BRITISH PHARMACOLOGICAL SOCIETY

TODAY'S SCIENCE TOMORROW'S MEDICINES

Clinical Pharmacology, Therapeutics and Prescribing Curriculum for Medical Degrees

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Preface

This document presents the updated British Pharmacological Society clinical pharmacology and prescribing curriculum for medical schools. This new edition has been produced through a modified Delphi process involving experts with a broad experience of clinical pharmacology education from across the United Kingdom. It has been overseen by a steering committee of expert educators in the field. It builds on previous publications from the society over the past 30-years and reflects evolution in medicines and prescribing practice in the United Kingdom.

Prescribing a medicine is the most common patient facing healthcare intervention and the process of prescribing a medicine is complex. This curriculum outlines core knowledge and skills that will provide graduating doctors with a foundation for safe and effective prescribing throughout their careers. The curriculum does not provide guidance on delivery of its content. We are of the opinion that individual medical schools are best placed to decide how it should/could be used in delivering clinical pharmacology and therapeutics learning within their degree. There is no 'right' way to teach the discipline. We view the utility of this curriculum in the UK as providing a supportive framework that could be used to map learning and provide assurance that a medical degree delivers the required learning.

The curriculum is divided into four distinct sections (I–IV). Principles of clinical pharmacology (section I) covers learning that broadly might be expected to be learned early in the medical degree to provide a foundation for future clinical application. Section II is a suggestion for a 'student formulary' – a core list of drugs that a graduating doctor should be familiar with in relative depth. Therapeutics (section III) provides a list of clinical conditions and their pharmacological treatment which is essential for a graduating medical student and prescribing and related skills are outlined in section IV. Each section is then divided into topic areas, sub-headings and bullet pointed learning objectives.

In defining this curriculum, we have applied a set of learning outcome command verbs such as describe, explain, identify, demonstrate, evaluate, etc. There is no universally accepted definition of these verbs within the education community and the definitions used by the steering group are provided in Appendix 1 for guidance.

We are grateful to all the experts who have contributed to the Delphi process that has run through 2024 and 2025. A list of experts who have consented for their details to be shared is provided in Appendix 2. Full methodology for the Delphi process has been published in XXXXX.

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Steering committee for the curriculum project.

Contents

Section I. Principles of Clinical Pharmacology

This section provides a list of learning outcomes outlining the expectations of a medical graduate. It is anticipated that some of these outcomes will be addressed in bespoke pharmacology and clinical pharmacology learning sessions, and some will be addressed within other elements of the degree. Individual medical schools are best placed to view how and where this learning can take place within their programmes. Of note, in formulating this list of outcomes, there is no explicit section on personalised or precision medicine.
Concepts underpinning these domains are integrated across learning outcomes.

In defining this curriculum, the steering committee has applied a set of learning outcome command verbs such as describe, explain, identify, demonstrate, evaluate, etc. There is no universally accepted definition of these verbs within the education community and the definitions used by the steering group are provided in Appendix 1 for guidance.

Overview of clinical pharmacology & therapeutics in healthcare

- Define the terms pharmacology, clinical pharmacology and therapeutics
- Define the terms drug and medicine
- Explain the extent of medicines use within society
- Discuss the societal benefits, costs and harms associated with the use of prescription medicines and illicit drugs
- Describe the impact of drug development, medicines policy and prescribing choices on the environment

Principles of pharmacodynamics

- Define the term pharmacodynamics
- Describe the mechanisms of drug action at the molecular, cellular, tissue and organ levels
- Describe the common targets for drugs, for example ion channels, receptors, transporters, enzymes, nucleic acid and antibodies
- Explain the relationship between drug dose and response
- Explain how a drug can interact with its target (e.g. agonist, antagonist)
- Explain the effect of antagonists on the dose-response curve of an agonist
- Explain the concept of receptor selectivity
- Define the terms affinity, efficacy and potency
- Define the term 'therapeutic index'
- Describe the phenomena of desensitisation and tolerance

Pharmacokinetics

Introduction to pharmacokinetics

- Define the term pharmacokinetics
- Explain the four phases of pharmacokinetics
- Explain why an understanding of pharmacokinetics is relevant to prescribers
- Explain the mechanisms of drug movement across physiological barriers

Drug absorption

- Explain fundamental differences between various routes of drug administration
- Describe first pass metabolism and its importance
- Explain how one drug can influence the absorption of another

Drug distribution

- Explain the distribution of drugs across body compartments
- Define apparent volume of distribution
- Explain how the distribution of a drug may influence how it works and how it may be dosed

Drug metabolism and excretion

- Describe how drugs are metabolised e.g. phase I and II metabolism
- Explain the important routes of drug excretion from the body
- Explain the role of the liver and cytochrome P450 enzymes in drug metabolism
- Explain why drug metabolism is a potential point of interaction between drugs

Concentration-time relationships

- Describe the typical concentration-time curve for a drug with first-order kinetics
- Explain the importance of zero-order (saturation) kinetics
- Define clearance and half-life
- Define bioavailability

Applied pharmacokinetics

- Discuss the pharmacokinetic factors that determine choice of formulation, dose, route and frequency of drug administration
- Explain the pharmacokinetics of repeated dosing including time to 'steady state'
- Explain how half-life has practical implications for dosing
- Explain the rationale for loading doses

Individual variability in the response to drugs including pharmacogenomics

- Identify factors (pharmacokinetic and pharmacodynamic/intrinsic and extrinsic) influencing variability in response to drugs and provide common examples
- Explain how inter-individual variability in pharmacokinetics can lead to variation in response to a dose of a drug
- Explain how pharmacodynamic factors can affect drug response (e.g. receptor sensitivity, tolerance, organ-disease)
- Identify important groups of people where pharmacokinetics is altered and explain the mechanisms involved and adjustments that may have to be made by prescribers
- Identify common ways in which genetic and epigenetic variation influences the handling and response to drugs and influences prescribing
- Explain how knowledge of pharmacogenetic variation can enable safer and more effective prescribing

