effective strategy for minimising medication errors as this would force humans to avoid 'at risk behaviour' and 'reckless behaviour'. An example of a forced function is when the system alerts, and blocks the prescriber from proceeding with his electronic prescription when two interacting drugs are prescribed in the same prescription. The use of certain technologies may not be immediately feasible in developing countries such as Sri Lanka. However, system-level changes can still be incorporated to the treatment process, such as introducing pre-printed prescription formats for prescribers. A study conducted in a tertiary care hospital in Sri Lanka showed that there was unacceptable use of unapproved and error-prone abbreviations in prescriptions. One survey has revealed that pharmacists found prescriptions difficult to read because of illegibility and use of unapproved abbreviations. Other studies here have found also that prescriptions are often incomplete. Introducing a pre-printed prescription format will force prescribers to write complete and more legible prescriptions.

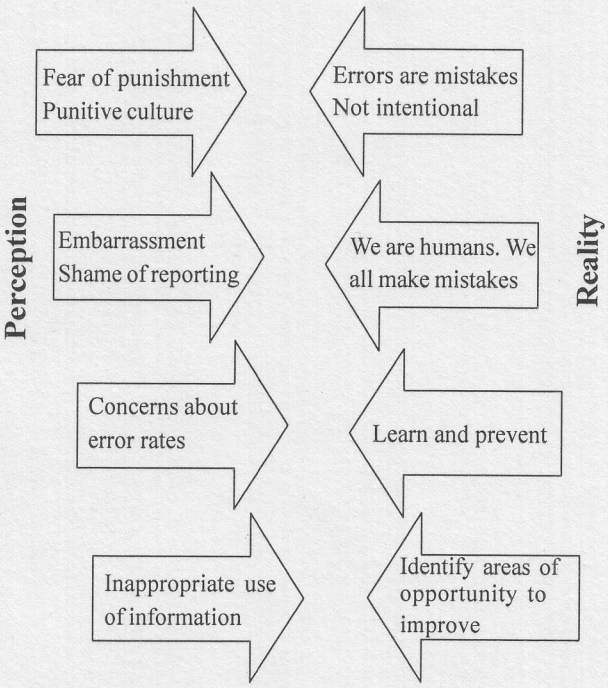
Figure 1. Error reduction strategies (*Institute of Safe Medication Practices*, February 2006)

Error reduction strategy	Power (leverage)
Forcing functions and constraints	High ↑
Automation and computerisation	↕
Standardisation	↕
Redundancies	↕
Reminders and checklists	↕
Rules and policies	↕
Education and information	↕
Suggestions to be more careful	Low ↓

Medication errors should be reported for managers to plan corrective action for the future, so a non-punitive environment should be established in hospitals to encourage health professionals to report medication errors. This would include the provision of a confidential reporting system where staff is made to understand that errors will not be linked to individual performance. In such a practice, reporting of medication errors will be rewarded and timely feedback is given on the corrective system changes done to avoid similar errors. It would also be important to change the mind-set of all health professionals towards a safety culture by changing their perceptions and tackling the factors that inhibit error reporting (Figure 2). There is a lack of safety culture within the healthcare system in Sri Lanka. It is time that hospital administrators regarded medication safety as a serious issue and inculcated a safety culture among Sri Lankan health professionals. Establishing a medication error reporting system and encouraging voluntary reporting among health professionals would be a good start. If medication errors happen in developed countries, in spite of sophisticated healthcare systems, medication errors would be far more likely to happen in Sri Lanka. If we knew the types of medication errors that occur frequently within our healthcare setting, it would be easier to tackle them through system improvement. More emphasis should be given for research related to medication safety as an incentive to improve our healthcare system.

Finally, a continuous quality improvement process must be in place to sustain patient safety in the treatment process. Studying the process, planning for improvement, taking corrective action and monitoring outcomes should be an ongoing process.

Figure 2. Factors that inhibit error reporting



Summary

Medication errors are a remediable threat to patient safety, and an extra burden to the healthcare costs. Medication errors could occur at any stage of the treatment process and may be avoided by system improvement, establishing a 'safety culture' among health professionals, and by a continuous quality improvement process. Hospital administrators together with all health professionals should strive to achieve an error-prone treatment process in hospitals.

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Self-assessment questions

Select the **best** response in each question

Question 1

A 45-year old man taking losartan 50 mg and atorvastatin 10 mg daily prescribed by his GP, was seen at the outpatients' department of a General Hospital with a history of retrosternal pain that lasted about 20 minutes, soon after a game of tennis. At the Emergency Treatment Unit his blood pressure, respiratory rate, clinical examination, and 12-lead ECG were normal. Urgent troponin T was reported as 0.06 g/l (reference range 0 - 0.1), and a random blood glucose was 5 mmol/l.

The most appropriate diagnosis at this stage is:

A non-STEMI
B unstable angina
C non-cardiac pain
D benign spontaneous pneumothorax
E pleuritic pain

Question 2

A 28-year old paddy farmer form Matugama is admitted to a General Hospital with a history of fever and sweats for 5 weeks. A GP had treated him with co-amoxiclav for 6 days after detecting 4 - 5 red cells and 10 - 15 pus cells in the urine examination, with no clinical improvement. In the hospital his oral temperature was found to be 39°C, and the Registrar found a 2 cm palpable spleen. Rest of the clinical examination was unproductive. Initial investigations were as follows.

haemoglobin	11.2 g/dl	(13.5 - 16.5)
MCV	78 fl	(80 - 96)
ESR	69 mm/1 hour	(0-18)
platelets	250 x 10^9/l	(150 - 400)
white cell count	10.5 x 10^9/l	(4 - 11)
blood cultures (x3)	negative	
urine cultures (x2)	negative	
renal test profile	normal	
liver test profile	normal	
urine analysis	5 - 6 red cells, 2 - 3 pus cells, occasional hyaline cast	

What is the most likely aetiology for his fever?

A renal cell carcinoma
B leptospirosis
C post-streptococcal glomerulonephritis
D renal tuberculosis
E perinephric abscess

Question 3

A 46-year old man underwent elective surgery for the removal of a falx meningioma. Surgery was uneventful, and on post-op day 1 he was alert and well orientated. On the second post-operative day he complained of headache and became drowsy. By 8.00 pm he was lethargic and confused. His BP, respiration rate and funduscopy were normal. His oral temperature was 38.2°C, and the white cell count was 10.2 x 10^9/l. Appropriate treatment was instituted.

The following data were obtained by the Registrar.

Post-op Day	Serum Na+ (mmol/l)	Urine Na+ (mmol/l)	Plasma osmolality (mosm/kgH_2O)	Urine osmolality (mosm/kgH_2O)
2	138	275	270	290
3	126	295	266	298

What is the most likely cause of his altered conscious level?

A post-surgical pyogenic meningitis
B viral meningitis
C inappropriate antidiuretic hormone secretion
D over-transfusion of isotonic saline
E hypovolaemia

Answers to self-assessment questions

Question 1. The best response is C at this stage, pending further investigation.

Question 2. The best response is D. Responses B, C and E are unlikely, given the history and laboratory investigations.

Question 3. The best response is C. The low serum Na^+ and osmolality, taken in conjunction with the level of natriuresis, is typical of SIADH.

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