

Medicines Management

*Medicines management and older people
- a guide for healthcare professionals*



Edited by
Ralph S Greenwall, BPharm (Hons)

Contents

1. Introduction	4	7. Compliance, concordance and adherence:	30
2. The ageing process and medication	5	Factors affecting adherence	31
3. Pharmacokinetics & pharmacodynamics:	8	8. Legal aspects of medication administration:	32
Drug absorption	8	Licensed and unlicensed medicines	32
Drug distribution	9	Medicines and the regulatory framework	32
Drug metabolism	10	The Human Medicines Regulations 2012	32
Drug excretion	11	Health and Social Care Act 2008 and the Care Quality Commission (CQC)	33
Plasma concentration	11	Equality Act 2010	33
Therapeutic window	12	The Nursing & Midwifery Council (2008) Standards for Medicines Management	34
4. Oral medicines:	13	Patient consent	34
Different types of oral formulations	13	Negligence	35
Tablets and capsules	13	9. Additional resources	36
Different types of coatings and modifications	14	10. Glossary of terminology	37
Dose dumping	16	11. References	41
Medication manipulation	17	12. Notes	42
Liquid alternatives	18	13. Biography	43
5. Adverse drug reactions:	19		
Type A reactions	19		
Type B reactions	19		
Reporting ADRs	20		
When to report an ADR	20		
Common medication causes of adverse drug reactions in older people	21		
Clinical presentation of ADRs in older people	22		
Common medication causes of adverse drug reactions in older people - Cardiovascular system	23		
Common medication causes of adverse drug reactions in older people - central nervous system (CNS)	24		
Common medication causes of adverse drug reactions in older people - anti-inflammatory drugs	25		
6. Medication and older people:	19		
Polypharmacy and cascade prescribing	26		
STOPP and START criteria	26		
Medication review	27		
Prescribing for older people	28		
Principles of medication management and older people	29		

1 Introduction

In 2010, 17 per cent of the population were over 65. The number of people aged 85+ more than doubled between 1985 and 2010 to 1.4 million.¹

The UK has an increasingly ageing population.¹ The average life expectancy is now over 80 years and predicted to rise to over 90 by 2035.² The percentage of people aged 65 and over increased from 15 per cent in 1985 to 17 per cent in 2010, an increase of 1.7 million people. By 2035 it is projected that those aged 65 and over will account for 23 per cent of the total population.¹

Older people have a higher prevalence of illness and take around 50% of all prescribed medicines.³ Four in five people over 75 take at least one prescribed medicine, with 36% taking four or more medicines.⁴

The medicines management of an older person is complicated by multiple diseases, complex medication regimes and the ageing process affecting the body's capacity to handle medicines. In addition, medicines have become increasingly sophisticated, particularly in their delivery systems and there are legal aspects to consider as well as pharmacological ones.

The safe delivery of medicines for older people is a critical and challenging aspect of patient care. This booklet aims to help healthcare professionals learn more about how medication works (focusing particularly on oral medicines), how the ageing process affects medicines, common adverse drug reactions, the definitions of compliance and concordance as well as to give an overview of some of the legal aspects of medicines management.

2 The ageing process and medication

Almost half of the NHS drugs bill is spent on medicines for older people and a core standard set out in the National Service Framework⁴ is to 'ensure that this is spent in a clinical and cost effective manner, to maintain or improve the health of older people and not to increase the effects of existing illness.'

Key points from the NSF⁴ in relation to medication and older people are:

- As many as 50% of older people may not be taking their medicines as intended
- Dosage instructions on the medicine label are sometimes inadequate - such that neither patient nor carer has access to the correct dosage information, for example, "Take as directed" or "Take as required"
- Some medicines are under-used in older people. For example, anti-thrombotic treatments to prevent stroke, preventive treatment for asthma, and antidepressants
- Some long-term treatments can be successfully withdrawn - diuretic treatment, for example, can be stopped in about half of patients providing progress is monitored
- Many adverse reactions to medicines could be prevented

*'Appropriate medicines management systems should be in place so that the medication needs of older people are regularly reviewed, discussed with older people and their carers, and information and other support provided to ensure older people get the most from their medicines and that avoidable adverse events are prevented.'*⁴

Drug absorption, distribution in the body, metabolism and excretion can all change as part of the ageing process. The presence of multiple medical conditions and complex medicine regimes can lead to a greater potential for medication problems. Older people have an increased susceptibility to drug induced side effects and may also experience difficulty in swallowing their medication.

Liver function reduced

There are age-related changes that are known to affect liver function, for example reduction in the both total liver size and total blood flow. The total blood flow to the liver of a person aged 91 may reduce by up to 58% compared to when they were 24 years old.⁵

2 The ageing process and medication (Continued)

The reduction in total liver size is likely to lead to a decrease in the levels of drug metabolizing enzymes. A further decrease in efficiency is likely to result from the reduction in liver blood flow, due to the decreased exposure of the drug to metabolising enzymes.

Renal impairment

The total size of the kidneys decreases with age, as does the number of functioning nephrons. There is also decreased renal blood flow with increasing age. This results in a progressive decrease in renal function. This problem is a combination of a fall-off in glomerular filtration rate and the propensity for dehydration in this age group. The mean glomerular filtration rate can fall from 140ml/min/1.73m² in a 30 year old to 97ml/min/1.73m² in an 80 year old.⁶

Reduced GI motility

A number of age-related diseases can affect gastrointestinal motility in older people: for example, long-standing diabetes mellitus may reduce gastric emptying in up to 50% of patients; depression significantly prolongs gut transit times; hypothyroidism may prolong oro-caecal transit times; and chronic renal failure is associated with impaired gastric emptying. In addition, various frequently prescribed drugs can cause reduced gastrointestinal motility in older patients, including anticholinergics, opioid analgesics and calcium antagonists.⁷

Changes in body composition

Altered plasma concentrations and individual body composition, in particular body fat and intracellular fluid content, can significantly influence drug distribution in older people. The decreased muscle and tissue mass that accompanies ageing will also influence the distribution of certain drugs, as will the reduced blood flow to tissues and organs. In addition, there is evidence that the blood brain barrier is less intact in older people which allows certain drugs to distribute into the brain in increased concentration.

Swallowing difficulties

The loss of muscle tone associated with ageing, together with a reduction in saliva production (xerostomia) can reduce the older person's ability to swallow medicines in a solid dosage form. Dysphagia (difficulty in swallowing) is estimated to occur to some degree in 70-90% of the older population.⁸ Ageing is also associated with conditions which have the potential to cause dysphagia e.g. stroke and Parkinson's disease. Therefore, before prescribing/administering any medication for an older person it is imperative that their ability to swallow the prescribed formulation is determined.⁹

In a recent study³ medication errors were three times more likely to occur when administering medicines to patients with dysphagia, than to patients with a normal swallowing function.

Always take extra care when giving medicines to people with swallowing difficulties.

Selecting the right formulation for this patient group can be as important as the treatment itself.⁶ If a patient is unable to swallow their medicines they are unlikely to take them.⁹ If the patient can swallow a liquid formulation safely and a suitable liquid or dispersible formulation is available then this may be the most appropriate solution.⁹ See <http://www.swallowingdifficulties.com> for a comprehensive list of liquid and non-oral alternatives to tablet or capsule formulations.

3 Pharmacokinetics & pharmacodynamics

Whether administering or prescribing medication, it is essential to understand how drugs work and interact with the body. Two key processes need to be considered; pharmacodynamics which is the effect that drugs have on the body and pharmacokinetics which is the way drugs move round the body during absorption, distribution, metabolism and excretion.

Pharmacokinetics	what the body does to the drug
Pharmacodynamics	what the drug does to the body

When a medicine is administered, it is absorbed into the bloodstream and distributed round the body. The drug reaches a peak level and soon after this, the level falls steadily as it is metabolised and/or eliminated. This basic process happens with every medication.

The key stages that a drug undergoes on entering the body are summarised below:

Eric is 84 and was recently prescribed furosemide, a diuretic, to reduce fluid retention in his legs. Whilst treating the condition well, Eric confided that his tablets caused him to urinate urgently for the first couple of hours after taking them. On several occasions he had not reached the bathroom in time. The pharmacist suggested taking the tablets with a meal, to slow drug absorption, whilst not reducing the actual amount of diuretic absorbed. Eric tried this and found the need to pass water did not come on quite so quickly, so he had time to reach the bathroom.