Partnership with patients, adherence and compliance

Partnership with patients

- Explain the importance of, and barriers to, shared decision-making
- Describe how the values, preferences and beliefs of patients and prescribers may influence prescribing decisions
- Define the term concordance
- Explain ways in which concordance can be improved (e.g. presenting accessible information)
- Demonstrate the ability to communicate the benefits and risks of drug therapy with patients
- Demonstrate the ability to explore patients' views and wishes in relation to drug treatment

Adherence to medication

- Define the terms adherence and compliance
- Describe the influence of patients' beliefs on adherence
- Explain non-adherence and its consequences on an individual and population level
- Make an accurate assessment of adherence to medication
- Describe measures to improve adherence (whether intentional or unintentional)

Monitoring drug therapy

Overview

- Explain how monitoring drug therapy can aid decisions around altering or stopping therapy
- Describe the ways in which therapy can be monitored including clinical outcomes,

pharmacodynamic responses and plasma drug concentrations, and identify the prerequisites, advantages and disadvantages of each approach
- List common examples where monitoring drug concentration is important

Using drug effect
- Explain why the impact of drugs on clinical outcomes can be difficult to measure
- Explain the difference between a surrogate and clinically relevant outcome
- Describe what makes a good surrogate outcome

Using drug concentration
- Describe the concept of inter-individual variability in the relationship between dose and plasma drug concentration, and the relationship between drug concentration and effect
- Describe the characteristics that make a drug suitable for monitoring by measurement of concentration
- List common medicines whose use is facilitated by measurement of drug concentration
- Describe the process of measuring plasma drug concentrations, including the timing of sampling in relation to dose
- Explain how to interpret drug concentration measurements, including explanation that some assays measure total- and some free- drug concentrations
- Explain how drug concentration measurements may be used to adjust dosage

Adverse drug reactions

Basic principles
- Define the term adverse drug reaction and other adverse outcomes of drug therapy (e.g. drug toxicity, hypersensitivity)
- Outline the frequency of adverse drug reactions and their impact on public health
- Discuss why all drugs have both beneficial and adverse effects and list patient groups most at risk of adverse drug reactions
- Describe classification systems for adverse drug reactions such as ABCDE or DoTS

Drug allergy
- List factors that may be associated with increased risk of hypersensitivity reaction (e.g. allergy or anaphylaxis)
- List drugs that are frequently associated with hypersensitivity
- Explain how to identify and characterise hypersensitivity reactions to drugs
- Describe the importance of accurate diagnosis and recording of hypersensitivity reactions to drugs
- Describe the precautions that should be taken to reduce risk of hypersensitivity reactions

Diagnosis, interpretation and management
- Explain how to respond if an adverse drug reaction is suspected
- Explain how to manage a suspected adverse drug reaction

Avoiding adverse drug reactions
- Describe risk factors that predict susceptibility to adverse drug reactions
- Describe how identification of those risk factors can influence prescribing decisions
- List important sources of information about adverse drug reactions including the British National Formulary (BNF) and the electronic medicines compendium
- Explain how warnings in prescribing resources can prevent adverse reactions
- Explain how monitoring can prevent adverse reactions (e.g. monitoring renal function, drug concentration)

Pharmacovigilance
- Explain the ways in which adverse drug reactions can be identified (e.g. drug development, voluntary reporting, record linkage) and outline the limitations of these approaches
- Explain why the adverse drug reaction profile of a drug may be incomplete at the time of

marketing authorisation, and how it improves through effective pharmacovigilance
- Discuss the importance of pharmacovigilance, including the role and responsibilities of the prescriber
- Outline how to report a suspected adverse drug reaction using the MHRA Yellow Card scheme

Drug interactions

- Explain how drug interactions may cause beneficial or harmful effects
- Outline the main types of drug interaction (e.g. pharmaceutical, pharmacokinetic, pharmacodynamic)
- Explain why the potential for drug interactions is increasing, including the impact of polypharmacy and multimorbidity
- Identify sources of information about drug interactions to inform prescribing including the British National Formulary (BNF) and the electronic medicines compendium
- Explain how to anticipate and avoid drug interactions
- Explain how a drug interaction that cannot be avoided could be managed (e.g. dose adjustment, additional monitoring)
- Describe points of clinically important drug interactions e.g. liver metabolism, cytochrome P450 enzymes and drug transporters
- Explain how enzyme metabolism can be inhibited or induced and the impact this has on drug handling

Medication errors

Frequency and causes

- Define medication errors, including subtypes (e.g. mistakes, violations, slips and lapses)
- Outline human error theory in simple terms
- Identify individual and systems factors leading to error
- Outline the steps that should be taken when a medication error is discovered, including the use of error reporting systems

Prevention

- Explain how prescribers and healthcare systems can reduce error, including the use of electronic prescribing
- Describe how collaboration with pharmacists and other healthcare professionals can prevent errors

Drug development and regulation

Drug development

- Outline how drugs are discovered
- Describe the stages of drug development (Preclinical, Phase I to Phase IV clinical trials)
- Describe the risks and costs involved in developing drugs

Clinical trials

- Explain the different forms of clinical trial and their advantages and disadvantages
- Describe the requirements of a good clinical trial including consent, ethics, bias, statistics and dissemination of its findings

Drug regulation

- Explain why drugs need to be regulated and identify the major regulatory authorities in the UK and internationally (e.g. MHRA, EMA and FDA)
- Outline the approval process for new drugs
- Describe the implications of market exclusivity and patents, e.g. on the range of products available and their cost

Drug marketing

- Outline how drugs are marketed by the pharmaceutical industry and the legal constraints on the

marketing process
- Describe the role of codes of conduct in relation to marketing of drugs (e.g. the Association of the British Pharmaceutical Industry code of conduct and the Medicines and Healthcare products Regulatory Agency blue guide)
- Describe the potential for marketing processes to change attitudes to a drug and how this can be abused