Food can affect drug absorption rates

Absorption - the process by which the drug enters the blood stream

Distribution - where the drug goes in the body after absorption

Metabolism - breakdown of the drug by the body

Excretion or elimination - where the drug or metabolites leave the body

Drug absorption

When a drug has been administered orally, it passes into the stomach and then into the intestines. During this time, the drug is absorbed into the blood stream.

Effect of food on drug absorption

Both the rate of absorption and the amount of drug that is actually absorbed are affected by the presence or absence of food in the gastro intestinal (GI) tract. For example, a large meal taken at the same time as some medicines may slow the progress of a drug through the GI system and reduce the rate of drug absorption. Some foods are known specifically to reduce drug absorption; large amounts of protein

reduce the absorption of levodopa and calcium rich foods reduce tetracycline absorption. Any food, fruit juice, tea or coffee can significantly reduce the absorption of bisphosphonates like alendronate and risedronate. Grapefruit juice is known to affect the absorption of a number of drugs including antihypertensives.¹⁰

Conversely, the presence of some foods may improve the absorption of a drug, for instance foods containing vitamin C help improve the absorption of iron.

Effect of medication formulation on absorption

The formulation of the medication affects drug absorption. Intravenous medicines bypass the absorption stage altogether, whilst intramuscular injections absorb gradually from the muscle tissue into the blood stream. Suppositories will absorb through blood vessels in the rectal wall and transdermal patches through the skin. Buccal and sub lingual tablets which are designed to dissolve in the mouth are rapidly absorbed through the oral mucosa. Drug coatings and special modified release mechanisms also affect the rate of absorption (See Oral Medicines for more details).

Drug distribution

Once drugs have been administered and absorbed they are distributed into body tissues. The extent and pattern of distribution will be dependent mainly on the plasma and tissue protein binding characteristics of the drug and its lipid solubility (solubility in fatty tissues).

Drugs which are highly bound to plasma proteins (e.g. warfarin) distribute very little into the organs since bound drugs cannot cross the capillary membranes due to the large size of the protein molecules. When drugs do bind to plasma proteins, it is usually the proportion of the drug that remains unbound which has an active effect. Some drugs can displace others from their binding sites on the plasma proteins for example aspirin displaces warfarin from plasma proteins, leading to significant increases in the International Normalized Ratio (INR) in patients, as the higher level of free warfarin has a greater effect.

Highly lipid soluble drugs tend to concentrate in fat tissue and in the brain. Drugs that are highly water soluble may be confined to extracellular fluid since they will not easily diffuse across the high lipid containing cellular membranes. Some drugs are taken up actively into various tissues, particularly if they resemble a naturally occurring nutrient.

As the drug enters the blood stream, the plasma level rises to a peak (the peak plasma level). The drug then starts to distribute itself around the body and drug metabolism starts.

3 Pharmacokinetics & pharmacodynamics (Continued)

Drug metabolism

Drug metabolism is the process by which the body chemically breaks down or changes a drug allowing eventual elimination from the body. Most metabolism takes place in the liver (hepatic metabolism), although it can occur in other areas of the body such as the intestines.

Some drugs which are known as *pro-drugs* are pharmacologically inactive until metabolised to the active form. An example is codeine which is metabolised to morphine by the body.

Drugs which are metabolised quickly have a short duration of action and need to be administered more frequently, whereas those which are metabolised more slowly will need less frequent administration. In general, as drugs are metabolised their therapeutic effect diminishes.

Some drugs undergo breakdown by *first pass metabolism*. They are absorbed through the stomach and small intestine after oral administration, and enter the portal circulation, which goes to the liver. They are then metabolised by liver enzymes before they have a chance to enter the systemic circulation. Buprenorphine and glyceryl trinitrate are examples of drugs which undergo extensive first pass metabolism. This is why they may be formulated for sublingual or transdermal administration to bypass this first pass metabolism effect, which would otherwise have quickly rendered the active ingredient(s) inactive.

Liver enzymes - inducers and inhibitors

Some drugs known as *enzyme inducers* cause certain liver enzymes involved in the metabolism of drugs to work faster. Other drugs known as *enzyme inhibitors* reduce the action of certain liver enzymes resulting in the slow metabolism of some drugs.

This effect is of particular importance when one of these enzyme affecting drugs is started, stopped or the dose changed, as this may well affect the metabolism of some other medication being taken. One drug may alter the absorption, distribution, metabolism, or excretion of another, thus increasing or reducing the amount of drug available to produce its pharmacological effects. Whenever a medication is changed, the effect this may have on other medicines being taken should be considered.

June went to see her GP about a chest infection. Her doctor wanted to prescribe erythromycin, but noted that she was taking simvastatin to reduce her cholesterol level. Erythromycin is an enzyme inhibitor and if taken with simvastatin will reduce the metabolism of simvastatin resulting in increased blood levels of this drug with an increase in side effects. The GP advised June to stop taking simvastatin until she finished the course of erythromycin.

Always consider the action of one drug on another

Particular attention should be paid to patients who have illnesses impacting on liver function for example congestive heart failure, as reduced liver function may impair the ability to metabolise some drugs.

Common enzyme inducing drugs

Carbamazepine
Griseofulvin
Phenytoin
Rifampicin
Nicotine

Common enzyme inhibiting drugs

Cimetidine
Erythromycin
Ciprofloxacin
Allopurinol
Chloramphenicol

Drug excretion

Once drugs have had their desired effect, they need to be eliminated by the body.

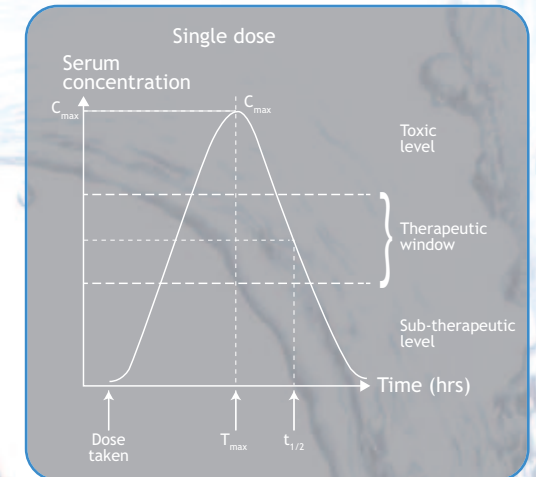
Excretion predominantly occurs via renal elimination in the kidneys. Other elimination routes include excretion in bile, saliva, sweat, tears, faeces and exhaled air.

Plasma concentration

There are several terms associated with the plasma concentration of a drug.

Maximum concentration (C_{max})

This is the highest concentration that a particular drug reaches in the blood stream and is sometimes referred to as the peak plasma concentration. The time taken to reach this level after taking a medicine is referred to as the T_{max} . In general the higher the C_{max} the greater the risk of a patient developing dose-related side effects. To try to prevent a drug becoming toxic (a drug overdose) the frequency and dose of the drug need to be adjusted to ensure the C_{max} does not exceed the toxic threshold.



3 Pharmacokinetics & pharmacodynamics (Continued)

Minimum concentration (C_{min})

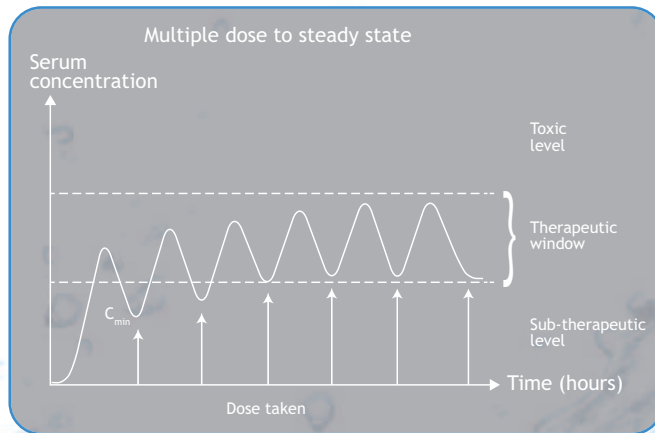
This is the minimum concentration that a drug will reach in the blood stream between successive drug doses. This is important because if the C_{min} drops below the therapeutic threshold then the medication may no longer be effective. This would be termed under-dosing or sub-therapeutic dosing.

Plasma half life ($T_{1/2}$)

This is the time taken for the C_{max} of a drug to fall by half in the blood stream. It is a good indication of how quickly a particular drug is broken down and eliminated from the body. The longer the half life, the longer the drug will remain in the body.

Therapeutic window

The difference between the minimum plasma level for the drug to be clinically effective (therapeutic threshold) and the plasma level at which the drug becomes toxic is termed the 'therapeutic window' of the drug. The narrower the therapeutic window, the less margin there is between a drug being therapeutic and a drug being toxic or sub-therapeutic. For most drugs the therapeutic window is wide and occasional missed or additional doses may not affect the drug's efficacy or safety.



However, a number of drugs have a narrow therapeutic window and even small changes in dose or metabolism can increase the likelihood of adverse effects or therapeutic failure.

Examples of drugs with a narrow therapeutic window include carbamazepine, phenytoin, lithium, warfarin, digoxin, gentamycin and vancomycin.

4 Oral medicines

Different types of oral formulations

Oral medicines are available in many different formulations including:

- Tablets
- Capsules
- Dispersible or effervescent tablets
- Sub-lingual tablets
- Buccal tablets and liquids
- Melts
- Oro-dispersible tablets
- Liquid medicines






Tablets and capsules

Tablets and capsules are the most commonly prescribed formulations of medicines, because they are convenient to use and provide a relatively stable environment for the drug. Tablets and capsules are made up of much more than just the active drug. They may also contain:

- Filling agents to provide bulk e.g. lactose, to which some people are intolerant
- Binders to hold the formulation together and possibly slow or delay drug absorption by slowing the break up of the tablet or capsule in the GI tract
- Disintegrants to help the dose break down quickly in the stomach to speed drug absorption
- Colourings to help identification
- Glidants to help during the manufacture of the tablet or capsule
- Surfactants to help drug absorption
- Flavourings to mask the taste
- Special coatings

Diagrammatic representation of a cross section of a tablet's contents



	Lubricant, glidant, antiadherent
	Flavourings and colourings
	Filler
	Binder
	Disintegrant
	Active ingredient/drug

Different types of tablet coatings and modifications

73 year old Edith lived alone at home. When her GP reviewed her analgesia for arthritic joints, she said that her tramadol capsules (50mg) were giving some relief but she found it difficult to remember to take them four times a day. Often it was only the return of the pain that reminded her to take her medication. Ethel's GP changed the prescription to tramadol 100mg MR tablets twice daily.

A week later Edith presented to the doctor with symptoms of nausea, dizziness and sweating. On examination her doctor could find no physical cause for these symptoms. Edith told her doctor that she seemed to feel worse an hour or two after breakfast and again in the evening.

She also reported that she did not really like her new tablets as they were much harder to crush to take with her food - the capsules had been much easier to open and mix with her meals. The side effects were a direct result of crushing the MR tablets.

Patients may sometimes crush or open capsules to make them easier to swallow without asking or informing any healthcare professional. To help prevent the potential risk of ADRs or poor clinical outcomes always ask patients if they are able to swallow tablets or capsules without manipulation.

To reduce the frequency with which a drug needs to be taken and help improve patient compliance, drug delivery systems have become increasingly complex. Tablets and capsules may have special coatings for example 'sugar coated', 'film coated' or 'enteric coated' or they may be designed to modify the rate at which the drug is released into the body. It is important to understand the mechanism as well as the rationale before deciding whether it is safe or appropriate to crush tablets or open capsules.

Film and sugar coating

A sugar coating is a thick, hard coating of sugar surrounding the tablet inside which is used to hide the flavour of particularly unpleasant tasting drugs e.g. ibuprofen and quinine, both of which are extremely bitter.

Due to the large increase in the size of the tablet caused by sugar coating, film coatings now tend to be used instead. These are very thin layers of a safe ingredient placed around the tablet to again protect the tongue from the flavour of the contents and the contents from moisture. The film will however break down with a little agitation and significant amounts of moisture e.g. saliva or stomach acid and therefore does not significantly affect the way in which the drug is absorbed into the body.

Crushing these tablets therefore may not seriously affect how the drug is released but may cause the resultant mixture to be unpleasant to taste.

These tablets often have the letters s/c or f/c after the drug name. Sometimes the coating is not mentioned in the name at all.

Enteric coating

Enteric coated (e/c) tablets or capsules have a special coating on the outside that does not dissolve in acid. This means the drug is not released in the acid environment of the stomach but is released in the alkaline environment of the intestines. Examples of drugs which often have enteric coatings include prednisolone EC, gastro-resistant aspirin and lansoprazole capsules.

There are three reasons for putting such a coating on a tablet or capsule ingredient:

- To protect the stomach from the drug
- To protect the drug from the stomach acid
- To target the release of the drug after the stomach i.e. in the intestines

Enteric coated tablets should not be crushed before being taken as this will affect the efficacy of the medication and could cause patient harm.

Modified release

Drugs with a short half life need to be given frequently meaning that numerous doses may need to be taken over a 24 hour period. This can adversely affect patient compliance. For this reason drugs with a short half life are often formulated into modified release formulations, usually this is to slow the release of the drug over 12 or 24 hours.

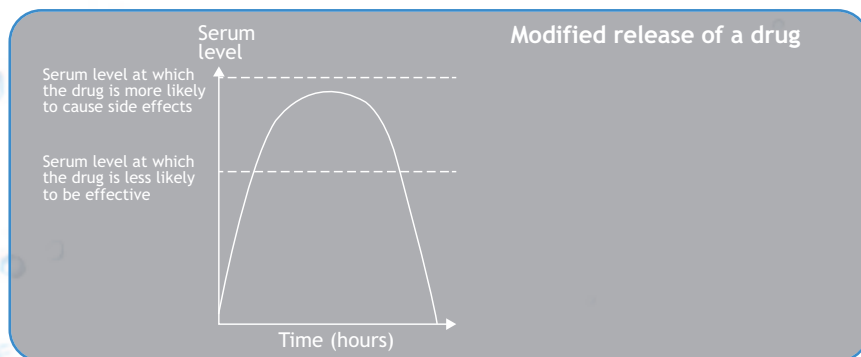
Tablets and capsules which are designed to provide modified release often have the letters MR, LA, XL, CR or SR in their names e.g. nifedipine MR, isosorbide mononitrate LA, diltiazem XL. Sometimes the words 'slow' or 'retard' can be used to denote modified release e.g. Diclofenac retard, Voltarol retard & Slow K.

There are a number of ways in which a medicine can have its release modified:

- Embedding the drug in a matrix which releases the drug as it disintegrates
- Placing a lasered hole in the capsule/tablet coat as the only point of release. e.g. venlafaxine XL and nifedipine LA
- Placing the active drug into granules with coatings of different thicknesses which release at different rates
- Compressing the tablet so it takes longer to break up

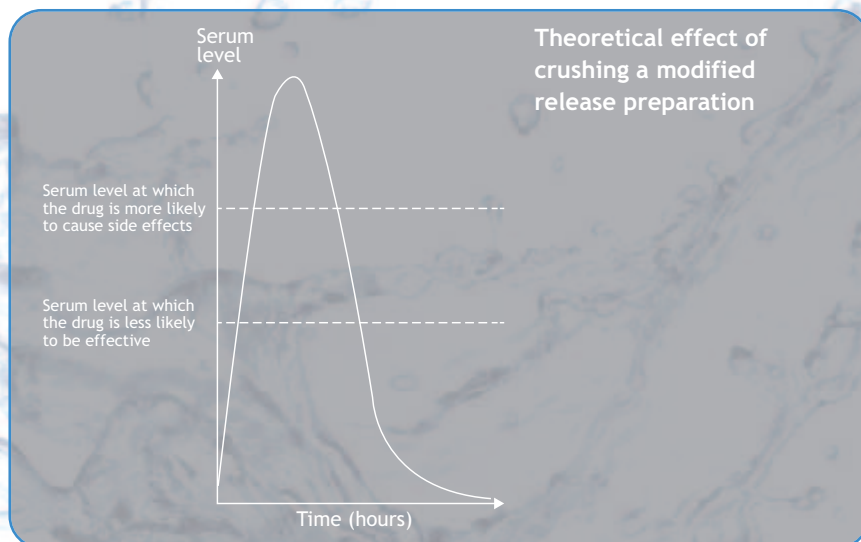
The figure overleaf shows how a drug is theoretically released from a modified release formulation. The serum concentration does not spike so the risk of side effects is reduced and there is a prolonged period of time when the drug is active in the body.