Evidence-based prescribing

Overview
- Outline the features of a randomised controlled trial, cohort study, case control study, systematic review and meta-analysis
- Explain the difference between interventional and observational studies
- Identify different kinds of evidence and outline their hierarchy in terms of validity and reliability
- Discuss the limitations of applying clinical trial data to individual patients

Critical appraisal of clinical studies
- Describe the process of critical appraisal of clinical studies and demonstrate the ability to appraise research
- Describe an approach to identifying methodological flaws, including sources of bias
- Explain the different types of endpoints or outcomes in clinical trials, e.g. patient centered, surrogate, biomarkers, clinically relevant
- Explain the concept of external validity and problems with extrapolating clinical trial results

Finding reliable information about drugs
- Identify important information resources that might inform prescribing decisions
- Describe how prescribers can keep up to date with change
- Evaluate sources of information for their reliability, e.g. websites, online tools

Medicines management

National processes
- Describe how new medicines are assessed on the basis of safety, clinical efficacy and cost-effectiveness
- Outline the principles of pharmacoeconomic assessments
- Describe the roles of guideline groups e.g. the National Institute for Health and Care Excellence (NICE)

Local processes
- Outline the role of local and regional committees in medicines management
- Describe the role of local formularies and guidelines in the choice and use of medicines
- Describe the factors that influence prescribing choices and why these have to be limited (e.g. cost, antibiotic resistance)
- Explain the responsibility of prescribers to avoid wasteful prescribing and support sustainability

Guidelines
- Define 'clinical guideline' and outline its purpose
- Describe the limitations and harms of clinical guidelines
- Outline the legal standing of guidelines

Formularies
- Outline the relationship between the British National Formulary and local formularies
- Describe the reasons for creating limited lists of medicines
- Outline the important issues relating to coordination of prescribing in primary and secondary care

British National Formulary
- Identify resources contained within the British National Formulary and describe how they may be used

- Describe the limitations of the information contained in the British National Formulary

Ethical and legal aspects of prescribing

Legal aspects of prescribing

- Outline the legal categorisation of drugs into General Sales List, Pharmacy medicines, Prescription-only medicines and Controlled drugs
- Describe who is entitled to prescribe medicines and the legal requirements involved
- Describe who is entitled to supply medicines and the legal requirements involved
- Describe the legal requirements associated with prescribing controlled drugs
- Identify common ways that prescription drugs can be supplied illegally (e.g. internet pharmacy)

Prescribing outside marketing authorisation

- Describe the circumstances in which drugs are prescribed 'off-label'
- Explain the additional responsibilities associated with prescribing 'unlicensed' or 'off-label' medicines
- Describe what information should be given to patients to allow them to make informed decisions about 'off-label' treatment

Ethical aspects of prescribing

- Describe the responsibilities of prescribing in a resource-limited healthcare system
- Describe the sometimes-conflicting responsibilities to individual patients and the wider healthcare community
- Discuss the benefits and costs of adhering to therapeutic guidelines and drug formularies
- Explain why it is important to recognise limits of competence and to ask for help when needed
- Explain the responsibility and importance of keeping one's prescribing practice up to date with advances in medical knowledge

Prescribing for patients with special requirements

Prescribing for patients with impaired liver function

- Describe how impaired liver function may alter physiology, pharmacokinetics and pharmacodynamics
- List common medicines that are likely to cause harm to patients with impaired liver function
- Outline the principles involved in selecting medicines and designing dosage regimens for patients with impaired liver function
- Explain where to find relevant information about choosing and adjusting drug dosage in patients with impaired liver function

Prescribing for patients with impaired renal function

- Describe how impaired renal function may alter physiology, pharmacokinetics and pharmacodynamics
- List common medicines that are likely to cause harm to patients with impaired renal function
- Outline the principles involved in selecting medicines and designing dosage regimens for patients with impaired renal function
- Explain where to find relevant information about choosing and adjusting drug dosage in patients with impaired renal function

Prescribing for elderly patients

- Describe how advanced age may alter physiology, pharmacokinetics and pharmacodynamics
- List common medicines to which elderly patients are especially likely to respond differently
- Explain where to find relevant information about choosing and adjusting drug dosage in elderly patients
- Outline the principles that underlie prescribing in the elderly

Prescribing for pregnant women and women of child-bearing potential

- Explain the reasons for caution when prescribing for pregnant women and women of child-bearing potential

- Describe how pregnancy alters physiology, pharmacokinetics and pharmacodynamics
- List common medicines to which pregnant women are especially likely to respond differently
- Describe the possible effects of drugs on the developing fetus, in relation to the stage of gestation
- Outline the principles involved in selecting medicines and designing dosage regimens for pregnant women and women of child-bearing potential
- Explain where to find relevant information about choosing and adjusting drug dosage in pregnant women and women of child-bearing potential

Prescribing during breastfeeding

- Explain the reasons for caution when prescribing for women who are breastfeeding
- List common medicines that are likely to cause harm to the newborn as a result of transmission via breast milk
- Outline the principles involved in selecting medicines and designing dosage regimens for women who are breastfeeding
- Explain where to find relevant information about choosing and adjusting drug dosage in women who are breastfeeding

Prescribing for children (including neonates)

- Describe the changes in physiology, pharmacokinetics and pharmacodynamics in early life
- List common medicines to which children are likely to respond differently
- Explain where to find relevant information about choosing and adjusting drug dosage for children
- Explain the principles that underlie prescribing for children and adolescents, e.g. administration, formulation, capacity

Rational approach to prescribing and dose selection

Rational approach to prescribing

- Make an accurate assessment of patient specific factors when prescribing
- Select an appropriate medicine based on its comparative efficacy, safety,
- convenience and cost
- Explain the importance of identifying a diagnosis (if possible) and therapeutic objectives
- Evaluate the factors that influence the choice of formulation, dose, route, frequency and duration of treatment
- Demonstrate the ability to review a medication list and optimise therapy