4 Oral medicines (Continued)



Dose dumping

If a modified release medication is damaged by chewing or crushing then the whole dose may well be released much more quickly than intended. This results in the patient being exposed to a dose which is designed to be released slowly (over a 12 or 24 hour period), being delivered in 15 or 20 minutes. This is known as 'dose dumping'. The outcome could be serious for the patient both in terms of an initial overdose of the medication causing toxicity and then due to a lack of continued 'sustained' release, a period of underdosing where the underlying medical condition is not being treated effectively. As it is not always possible to tell whether a modified release system is included as part of a tablet or capsule, no tablet or capsule should be crushed or opened prior to administration, unless it is specifically designed to be administered in this way, or there are clear, written instructions from the prescriber.



In cases where a patient is unable to tolerate solid medication, then the advice of a doctor or pharmacist should be sought about suitable alternative formulations.

Medication manipulation

When a patient has difficulty swallowing a solid medicine, crushing tablets, opening capsules, dissolving/dispersing/suspending solid medicines not licensed or designed for use in this way, should never be undertaken unless there are specific, written instructions from the prescriber to do so or the Summary of Product Characteristics (SPC) states that this is how the medicine can be administered. See: www.medicines.org.uk/emc to access product SPCs.

The act of crushing tablets or opening capsules, which are not designed to be administered in this way, alters the formulation of the medication and potentially can have serious negative consequences for the patient. In particular, modified release drugs should always be swallowed whole (See above).

Reasons not to manipulate medicines, unless specifically licensed for this purpose:

1. A crushed tablet or opened capsule which is not designed for administration in this way is no longer a licensed product, making the prescriber and/or administrator and/or the person advising this practice legally liable if the patient suffers any harm as a result of the practice.
2. The rate or site of absorption may be affected, which could negatively impact on the effects of the medication.
3. Crushing medicines which are active over a small therapeutic window, such as digoxin, phenytoin, lithium and warfarin can change the rate of absorption of the active ingredient and could reduce efficacy and/or cause side effects.
4. Medicines which are enteric coated to prevent absorption in the stomach may be broken down in the stomach causing irritation or failure to reach the intended site of action.
5. Crushing a modified/slow release medication means that the patient may receive a large bolus very quickly, followed by a period of time when no active drug is being absorbed by the body.
6. Crushing of medicines which are coated to disguise the flavour of the drug, e.g. ibuprofen, quinine, will result in the patient receiving an unpalatable medicine, which could adversely impact on adherence to treatment.
7. A coating may prevent the administrator from suffering contact sensitisation, such as a skin rash from drugs such as chlorpromazine.
8. With any crushed tablet there is a risk of inhalation by the administrator and this is of greatest concern when hormonal or cytotoxic treatments are prescribed.

4 Oral medicines (Continued)

Liquid alternatives

If a patient has difficulty swallowing a solid medication, a liquid medicine may be more appropriate and easier to swallow. Many solid medications are available as licensed liquids, which means they have a Marketing Authorisation (MA) for use, issued by the Medicines and Healthcare products Regulatory Agency (MHRA) or the European Medicines Agency (EMA).

For products listed in the British National Formulary (BNF) or the Monthly Index of Medical Specialities (MIMS) for which there would appear to be no liquid version available, there are companies licensed to manufacture 'special' liquids. Pharmacists can advise on the availability of liquid alternatives.

5 Adverse drug reactions

An adverse drug reaction (ADR) is defined by the Medicines and Healthcare products Regulatory Agency (MHRA) as *'an unwanted or harmful reaction experienced following the administration of a drug or combination of drugs under normal conditions of use, which is suspected to be related to the drug'*. The reaction may be a known side effect of the drug or it may be new and previously unrecognised.

ADRs are common particularly amongst older patients. A study of ADRs as a cause of acute hospital admission in patients over 75 years found:

- 30% of acute admissions may have been due to ADRs
- 53% of the ADRs were preventable
- 48% were caused by cardiovascular drugs
- 26% were due to non-compliance with medication
- The most common manifestations of ADRs were falls, postural hypotension, heart failure and delirium¹¹

Type A reactions

Type A (augmented) reactions result from an exaggeration of a drug's normal pharmacological actions when given at the usual therapeutic dose and are normally dose-dependent.

Examples include:

- Low blood pressure with antihypertensives
- Low blood sugar with insulin

Type A reactions also include those that are not directly related to the desired pharmacological action of the drug (e.g. dry mouth that is associated with tricyclic antidepressants).

Type B reactions

Type B (bizarre) reactions are novel responses that are not expected from the known pharmacological actions of the drug, for example:

- Anaphylaxis with penicillin
- Skin rashes with antibiotics

5 Adverse drug reactions (Continued)

Type A	Type B
Predictable	Unpredictable
Usually dose dependent	Rarely dose dependent
High morbidity	Low morbidity
Low mortality	High mortality
Responds to dose reduction	Responds to drug withdrawal

Reporting ADRs

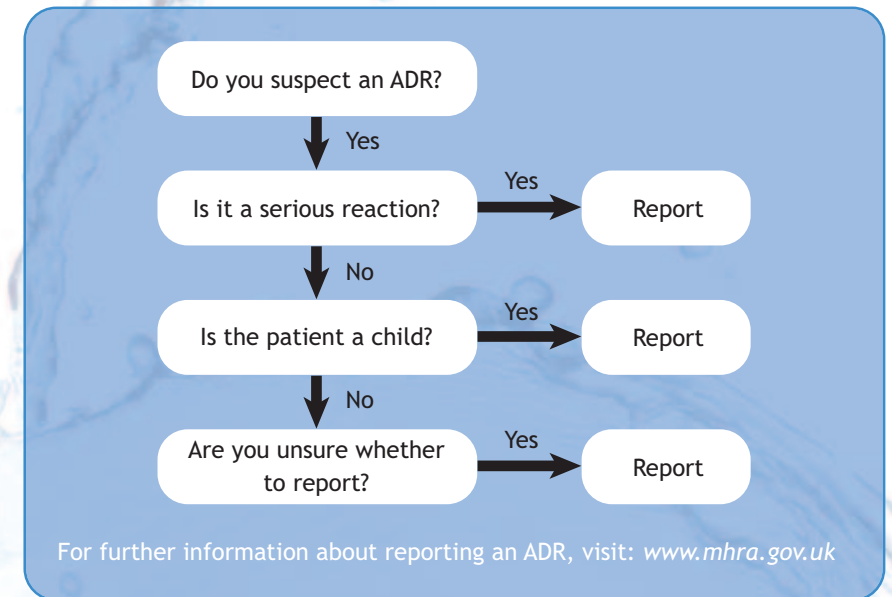
The MHRA recommends that a Yellow Card is completed if there is a suspicion that a drug has caused an adverse reaction. See: <http://yellowcard.mhra.gov.uk>

All suspected adverse reactions which are considered to be serious should be reported through the Yellow Card system. The MHRA defines serious reactions as those which are:

- fatal
- life-threatening
- disabling
- incapacitating
- have resulted in, or prolonged hospitalisation
- medically significant
- caused congenital abnormalities
- noxious and unintended

The MHRA are particularly interested in receiving reports about adverse reactions in older people, who may be more susceptible to developing reactions as they tend to metabolise medicines less effectively, and be more sensitive to their effects. Therefore, they may be more susceptible to developing reactions. The MHRA now regards reports direct from patients as valid. Their definition of an ADR has been extended to include all reports where harm has occurred to a patient. This will mean that ADRs that are a result of error, misuse and where used off-label should be reported.

When to report an ADR¹²



Common medication causes of adverse drug reactions in older people

Pharmacokinetic, pharmacodynamic and physiological changes which result from ageing contribute to an increased sensitivity to drugs and adverse drug reactions in older people.

The most common causative drugs of ADRs in older patients are cardiovascular drugs.¹¹ See chart on next page.

Medication group	Drug class	% drugs causing ADR
Cardiovascular	ACE-Inhibitor	13.9%
	Diuretics	10.7%
	Beta-blockers	7.4%
	Calcium antagonists	6.6%
	Digoxin	4.9%
	Nitrates	4.9%
Total cardiovascular ADR %		48.4%
CNS	Antidepressants	7.4%
	Benzodiazepines	4.9%
	Phenothiazines	4.9%
	Antiparkinsonian	2.5%
	Anti-epileptics	0.8%
Total CNS ADR %		20.5%
Anti-inflammatories	Corticosteroids	5.7%
	NSAIDs	4.9%
Total anti-inflammatories ADR %		10.6%
Anti-thrombotics	Aspirin	4.1%
	Warfarin	1.6%
Total anti-thrombotics ADR %		5.7%
Others		15.6%

Adapted from Chan M, Nicklason F and Vial JH¹¹

Clinical presentation of ADRs in older people

Adverse drug reactions often present in older patients in a non-specific way. Common manifestations of ADRs include confusion (caused by almost any of the most commonly prescribed drugs), constipation (with antimuscarinics and many tranquillisers), postural hypotension and falls (with diuretics and many psychotropics).¹³

The most common presentations of ADRs in older patients are listed below¹¹:

- Falls
- Pulmonary oedema/heart failure
- Delirium
- Acute renal failure
- Stroke
- Palpitations
- Angina
- Bradycardia
- Nausea and vomiting
- Hyper/hypoglycaemia
- Seizure
- Parkinsonism

Common medication causes of adverse drug reactions in older people - cardiovascular system

ACE inhibitors need to be given with care to patients receiving diuretics. First doses can cause hypotension especially in patients taking high doses of diuretics. They can cause a very rapid fall in blood pressure and close observation is recommended after administration of the first dose of ACE inhibitor, for at least 2 hours or until the blood pressure has stabilised.¹³

Beta blockers slow the heart and can depress the myocardium. They can affect carbohydrate metabolism, causing hypoglycaemia or hyperglycaemia in patients with or without diabetes.¹³

Calcium channel blockers (calcium antagonists) can cause hypotension, but different drugs in this category have different sites of action, with different therapeutic effects and side effects.¹³

Digoxin The level of potassium in the body has a significant effect on the toxicity of digoxin. Low potassium (hypokalaemia) is a major cause of digoxin toxicity. Signs of digoxin toxicity include:

- Nausea/vomiting
- Dizziness
- Visual disturbance
- Cardiac arrhythmia

Diuretics side effects relate directly to the action of the diuretic:

Loop diuretics such as furosemide produce a fast onset of diuresis (usually complete within six hours) which may lead to:

- Urinary incontinence
- Acute retention

If taken on an empty stomach, diuresis is more rapid in onset and shorter in duration. Doses may be split to give a more gradual diuresis.

Thiazides like bendroflumethiazide have a more prolonged diuresis than loop diuretics (around 12 hours).

Both groups of diuretics cause potassium and sodium depletion, which may cause retention of uric acid leading to gout. The changes in salt balance can lead to potential reactions with other medications. Loop and thiazide diuretics

5 Adverse drug reactions (Continued)

are often combined with a potassium sparing diuretic such as spironolactone or amiloride to try to stabilise potassium levels.¹³

Common medication causes of adverse drug reactions in older people - central nervous system (CNS)

Hypnotics and sedatives: Many hypnotics with long half-lives have serious hangover effects; including drowsiness, unsteady gait, slurred speech and confusion.¹³

Benzodiazepines are the most commonly used anxiolytics and hypnotics. A paradoxical increase in hostility and aggression may be reported by patients taking benzodiazepines. The effects range from talkativeness and excitement to aggressive and antisocial acts. Increased anxiety and perceptual disorders are other paradoxical effects. Benzodiazepines impair balance, which can result in falls.¹³

Withdrawal of a benzodiazepine should be gradual because abrupt withdrawal may produce confusion, toxic psychosis, convulsions, or a condition resembling delirium tremens.¹³

Tricyclic antidepressants: All tricyclic drugs including amitriptyline, imipramine and lofepramine can cause drowsiness, confusion, postural hypotension and anticholinergic side effects: drowsiness, dry mouth, blurred vision, constipation and urinary retention. They also interfere with body temperature regulation so regular temperature records are important for elderly people prescribed these drugs.

The BNF recommends that as *'Elderly patients are particularly susceptible to many of the side-effects of tricyclic antidepressants; low initial doses should be used, with close monitoring, particularly for psychiatric and cardiac side-effects'*.

Tricyclic and related antidepressant drugs should be used with caution in patients with cardiovascular disease because of the risk of arrhythmias.¹³

Lithium: Altered pharmacokinetics in the elderly often prolongs the half-life of lithium, so caution must be exercised to avoid toxicity, particularly as lithium has a narrow therapeutic window. Toxic effects include tremor, ataxia, dysarthria, nystagmus, renal impairment and convulsions.¹³

Note: Low sodium levels (hyponatraemia) have been associated with all types of antidepressants and should be considered in patients who develop

drowsiness, confusion or convulsions while taking an antidepressant.

Neuroleptic (antipsychotic) drugs commonly prescribed for older people include phenothiazines like chlorpromazine and trifluoperazine; and butyrophenones like haloperidol. They are likely to cause drowsiness, hypotension, constipation and impaired temperature control. The use of phenothiazines can sometimes cause seizures. Extrapyramidal (anti-dopaminergic) side effects are common. These include:

- Parkinsonism
- Dystonia (abnormal face and body movements) which may appear after only a few doses
- Akathisia (restlessness) which may resemble an exacerbation of the condition being treated
- Tardive dyskinesia (involuntary movement) which may appear after a longer period

Antipsychotics can increase the risk of stroke in older people with dementia and in any patient with pre-existing risk factors.¹⁴

Common medication causes of adverse drug reactions in older people - anti-inflammatory drugs

Bleeding associated with aspirin and other NSAIDs (non-steroidal anti-inflammatory drugs) is more common in older people who are more likely to have a fatal or serious outcome. NSAIDs are also a special hazard in patients with cardiac disease or renal impairment which may again place older patients at particular risk.¹³

256 patients in 55 homes on a mean of 8 medicines each were studied. 69.5% of patients experienced at least one medication error. 39.1% received a prescribing error, 18.4% a monitoring error, 36.7% a dispensing error and 22.3% an administration error.

The report concluded: **There is an unacceptable prevalence of medication errors in care homes, affecting some of the most vulnerable members of society. Action is required from all concerned.**¹⁵

Polypharmacy and cascade prescribing

Increasing age is associated with multiple co-morbidities, which means that older people receive more prescribed medicines to treat a number of conditions. The prescription of four or more medicines is known as polypharmacy. Although it might be appropriate to prescribe numerous medications for a patient there is a risk of cascade prescribing, where side effects from one drug result in a new drug being added to treat the effects, e.g. prescribing prochlorperazine for patients with digoxin induced nausea.⁹ Another example would be a treatment with a non-steroidal anti-inflammatory drug leading to a rise in blood pressure, with a subsequent prescription of an antihypertensive drug.

To ensure that a new prescription is not being initiated to treat the side effects of another drug, it is necessary to differentiate adverse drug reactions from underlying pathology. This is particularly true of the four conditions below which are common in older patients:⁹

- **Incontinence** - may be caused by medication, infection, decreased mobility or a range of disease states e.g. benign prostatic hypertrophy
- **Intellectual impairment** - caused by medication and a number of diseases including dementia
- **Instability** - caused by medication, postural hypotension or visual impairment
- **Immobility** - caused by instability, previous falls and diseases such as arthritis

Whenever an older person presents with one of the above conditions it is necessary to review the medications being prescribed in relation to the physiological changes associated with ageing.⁹

STOPP and START criteria

The STOPP (Screening Tool of Older Persons' potentially inappropriate Prescriptions) and START (Screening Tool to Alert to Right Treatment) criteria have been designed and validated to help improve medication management in older people.