Dose selection

- Explain the importance of accurate calculation of drug dosage, especially for intravenous infusions
- Demonstrate the ability to interpret and convert between different expressions of drug concentration or dose
- Calculate appropriate doses for individual patients, based on age, body weight and surface area
- Select drug dosage using commonly available nomograms
- Identify factors that may necessitate amendments of standard doses

Clinical toxicology

Principles of assessing poisoned patients

- Describe the epidemiology of poisoning
- Outline the principles of assessment of a poisoned patient
- Discuss the role of urine and blood sampling in poisoned patients
- Describe the clinical features of overdosage with commonly used medicines (e.g. paracetamol, salicylates, tricyclic antidepressants, opioids and benzodiazepines)

Principles of treating poisoned patients

- Outline the principles involved in treating a poisoned patient
- Explain how to access and obtain information from the National Poisons Information Service

(e.g. TOXBASE)
- List drugs and toxins to which effective antidotes are available and explain the mechanisms of action
- Explain how the elimination of drugs or toxins can be hastened

Misuse of drugs

- List drugs that are commonly misused (e.g. cannabinoids, MDMA, hallucinogens, volatile solvents, cocaine, opioids, alcohol) and outline some of their important pharmacodynamic effects
- Recognise that making, taking, carrying or selling some drugs is illegal and controlled by the UK Misuse of Drugs Act 1971
- Explain the extent of illicit drug use and its public health consequences
- Define tolerance, physical dependence and psychological dependence

Complementary and alternative medicine

- Describe the prevalence of use of complementary and alternative therapeutic approaches and recognise variation in use between populations.
- Outline the motivations that lead people to seek complementary and alternative therapies
- Describe common therapies used by practitioners of complementary and alternative medicine and the evidence for their efficacy and safety
- Explain the potential of complementary and alternative medicines to cause adverse effects, including interactions with conventional therapy
- Describe the regulation of complementary and alternative medicines

Section II. Drugs (a 'Student Formulary')

This section provides a list of drug classes (with exemplar drugs) with which a graduate should be familiar after completing five years of undergraduate study. They are based on prior iterations of this curriculum and published formularies listing drugs commonly prescribed by doctors, particularly those in the early phases of their careers. For each, students should be able to describe the mechanism of action, indications for use, relevant contraindications and adverse effects to a depth that will enable them to anticipate their clinical effects, communicate effectively with colleagues and counsel patients. It is acknowledged that the depth of knowledge required for practice at graduation will vary a little between classes.

The intention of this list is to provide a core list, or student formulary on which students will build their own formularies. It is anticipated that students will come across additional drugs in specialist rotations at undergraduate level. Biologics in particular represent a rapidly evolving and pharmacologically diverse area of therapeutics. This represents a challenge for educators that cannot easily be resolved within a therapeutics curriculum. When designing course content, we would encourage reflection on the fact that graduating doctors will require a greater knowledge of drugs that they are more likely to initiate and prescribe regularly, compared to those which they require knowledge of the impact of but are unlikely to be initial prescribers of. For example, targeted cancer treatments are likely to only be prescribed in a specialist setting and the type of knowledge that a student may require of these will be necessarily different to that they require for simple analgesics.

Drugs are listed under organ systems to provide some structure to this section. Many of these drugs could be listed under several systems. Duplication in this way has generally been avoided for the sake of brevity.

Gastrointestinal system

Peptic ulcer disease

- Alginates and antacids
- H_2-Antagonists (e.g. famotidine)
- Proton pump inhibitors (e.g. omeprazole)

Antidiarrhoeal drugs

- Antimotility drugs (e.g. codeine, loperamide)

Laxatives

- Laxatives (e.g. bran, ispaghula husk, senna, lactulose, phosphate, glycerol)

Antispasmodic drugs

- Antispasmodics (e.g. mebeverine, atropine)

Inflammatory bowel disease

- Aminosalicylates (e.g. mesalazine)
- Biologics (e.g. infliximab)

Antiemetics

- Dopamine D2-receptor antagonists
- Histamine H1-receptor antagonists
- Serotonin 5-HT3-receptor antagonists

Antimuscarinics

- Hyoscine

Vitamins

- Vitamins (e.g. vitamin K, B12, thiamine)

Cardiovascular system

Diuretics

- Thiazide and thiazide-like diuretics (e.g. bendroflumethiazide and indapamide)

- Loop diuretics (e.g. furosemide)
- Potassium-sparing diuretics (e.g. amiloride, spironolactone)

Beta-adrenoceptor blocking drugs

- Beta-adrenoceptor blocking drugs (e.g. atenolol, bisoprolol)

Calcium channel blockers

- Calcium channel blockers (e.g. amlodipine, verapamil)

Nitrates

- Nitrates (e.g. glyceryl trinitrate)

Drugs affecting the renin-angiotensin system

- ACE inhibitors (e.g. ramipril)
- Angiotensin II receptor antagonists (e.g. losartan)

Alpha-adrenoceptor blocking drugs

- Alpha-adrenoceptor blocking drugs (e.g. doxazosin)

Anti-arrhythmic drugs

- Digoxin
- Amiodarone
- Adenosine

Anti-platelet drugs

- Anti-platelet drugs (e.g. aspirin, clopidogrel, ticagrelor)

Thrombolytics

- Thrombolytic drugs (e.g. alteplase)

Anticoagulants

- Heparins (unfractionated, low molecular weight) and fondaparinux
- Oral anticoagulants (e.g. warfarin and direct oral anticoagulants)

Lipid-lowering drugs

- Statins (e.g. atorvastatin)

Antimuscarinics

- Atropine

Respiratory system

Oxygen

- Oxygen therapy

Bronchodilators

- Beta$_2$ adrenoceptor agonists (e.g. salbutamol, formoterol)
- Antimuscarinics (e.g. tiotropium, ipratropium)
- Phosphodiesterase inhibitors (e.g. theophylline)