The STOPP screening tool

STOPP (Screening Tool of Older Persons' potentially inappropriate Prescriptions) is a medicine review tool comprising of 65 clinically significant criteria for potentially inappropriate prescribing in older people. The aim is to identify drugs which should be avoided in older people because the risks often outweigh the benefits.

STOPP criteria identified at least one potentially inappropriate medication in 35% of older patients requiring admission to hospital.¹⁶

Examples from STOPP include:

- Potentially inappropriate prescription of NSAIDs e.g. in people with peptic ulcer disease, heart failure, hypertension
- Patients with a history of falls receiving potentially inappropriate psychoactive medications like long-acting benzodiazepines
- Patients with an isolated fall inappropriately prescribed sedating antihistamines and opiates

The START screening tool

The START screening tool (Screening Tool to Alert to Right Treatment) was designed and validated for identifying prescribing omissions in older adults. Using the START list, one or more prescribing omissions in 57.9% of patients were identified. In order of prevalence, the most common prescribing omissions were:

- Statins in atherosclerotic disease (26%)
- Warfarin in chronic atrial fibrillation (9.5%)
- Anti-platelet therapy in arterial disease (7.3%)
- Calcium/vitamin D supplementation in symptomatic osteoporosis (6%)¹⁷

Medication review

As people get older, their use of medicines tends to increase. Four in five people over 75 take at least one prescribed medicine, and 36% take four or more medicines. All people over 75 years should have their medicines reviewed at least annually and those taking four or more medicines should have a 6 monthly review.⁴

Multiple diseases and complicated medication regimes may affect a patient's capacity and ability to manage their own medication. Appropriate prescribing for older people and monitoring of their condition are key objectives set out in the NSF for Older People. However, it is not only the medicines prescribed but also how the medicines are actually used by patients that should be considered. The lifestyle and physical needs of the patient need to be taken into consideration.

An 80 year old lady, living at home was prescribed Slo-Phyllin capsules to help her breathing difficulties. She was advised not to break open the capsules but to swallow them whole. She understood this to mean that she should not pop the capsules out of the blister pack. She cut round each blister and swallowed both the capsule and blister. She was admitted to hospital with an intestinal obstruction.

Ensure that directions about how to take medication have always been fully understood.

6 Medication and older people (Continued)

Community pharmacists offer a Medicines Use Review (MUR) service which is a planned face-to-face consultation between a pharmacist and a patient to discuss their medicines. The review is concordance-centred and aims to help increase the patients' knowledge and understanding of their medicines, including how and why they should be taken. It also provides an opportunity to highlight any concordance issues, side effects or other medicine-related problems from the patient's perspective and propose solutions if appropriate.

Prescribing for older people

Older patients require special care and consideration from prescribers. *Medicines for Older People*, a component document of the National Service Framework for Older People describes how to maximise the benefits of medicines and how to avoid excessive, inappropriate, or inadequate consumption of medicines by older people.

Appropriate prescribing

Elderly patients often receive multiple drugs for their multiple diseases. This greatly increases the risk of drug interactions as well as adverse reactions, and may affect compliance. The balance of benefit and risk of some medicines may be altered in older people. Therefore, older patients' medicines should be reviewed regularly and medicines which are not of benefit should be stopped.

Formulation of the medicine

Older patients may have difficulty swallowing tablets; if left in the mouth, ulceration may develop. They should always be encouraged to take their tablets or capsules with enough fluid, and whilst in an upright position, or be prescribed the medication in a liquid format instead.

Manifestations of ageing

In the very old, manifestations of normal ageing may be mistaken for disease and lead to inappropriate prescribing. In addition, age-related muscle weakness and difficulty in maintaining balance should not be confused with neurological disease. Disorders such as lightheadedness not associated with postural or postprandial hypotension, are unlikely to be helped by drugs.

Sensitivity

The nervous system of older patients is more sensitive to many commonly used drugs, such as opioid analgesics, benzodiazepines, antipsychotics, and antiparkinsonian drugs, all of which must be used with caution. Similarly, other organs may also be more susceptible to the effects of drugs such as antihypertensives and NSAIDs.⁴

Principles of medication management and older people

The following basic principles will help ensure that an older person receives appropriate treatment with the most appropriate medication to optimise their health and well-being.⁹

- Limit the range of drugs used so that you are familiar with them
- Consider starting any new drugs at half the usual adult dose and avoiding any drugs where potential risks outweigh possible benefits
- Review medication regularly - ensure there is an indication and therapeutic goal for all prescribed drugs. Stop any that are no longer required. Monitor renal function and alter dosages as necessary
- Simplify regimes - try to choose medicines which only require once or twice a day dosing intervals
- Explain any changes to medication clearly and ensure prescriptions contain full dosing instructions
- Explain what to do when the patient has finished their medication, including what to do with stocks of medicine that have been discontinued
- If you believe that the patient is not coping despite the above measures think about enrolling the help of a relative or friend

7 Compliance, concordance and adherence

Medicines which are prescribed but not taken by patients represent a waste of NHS resources, as well as negatively impacting on patient care. However, without effective information and education, many patients are unable or unwilling to take their prescribed medication. Healthcare professionals have a key role in working with patients to achieve concordance with prescribed treatment.

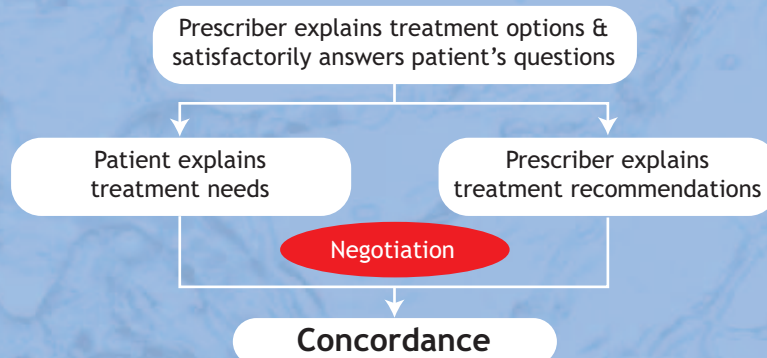
The terms compliance, adherence and concordance have different and specific meanings which are described below.

Compliance Until relatively recently the most common term for following treatment instructions was 'compliance'. Compliance may be simply defined as: *'The extent to which the patient's behaviour matches the prescriber's recommendations'*. Although the term compliance is still used, it has been criticised for having negative connotations in terms of the healthcare professional-patient relationship.

Adherence The term adherence has been adopted by many as an alternative to compliance, in an attempt to emphasise that the patient is free to decide whether to follow the prescriber's recommendations and that failure to do so should not be a reason to blame the patient. Adherence develops the definition of compliance by emphasising the need for agreement and may be defined as: *'The extent to which the patient's behaviour matches agreed recommendations from the prescriber'*.

Concordance The term concordance is increasingly used in relation to medication-taking and can be defined as: *'an agreement reached after negotiation between a patient and a health care professional that respects the beliefs and wishes of the patient in determining whether, when and how medicines are to be taken.'* This gives the patient an informed choice, involves knowledge sharing and communication.

Diagrammatic representation of concordance⁶



Factors affecting adherence

It is estimated that up to 50% of patients do not take their medication as prescribed and reports of unused or wasted medications exceed £100m every year.⁹ Several factors have been implicated in non-adherence and considering these factors and discussing where appropriate with the patient is the best approach to minimise non-adherence.

Difficulty accessing medication from packaging - it may be difficult for an older person with for example arthritis to unscrew a cap or remove tablets from a blister pack. Child-resistant containers may pose particular difficulties.

Sight impairment - this will affect a person's ability to distinguish between their medicines, read container labels and access medication from packaging.

Dysphagia - swallowing difficulties may impair a patient's ability to adhere to prescribed medicines. The most frequently reported problem is the size of oral solid dosage forms.

Confusion/forgetfulness and advancing age - forgetfulness is often given as a reason for non-adherence.