Corticosteroids

- Inhaled corticosteroids (e.g. beclometasone)

Other drugs for respiratory disease

- Leukotriene receptor antagonists (e.g. montelukast)
- Mucolytics (e.g. carbocisteine)

Nervous system

Drugs for Parkinson's disease

- Levodopa and dopa-decarboxylase inhibitors (e.g. co-careldopa)
- Other antiparkinsonian drugs (e.g. ropinirole)

Drugs used to treat epilepsy

- Anticonvulsant drugs (e.g. phenytoin, carbamazepine, valproate, lamotrigine, levetiracetam)

Drugs used to treat migraine

- 5-HT$_1$-receptor agonists (e.g. sumatriptan)

Drugs for dementia

- Acetylcholinesterase inhibitors (e.g. donepezil, rivastigmine)
- Glutamate receptor antagonist (e.g. memantine)

Drugs for stroke

- Anti-platelet agents (e.g. aspirin, clopidogrel)
- Thrombolytic drugs (e.g. alteplase)

Drugs for muscle spasm

- Baclofen

Psychiatric disease

Anxiolytic and hypnotic drugs

- Benzodiazepines (e.g. diazepam, lorazepam)
- Z-drugs (e.g. zopiclone)

Antidepressant drugs

- Tricyclic antidepressants (e.g. amitriptyline)
- Selective serotonin reuptake inhibitors (e.g. fluoxetine, citalopram)
- Other antidepressant drugs (e.g. serotonin-noradrenaline reuptake inhibitors)

Antipsychotic drugs

- First- and second- generation (e.g. haloperidol, olanzapine, aripiprazole)

Mood stabilisers

- Mood stabilisers (e.g. lithium)

Drugs for ADHD (e.g. methylphenidate)

Drugs that are misused

As with other therapeutics, there are changes with time in drugs that are misused. Some examples include:

- Ethanol
- Opioids
- Cannabinoids
- Amphetamines
- Cocaine
- Ketamine

Infectious disease

Antibacterial drugs

- Penicillins (e.g. benzylpenicillin, amoxicillin, flucloxacillin)
- Cephalosporins (e.g. cefuroxime)
- Aminoglycosides (e.g. gentamicin) and glycopeptides (e.g. vancomycin)
- Antituberculous drugs (e.g. isoniazid, rifampicin, ethambutol)
- Other antibiotics (e.g. chloramphenicol, meropenem, macrolides, nitrofurantoin quinolones, tetracyclines, trimethoprim, metronidazole)

Antifungal drugs

- Antifungal drugs (e.g. clotrimazole, amphotericin, nystatin)

Antiviral drugs

- Antiviral drugs (e.g. aciclovir)
- HIV infection treatment

Antiprotozoal drugs

- Antimalarial drugs (e.g. artesunate chloroquine)

Immunisation

Endocrine and Metabolism

Drugs for diabetes mellitus

- Insulins
- Metformin
- Oral hypoglycaemic agents (e.g. sulfonylureas, thiazolidinediones, dipeptidyl peptidase-4 inhibitors, SGLT-2 inhibitors)
- GLP-1 agonists

Drugs for thyroid disease
- Drugs for thyroid disease (e.g. levothyroxine, propranolol, carbimazole)

Osteoporosis
- Bisphosphonates (e.g. alendronic acid)
- Other drugs used in osteoporosis treatment and prophylaxis (e.g. denosumab, calcium, vitamin D, oestrogens and related drugs)

Corticosteroids
- Corticosteroids (e.g. hydrocortisone, dexamethasone, prednisolone)

Drugs for obesity
- GLP-1 agonists

Renal and Urological disease

Immunosuppressant drugs
- Immunosuppressants (e.g. ciclosporin, azathioprine, cyclophosphamide, tacrolimus)

Drugs for benign prostatic hyperplasia/enlargement
- Alpha blockers (e.g. tamsulosin)
- 5α reductase inhibitors (e.g. finasteride)
- Gonadorelin analogues (e.g. goserelin)

Drugs for urinary frequency, urgency and incontinence
- Antimuscarinics (solifenacin, oxybutynin)

Drugs for erectile dysfunction
- Phosphodiesterase (type 5) inhibitors (sildenafil)

Diuretics
- Diuretics (e.g. loop, thiazide and thiazide-like)

Drugs affecting the renin-angiotensin system
- ACE inhibitors (e.g. ramipril)
- Angiotensin II receptor antagonists (e.g. losartan)

Obstetrics and Gynaecology

Female sex hormones
- Female sex hormones (e.g. oestrogens, progestogens)

Oxytocic drugs
- Oxytocic drugs (e.g. prostaglandins, ergometrine, oxytocin)

Other drugs in this specialty area
- Tranexamic acid

Skin, Eyes, Ears, Nose and Throat

Drugs for allergic rhinitis
- Antihistamines (e.g. cetirizine, chlorphenamine)

Drugs for the eyes
- Ocular lubricants (e.g. hypromellose, carbomer)
- Prostaglandin analogues (e.g. latanoprost eye drops)

Drugs for the skin
- Emollients
- Topical corticosteroids (e.g. hydrocortisone cream)
- Acne (e.g. benzoyl peroxide, topical and systemic retinoids)

- Permethrin and malathion

Oncology/cancer therapeutics

- Cytotoxic chemotherapies (e.g. doxorubicin, cisplatin, 5-flurouracil)

Targeted chemotherapeutics (a diverse field with some examples provided)

- Biologics
- Hormonal cancer therapies (e.g. tamoxifen, goserelin)

Rheumatology and other immunological disease

- Non-steroidal anti-inflammatory drugs (e.g. ibuprofen, naproxen)

Disease-modifying therapies

- Disease-modifying anti-rheumatic drugs (e.g. sulfasalazine, methotrexate)
- Biologics
- Drugs for gout (e.g. allopurinol, colchicine)

Surgery, Anaesthesia & Intensive Care

Anaesthetic drugs

- General anaesthetics (e.g. propofol, isoflurane and other volatile agents)
- Local anaesthetic drugs (e.g. lidocaine)
- Muscle relaxants (e.g. suxamethonium, rocuronium)

Analgesic drugs

- Non-steroidal anti-inflammatory drugs (e.g. ibuprofen)
- Paracetamol and combination analgesics (e.g. co-codamol, co-dydramol)
- Opioids (e.g. codeine, tramadol, morphine sulfate)
- Gabapentinoids

Fluid and electrolyte replacement

- Intravenous fluids (e.g. 0.9% sodium chloride, balanced crystalloids, glucose solutions, magnesium, potassium and calcium)
- Blood transfusion (and other blood products)

Emergency drugs

- Adrenaline
- Adenosine
- Activated charcoal
- Atropine/antimuscarinics
- Calcium chloride/gluconate
- Naloxone
- Thrombolytics/fibrinolytics

Section III. Therapeutics

This section provides a potential list of therapeutic problems with which a graduate should be familiar after completing a medical degree. For each they should be able to formulate a basic management plan and identify drugs (and non-pharmacological approaches) that might be indicated. For programmes in the United Kingdom, the General Medical Council's medical licensing assessment content map and the outcomes for graduates will already cover this content.

Gastrointestinal system

Gastric acid disorders and ulceration
- Peptic ulcers (including eradication of H. pylori)
- Gastro-oesophageal reflux disease

Diarrhoea and constipation
- Diarrhoea
- Constipation

Nausea and vomiting

Functional bowel disorders
- Irritable bowel syndrome

Inflammatory bowel disease
- Ulcerative colitis
- Crohn's disease

Liver disease
- Hepatic encephalopathy and portal hypertension
- Ascites
- Alcohol withdrawal

Upper gastrointestinal bleeding

Cardiovascular system

Hypertension
- Adult hypertension
- Hypertension in pregnancy

Myocardial ischaemia
- Stable angina
- Unstable angina/non-ST elevation myocardial infarction
- Acute ST elevation myocardial infarction

Heart failure
- Acute heart failure
- Chronic heart failure

Arrhythmias
- Atrial fibrillation
- Bradyarrhythmias
- Supraventricular tachycardia
- Ventricular arrhythmias
- Cardiac arrest

Vascular disease
- Acute and chronic limb ischaemia

Thromboembolic disease
- Deep vein thrombosis
- Pulmonary embolus

Hyperlipidaemia

- Hypercholesterolaemia

Pericarditis

Respiratory system

Asthma

- Acute asthma
- Chronic asthma

Chronic obstructive pulmonary disease (COPD)

- Acute exacerbations of COPD
- Stable COPD

Cough

- Cough and congestion

Respiratory failure

- Hypoxaemia

Nervous system

Stroke and transient ischaemic attack

- Acute stroke and transient ischaemic attack
- Primary and secondary prevention of stroke

Pain

- Principles of managing pain (including the analgesic ladder)
- Neuropathic pain

Movement disorders

- Parkinson's disease

Epilepsy

- Status epilepticus
- Chronic epilepsy

Headache

- Acute migraine
- Prophylaxis of migraine
- Cluster headache
- Tension headache

Vertigo

Dementia

Muscle spasm

Sleep disorders

- Insomnia

Psychiatric disease

Anxiety disorders

- Chronic anxiety
- Panic disorders

Depression

- Chronic depressive illness
- Bipolar disorder

Schizophrenia

- Chronic schizophrenia

Acute behavioural disturbance

- Acute behavioural disturbance

Drug dependence

- Alcohol dependence

- Nicotine dependence and withdrawal
- Opioid dependence and withdrawal

Infectious disease

Gastrointestinal infections

- Acute gastroenteritis
- Acute abdominal infections (e.g. appendicitis, cholecystitis, peritonitis)

Cardiovascular infection

- Acute bacterial endocarditis

Respiratory infections

- Upper respiratory tract infections
- Lower respiratory tract infections (e.g. pneumonia, bronchiolitis)
- Tuberculosis
- Viral infections (e.g. COVID-19, influenza)

Neurological infections

- Meningitis
- Encephalitis

Genito-urinary infection

- Urinary tract infection (e.g. cystitis, pyelonephritis)
- Epididymitis and orchitis
- Sexually transmitted infections (e.g. chlamydia, gonorrhoea)

HIV infection

- HIV infection

Skin infections

- Cellulitis

Post-operative infections

- Surgical site infection
- Post-operative peritonitis

Sepsis and bacteraemia

- Sepsis
- Bacteraemia of unknown origin

Hospital-acquired infections

- Clostridium difficile infection
- Methicillin-resistant staphylococcus aureus (MRSA) infection
- Infection in an immunocompromised host
- Sepsis in an immunocompromised patient

Tropical infections

- Malaria

Endocrine and Metabolism

Type 1 diabetes

- Management of type 1 diabetes
- Diabetic ketoacidosis
- Hypoglycaemia

Type 2 diabetes

- Management of type 2 diabetes

Thyroid disease

- Hyperthyroidism
- Hypothyroidism

Bone disease

- Osteoporosis
- Osteomalacia

Adrenal disease

- Addison's disease (incl. Addisonian crisis) ○ Hyperaldosteronism

Obesity
Electrolyte imbalance

Renal and Urological disease

Kidney disease

- Chronic kidney disease
- Acute kidney injury
- Glomerulonephritis
- Nephrotic syndrome

Urinary tract infection

- Cystitis
- Pyelonephritis

Bladder disease

- Incontinence
- Over-active bladder

Prostate disease

- Benign prostatic hyperplasia/enlargement
- Prostate cancer

Sexual dysfunction

- Erectile dysfunction

Obstetrics and Gynaecology

Contraception

- Hormonal contraception
- Non-hormonal contraception (e.g. spermicide, barrier and intrauterine devices)

Menopause
Polycystic ovary syndrome
Endometriosis
Pre-eclampsia
Gestational diabetes mellitus