Treatment regimen - research shows a progressive decline in adherence with an increasing number of medications prescribed. Simplifying dosing to once or twice daily may help.⁹

Licensed and unlicensed medicines

Before a medicine can be sold in the UK, a product must have a licence called a 'marketing authorisation' (formerly known as a 'product licence'). The use of licensed medicines maximises patient safety while minimising liability, but there are occasions when an unlicensed or off-label medicine is prescribed and dispensed. This may be because:

- It is an unusual formulation or strength
- It may be a preservative or additive-free product
- For some diseases there are no licensed medicines
- It might be prescribed for a disease or a type of patient outside of the drug's Marketing Authorisation

An 'off-label' medicine is a licensed medicine which is used outside its licence. For example a medicine might have a licence for one condition, but may be prescribed for a different condition.

Medicines and the regulatory framework

Medication is a key element of patient care and all professionals who are involved in medicines management are governed by a legal and professional accountability to follow best practice when prescribing and administering medication. A strict legal framework regulates the supply, prescription and administration of medicines to protect patient safety.

In summary, the law requires that the:

- Right medicine is given to the:
- Right patient, at the
- Right time, using the
- Right dose, in the
- Right formulation

The following is a summary of some of the laws and professional codes of conduct which govern the prescription and administration of medicines in the UK.

The Human Medicines Regulations 2012

The Human Medicines Regulations 2012 regulates the licensing, supply and administration of medicines. Medicines must be used in line with the marketing authorisation (MA) abbreviated in the summary of product characteristics (SPC) supplied by the manufacturer. If the dose, route of administration or form of the medicine is changed from that set out in the SPC for example, by crushing a tablet not licensed to be given in this way, this would be a breach of the 2012

Regulations. If any harm arose to the patient as a result, the person manipulating the medicine would be held legally liable.¹⁸

Health and Social Care Act 2008 and the Care Quality Commission (CQC)

This Act created a new regulator, the Care Quality Commission (CQC) and all providers of health and adult social care services need to register with the Commission which has the authority to impose essential standards for quality and safety.

Managing medicines is a regulated activity under this Act and healthcare professionals have a duty to protect patients against risks associated with the management of medicines. The Act requires that:

'The registered person must protect service users against the risks associated with the unsafe use and management of medicines, by means of the making of appropriate arrangements for the obtaining, recording, handling, using, safe keeping, dispensing, safe administration and disposal of medicines used for the purposes of the regulated activity.'

Medicines provided to service users should be appropriate and person-centred, taking into account the age, preferences, lifestyle, condition and disabilities of the patient. The most appropriate medicine, route and form of the drug should be considered in each patient's case. The CQC also requires that all prescriptions be up to date, reviewed and changed as the service user's needs change.

The CQC works with professional regulatory bodies, including the General Medical Council and the Nursing & Midwifery Council (NMC) and will pass on evidence of poor practice to the relevant regulator for investigation of fitness to practise.¹⁹

Equality Act 2010

Medication management must comply with the requirements of the Equality Act 2010. This law gives people with disability the same right to access services as an able-bodied person, and it is unlawful to discriminate against a person because of their disability. This includes the right of access to, and benefit from, medicinal products. Providing disabled service users with support to manage and take medicine safely is a duty under the Act. It may be necessary to request the changing of a bottle top to a non-safety version, or remove tablets from blister packs into a bottle for a person with arthritis. Patients with visual impairment can have large-print labels, and the outer packaging of medicines must now have the name of the drug in Braille.¹⁹

People with complex medicine regimens or who are forgetful may be given medication administration records to help manage their medicines and, where further assistance is required, pharmacists may provide monitored dosing systems for the patient.

Swallowing difficulties may affect a patient's ability to take the prescribed medication and these patients will need particular management if medication compliance is to be achieved. Most commonly prescribed medicines are available in liquid form, which can make swallowing easier.¹⁹

The Nursing & Midwifery Council (2008) Standards for Medicines Management

The Nursing & Midwifery Council (NMC) has issued standards (2008) for medicines management that remind nurses that they have a responsibility to deliver safe and effective care based on current evidence and best practice. The NMC recognises the importance of medicines and states:

'The administration of medicines is an important aspect of the professional practice of persons whose names are on the Council's register. It is not solely a mechanistic task to be performed in strict compliance with the written prescription of a medical practitioner (can now also be an independent and supplementary prescriber). It requires thought and the exercise of professional judgement...'

Minimum standards are set for safe practice in the management and administration of medicines and reflect the process from prescribing through to dispensing, storage, administration and disposal.

The NMC has also issued advice about tablet crushing, stating that:

*"The mechanics of crushing medicines may alter their therapeutic properties rendering them ineffective and are not covered by their product licence. Medicinal products should not routinely be crushed unless a pharmacist advises that the medication is not compromised by crushing, and crushing has been determined to be within the patient's best interest."*²⁰

Patient consent

Even though an appropriately qualified healthcare professional has the right to prescribe a medicine, the medicine can only be given to the person with their consent. A patient has a right to refuse medication (however unreasonably) and those caring for the patient must respect that right.

*'It is established that the principle of self-determination requires that respect must be given to the wishes of the patient, so that if an adult patient of sound mind refuses, however unreasonably, to consent to treatment or care [those] responsible for his care must give effect to his wishes, even though they do not consider it to be in his best interests to do so.'*⁹

However, the right to decide presupposes the mental capacity to do so. Every adult is presumed to have this capacity unless this can be rebutted under the Mental Capacity Act 2005. The Act states that a person lacks capacity if some impairment or disturbance of mental functioning renders the person unable to make a decision whether to consent to or refuse treatment.⁹

Negligence

The law of negligence places a duty of care on healthcare professionals to prescribe and administer medication to patients to a standard consistent with a responsible body of professional opinion. If harm is caused as a result of breaching a duty of care then there will be liability in negligence.

The duty of care extends to advice giving, diagnosis, treatment and prescribing practice. If a healthcare professional recommended that medication is crushed or a capsule opened to assist a person with a swallowing difficulty and harm results then liability in negligence would arise.

In the event of a negligence case being brought with regard to tablet crushing, the court would consider whether:

- There were alternative products available such as liquid preparations, including 'specials'
- The prescriber gave approval for crushing
- The pharmacist was consulted about the safety of crushing the tablet
- The person was told about the risks involved and gave consent or a determination of best interests was made
- A respected body of professional opinion would have crushed the medication in the same circumstances
- The evidence stands up to logical analysis⁹

The practice of crushing tablets and opening capsules is one that has the potential to endanger public safety and thereby breach the legal and professional requirements. It must not be done when there is a safer alternative such as a liquid preparation.⁹

www.bnf.org

www.ema.europa.eu

www.medicines.org.uk

www.mhra.gov.uk

www.swallowingdifficulties.com

www.yellowcard.mhra.gov.uk

Absorption	the process of how the medicine enters the body (blood and other organs).
Adverse drug reaction	an unwanted or harmful reaction experienced following the administration of a drug or combination of drugs under normal conditions of use, which is suspected to be related to the drug.
Akathisia	a movement disorder characterized by a feeling of inner restlessness and a compelling need to be in constant motion. Is often a side effect of certain drugs.
Anxiolytic	a type of drug which is used to treat anxiety.
Arrhythmias	the deviations from the normal rhythm of the heart.
Ataxia	lack of voluntary coordination of muscle movements, e.g. as in walking.
Blood-brain barrier	the semi-permeable membrane which keeps circulating blood separate from the cerebral-spinal fluid surrounding the brain.
Cascade prescribing	the prescribing of a second drug to treat the side effects of a first.
Cellular membrane	the membrane that surrounds each cell. It contains a high level of fats called lipids.
Delirium	an acute confusional state.
Distribution	where the medicine is distributed around the body after the drug has been absorbed.
Diuresis	the production of urine.
Dysarthria	a motor speech disorder.
Dysphagia	the medical term for the symptom of difficulty in swallowing.
Dystonia	abnormal face and body movements.
Elimination	the routes by which the drug or the metabolites of the drug leave the body. Also known as excretion.
EMA	the European Medicines Agency, which is