Haematological disease

Anaemia

- Iron deficiency anaemia
- Macrocytic anaemias

Blood transfusion (and other blood products)
Anticoagulant reversal

Oncology

Cancer therapeutics

- Adverse effects related to cancer therapeutics (e.g. chemotherapy – neutropenia, nausea and vomiting)

Palliative care

- Cancer-related pain
- Management of other symptoms in terminal malignant disease

Breast Cancer

Locomotor system

Osteoarthritis

Gout

- Acute gout
- Prophylaxis of gout

Inflammatory arthropathies

- Rheumatoid arthritis

Temporal arteritis and polymyalgia rheumatica

Diseases of the Skin, Eyes, Ear, Nose and Throat

Diseases of the skin

- Atopic dermatitis and eczema
- Psoriasis
- Acne vulgaris
- Cellulitis and impetigo
- Urticaria
- Scabies and head lice

Diseases of the eye

- Acute glaucoma
- Chronic 'open-angle' glaucoma
- Conjunctivitis
- Uveitis

Diseases of the ear, nose and throat

- Allergic rhinitis
- Vertigo
- Otitis media/externa
- Throat infections and tonsillitis

Surgery, Anaesthetics and Intensive Care

Preparation of a patient for surgery

- Antibiotic prophylaxis
- Thromboprophylaxis
- Managing and amending regular medication (e.g. warfarin, insulin)

Post-operative treatment

- Post-operative pain (including patient-controlled analgesia)
- Post-operative fluid replacement
- Post-operative infections

Accident and Emergency Medicine

Overdoses

- Paracetamol poisoning
- Tricyclic antidepressant poisoning
- Acute opiate intoxication

Allergic emergencies

- Acute anaphylaxis
- Other skin and systemic adverse drug reactions

Section IV. Prescribing and related skills

This section provides a list of learning outcomes expressing what a graduate should be able to do after completing a medical degree.

Medication history taking

Take a medication history

- Demonstrate the ability to elicit and document an accurate medication history, including current and recent medicines, to support effective medicines reconciliation
- Identify, where possible, for each drug the original indication, formulation, dose, route, duration and effects
- Assess exposure to non-prescribed agents and therapies (e.g. over-the-counter, complementary therapies, alcohol, tobacco, recreational drugs, internet-sourced drugs)
- Identify alternative sources of information about current treatment and outline the limitations of these information sources (e.g. electronic medical records, general practice records, carers)
- Interpret the medication history so that allergies and adverse drug reactions (ADRs) can be identified (distinguish between a history of drug allergy and intolerance)
- Identify common potentially important drug interactions

Prescribe a new medicine

Prescribe drugs safely, effectively, economically and sustainably

- Identify health concern(s) to be treated
- Identify the therapeutic objective(s) for new therapy
- Evaluate the risks and benefits of specific drug therapies
- Identify drugs with a narrow therapeutic index or high potential for serious adverse effects/interactions, and take appropriate precautions when prescribing them
- Demonstrate the ability to follow clinical guidelines, protocols and formularies where appropriate
- Outline economic and sustainability factors within prescribing decisions (e.g. choice of inhaler)

Write prescriptions that consider the needs of individual patients

- Identify possible contraindications, drug–drug interactions, previous ADRs, any special circumstances (including religious beliefs or lifestyle choices [e.g. porcine- derived medications or excipients]), age, weight, gender, and diseases
- Select the appropriate formulation, dose, route, frequency and duration of a drug
- Interpret data that is relevant to prescribing decisions (e.g. renal function, drug concentrations)

Other prescribing-related skills

- Record the rationale for new prescribing decisions in the medical record
- Identify and reduce the risk of medication errors
- Identify situations where one's own prescribing skills are not sufficient, and seek advice before proceeding
- Identify situations where non-pharmacological approaches may be more appropriate
- Prescribe in written and electronic form

Calculate drug doses

Drug calculations

- Calculate appropriate doses using individual patient data such as body weight, surface area, organ function and nomograms where appropriate
- Convert doses between common units and convert between concentrations expressed as percentage and mass by volume
- Calculate equivalent doses when changing drug or pharmaceutical formulation (e.g. corticosteroid and opioid)

Prescription writing

Prescribe on hospital in-patient prescription forms (paper or electronic)

- Write an unambiguous, legible, complete and legal prescription (approved name, appropriate form and route, correct dose, any other necessary instructions, and signature), avoiding abbreviations and ambiguities (e.g. writing micrograms in full)
- Prescribe 'once-only', regular and 'as required' medicines

Prescribing on other documentation

- Prescribe on hospital supplementary prescription charts (e.g. insulin, anticoagulants)
- Prescribe 'to take out' drugs on discharge from hospital
- Prescribe on general practice prescription forms (e.g. FP10)
- Keep accurate records of prescriptions and drug responses
- Discontinue prescriptions appropriately

Communication

Discussing prescribing options with patients

- Engage in shared decision making
- Communicate a treatment plan
- Offer guidance about safe and effective ways to take specific medicines (e.g. bisphosphonates, inhalers)
- Discuss important and common adverse effects and when to discontinue medicines or seek help if these occur

Discussing prescribing decisions with colleagues

- Communicate treatment plans and monitoring arrangements clearly with other members of staff, in both verbal and written form
- Keep accurate written records of management plans
- Write accurate discharge prescriptions and letters to other healthcare practitioners

Reviewing prescriptions

Reviewing current lists of prescribed medicines

- Identify and correct prescription writing errors
- Identify and manage inappropriate prescribing and/or polypharmacy
- Identify opportunities for deprescribing and medicines optimisation with patients

Adverse drug reactions

Managing, reporting and avoiding adverse drug reactions (ADRs)

- Assess and manage common ADRs and interactions in the context of the current clinical situation
- Report a suspected ADR using the MHRA Yellow Card scheme
- Find and interpret information about adverse drug reactions (e.g. British National Formulary [BNF])