	responsible for the scientific evaluation of medicines developed by pharmaceutical companies for use in the European Union.		
Enteric coating	a special coating on the outside of a tablet or capsule that does not dissolve in the stomach acid.	Licensed product	a medicinal product that has a Marketing Authorisation. Its use is stipulated in its Summary of Product Characteristics.
Enzyme inducers	chemicals or drugs that increase the level of metabolism of a chemical.	Marketing Authorisation	medicines which meet the MHRA's standards of safety, quality and efficacy are granted a marketing authorisation (previously a product licence).
Enzyme inhibitors	chemicals or drugs that increase the level of metabolism of a chemical.	Medication manipulation	the act of crushing a tablet, opening a capsule, dissolving or "melting" a tablet or capsule content.
Excretion/elimination	the routes by which the drug or the metabolites of the drug leave the body.	Metabolism	is the mechanism by which the drug is broken down by the body usually undertaken by enzymes in the liver. Some drugs are designed to only become active after they have been metabolised. These are called "pro-drugs".
Extracellular fluid	the liquid in between the cells of the body.	MHRA	the Medicines and Healthcare products Regulatory Agency (MHRA) is the government agency which is responsible for ensuring that medicines and medical devices are effective, and are acceptably safe.
Extrapyramidal side effects	otherwise known as Parkinsonism. Characterised by tremor, rigidity, poverty of movement, difficulty swallowing, loss of facial tone, and stooped, shuffling gait.	Modified release	tablets or capsules that have a mechanism to prolong the release of the drug over a longer period of time. Also known as slow release.
First-pass metabolism	when a drug is absorbed from the GI tract it enters the hepatic blood stream and goes to the liver where it undergoes rapid metabolism before going to the rest of the body. This can be avoided by using a different route such as IV injection.	Myocardium	the muscle of the heart.
Gastro intestinal motility	how quickly the GI contents move down the GI tract.	Nystagmus	a condition of involuntary eye movement.
Hepatic	concerning the liver.	Paradoxical excitement	agitation caused by administration of a sedative.
Hyperglycaemia	a higher than normal blood glucose level.	Peak plasma concentration	the highest concentration that a drug reaches in the blood.
Hypnotic	a type of drug that induces sleep.	Pharmacodynamics	the study of the biochemical and physiological effects of drugs on the body and the mechanisms of drug action and the relationship between drug concentration and effect it exerts.
Hypoglycaemia	a lower than normal blood glucose level.	Pharmacokinetics	the study of the mechanisms of absorption and distribution of an administered drug, the rate at which a drug action begins and the duration of the effect, the chemical changes of the substance in the body (e.g. by metabolic enzymes) and the
Hyponatraemia	a lower than normal blood sodium level.		
Hypokalaemia	a lower than normal blood potassium level.		
Intracellular fluid	the fluid contained within the cells of the body.		
Legal liability	the extent to which a person is liable for any harm caused to another.		
Lipid solubility	solubility of the drug in fatty tissues.		

10 Glossary of terminology (Continued)

	effects and routes of excretion of the metabolites of the drug.
Plasma proteins	proteins in the plasma which can bind with some drugs.
Plasma protein binding	the extent to which drugs are bound to proteins in the plasma which affects their level of activity and the extent to which they are distributed round the body.
Polypharmacy	multiple drug prescribing.
Postural hypotension	a rapid onset of low blood pressure due to standing or stretching too quickly.
Pro-drug	a drug that is administered in an inactive form, which becomes active following metabolism within the body.
Renal	concerning the kidneys.
Renal clearance	the rate at which waste products are eliminated from the body by the kidneys.
Renal function	a measure of how well the kidneys are working.
Slow release	tablets or capsules that have a mechanism to prolong the release of the drug over a longer period of time. Also known as modified release.
Solid medication	a tablet or capsule.
Sub-therapeutic	below the dose required to have a medically beneficial effect.
Tardive dyskinesia	neurological disorder of involuntary movements usually caused by long-term use of antipsychotic or neuroleptic drugs.
Therapeutic window	the difference between the minimum plasma level for the drug to be clinically effective and the plasma level at which the drug becomes toxic.
Xerostomia	dryness of the mouth, due to reduced saliva production.

11 References

1. Office for National Statistics (ONS), Population Ageing in the United Kingdom its constituent countries and the European Union, 2nd March 2012. <http://www.ons.gov.uk/ons/rel/mortality-ageing/focus-on-older-people/population-ageing-in-the-united-kingdom-and-europe/rpt-age-uk-eu.html>
2. Office for National Statistics (ONS), 2010-based Period and Cohort Life Expectancy tables, 26th October 2011. <http://www.ons.gov.uk/ons/rel/lifetables/period-and-cohort-life-expectancy-tables/2010-based/index.html>
3. Kelly J, Wright D, Wood J, (2011) Medicine administration errors in patients with dysphagia in secondary care: a multi-centre observational study. *Journal of Advanced Nursing* 67(12), 2615-2627
4. Department of Health, Medicines and Older People: Implementing medicines-related aspects of the NSF for Older People, March 2001
5. Wynne HA, Cope LH, Mutch E *et al*, (1989), The effect of age upon liver volume and apparent liver blood flow in healthy man. *Hepatology* 9(2): 297 - 301
6. Kafetz K, (1983) Real impairment in the elderly: a review. *Journal of the Royal Society of Medicine* 76.
7. O'Mahony D, O'Leary P, Quigley EM (2002) Aging and intestinal motility: a review of factors that affect intestinal motility in the aged. *Drugs Aging*; 19(7):515-27.
8. Murry T & Carrau R, (2006) Clinical Management of Swallowing Disorders. Plural Publishing, Oxford.
9. Wright DJ, (2011) Prescribing medicines for patients with dysphagia - a handbook for healthcare professionals, Grosvenor House Publishing
10. Bailey DG, Malcolm J, Arnold O, and Spence JD, (1998) Grapefruit juice-drug interactions, *Br J Clin Pharmacol.* 46(2): 101-110.
11. Chan M, Nicklason F and Vial JH, (2001) Adverse drug events as a cause of hospital admission in the elderly. *Internal Medicine Journal*; 31:199-205
12. MHRA 2012. <http://www.mhra.gov.uk/Safetyinformation/Reportingsafetyproblems/Reportingsuspectedadversedrugreactions/index.htm> (accessed Sept 2012)
13. British National Formulary (BNF) <http://bnf.org/bnf/index.htm>, accessed 14th February 2012
14. MHRA, antipsychotic drugs, accessed online 14th February 2012 <http://www.mhra.gov.uk/Safetyinformation/Generalsafetyinformationandadvice/Product-specificinformationandadvice/Product-specificinformationandadvice-A-F/Antipsychoticdrugs/index.htm#3>
15. Alldred DP *et al* (2009), Care Home Use of Medicines Study, *Qual Saf Health Care*; 18:341-346
16. Gallagher P, O'Mahony D (2008), STOPP (Screening Tool of Older Persons' potentially inappropriate Prescriptions): application to acutely ill elderly patients and comparison with Beers' criteria *Age and Ageing*; 37: 673-679
17. Barry PJ, Gallagher P, Ryan C, O'Mahony D, (2007) START (screening tool to alert doctors to the right treatment)—an evidence-based screening tool to detect prescribing omissions in elderly patients, *Age and Ageing*, Volume 36, Issue 6, Pp. 632-638.
18. The Human Medicines Regulations (2012) SI 2012/1916. London, HMSO.
19. Griffith R, Accountability for medication management, (2011) *Nurse Prescribing*, Vol 9 No 2 45-48
20. Nursing & Midwifery Council (2008) Standards for Medicines Management. NMC, London

Ralph S. Greenwall, BPharm (Hons)

Ralph first registered as a pharmacist in 1990. He has worked extensively with care homes as a community pharmacist, a care home owner, and as the pharmaceutical advisor to a national care home provider. He has developed a keen interest in the management of medication in older people particularly in the areas of compliance and concordance. Over the years Ralph has been involved in numerous projects to develop and improve this field of care.

Ralph says: "The safe delivery of medicines for older people is a critical and challenging aspect of care. It is complicated by multiple diseases, complex medication regimes and the ageing process affecting the body's capacity to handle medicines. In addition, medicines have become increasingly sophisticated, particularly in their delivery systems and there are legal aspects to consider as well as pharmacological ones. This new guide aims to help healthcare professionals deliver the best possible medication care for their patients and residents."

**For further free copies of this booklet, please contact
Rosemont Pharmaceuticals:**

Tel: +44 (0)113 244 1999

Email: marketing@rosemontpharma.com

www.rosemontpharma.com



Rosemont®

The source of liquid solutions.

An educational support booklet sponsored by
Rosemont Pharmaceuticals