Obtaining information to support rational prescribing

Find reliable sources of drug information and use them appropriately

- Demonstrate the ability to find and use a Summary of Product Characteristics
- Demonstrate the ability to use the British National Formulary
- Demonstrate the ability to find and use Poisons Information Services (e.g. TOXBASE)
- Interpret national or international guidance (e.g. National Institute for Health and Care Excellence [NICE]) in the context of the care of individual patients

Prescribing high-risk medicines

Oxygen

- Prescribe oxygen safely using appropriate documentation
- Interpret oxygen saturations and symptoms to guide oxygen therapy

Anticoagulants

- Prescribe anticoagulants safely using appropriate documentation
- Interpret therapeutic drug monitoring where appropriate· to guide anticoagulation

Insulin

- Prescribe insulin safely using appropriate documentation
- Interpret blood glucose and other measures where appropriate (e.g. HbA1C, ketones, electrolytes) to guide insulin therapy

Intravenous fluids and electrolytes

- Prescribe intravenous fluids and electrolytes safely using appropriate documentation
- Monitor the clinical and biochemical effects of intravenous fluids and electrolytes

Opioid analgesics

- Prescribe opioid analgesics safely and effectively
- Convert between one opioid and another, recognising differences in potency, duration of action and elimination routes

Drug administration

Administering parenteral medicines

- Administer drugs by subcutaneous injection
- Administer drugs by intramuscular injection
- Administer drugs by intravenous injection
- Administer drugs by intravenous infusion pumps

Administering medicines by other routes

- Administer drugs using an inhaler
- Administer drugs using a nebuliser
- Administer drugs to the eye
- Administer drugs to the ear
- Administer drugs to the skin

BRITISH PHARMACOLOGICAL SOCIETY

Appendix 1: Command verbs

Command verb	Definition applied in this curriculum
List	Recall a series of names or things.
Define	Give the meaning of a word, phrase or concept.
Outline	Indicate the principal features or main points
Select	Select or choose from a number of possibilities.
Describe	Give characteristics and main features
Identify	Recognise, pinpoint, or distinguish a specific piece of information, concept, or element from a larger set, and explain, evaluate or assess its relevance in the wider concept or issue.
Explain	Identify why or how something happens, set out purposes or reasons / make the relationships between things clear.
Discuss	Give a critical account of the points involved in a topic, including the arguments for and against an issue (supported by relevant evidence), and consider the wider implications of the issue.
Calculate	Generate a numerical answer.
Interpret	Review a scenario or set of data and draw conclusions/make deductions
Assess / Make an accurate assessment of	Make an informed judgement, give an account with the relative importance of ideas and an evaluative statement
Demonstrate	Demonstrate the ability to perform a task
Evaluate	Judge or assess the quality, importance of something using evidence.

Appendix 2: List of experts contributing to the Delphi process

The following experts have consented their details being published as contributors to the Delphi process. We are indebted to them for their time and expertise on this project. Names, post nominals, roles and institutions are all self-entered by the contributors

Title	Name	Post nominals	Role	Institution
Mrs	Alison Westley	MRPharmS PGDip	Senior University Teacher	School of Medicine and Population Health, University of Sheffield
Dr	Andy Grant	MA PhD FHEA	Senior lecturer in pharmacology, lead for pharmacology education for MBChB course	Edge Hill University
Dr	Anoop D Shah	PhD FRCP FBCS	Associate Professor and Honorary Consultant in Clinical Pharmacology	University College London and University College London NHS Foundation Trust
Dr	Claire Lavelle	MBChB	Clinical Teaching Fellow, Therapeutics Lead	Lancaster Medical School
Prof	Clare Guilding	BSc, PhD, MMedEd, FHEA, FBPhS, NTF	Professor of Pharmacology & Medical Education	Newcastle University
Dr	Dagan Lonsdale	MBBS FRCP FFICM SFHEA PhD	Reader in clinical pharmacology and intensive care medicine	City St George's, University of London & St George's University Hospitals NHS Foundation Trust
Dr	Daniel Burrage	MBBS PhD FRCP	Honorary Senior Lecturer, lead for undergraduate clinical pharmacology education for MBBS course	City St George's, University of London & St George's University Hospitals NHS Foundation Trust
Dr	David Ryan Owen	PhD FRCP	Clinical Pharmacologist	Imperial, ICHT
Dr	Fraz Mir	MBBS MA FRCP	Lead for clinical pharmacology	University of Cambridge

Dr	Fu Liang Ng	MBBS MRCP PhD	Clinical Senior Lecturer in Clinical Pharmacology	City St George's, University of London & St George's University Hospitals NHS Foundation Trust
Dr	Gordon Dent	PhD SFHEA	Senior Lecturer in Pharmacology	Keele University School of Medicine
Mrs	Helen Day	BPharm ClinDipPharm	Lead in Clinical Pharmacology and Prescribing Education for Graduate Entry Medicine	Swansea Bay University Health Board and Swansea University Faculty of Medicine, Health and Life Science
Prof	Jamie J Coleman	MBChB MD MA(MedEd) FRCP HonFBPhS FFPM(Hon)	Professor of Clinical Pharmacology and Medical Education	University Hospitals Birmingham NHS Foundation Trust & University of Birmingham
Dr	Jennifer Koenig	FBPhS SFHEA PhD	Associate Professor, Pharmacology Lead for Graduate Entry Medicine, University of Nottingham	University of Nottingham
Dr	John Broad	PhD	Senior Lecturer in Pharmacology Education	King's College London
Dr	Kate D Linton	MBChB, MD, FRCS (Urol), MEd	Co-lead for pharmacology and prescribing for MBChB course	University of Sheffield and Chesterfield Royal Hospital NHSFT
Dr	Marie Fisk	MRCP PhD	BPS Clinical Committee Education & Training Lead	Cambridge University Hospitals NHS Foundation Trust
Dr	Maryam Malekigorji	Pharm.D. PhD SFHEA	Senior Lecturer in Medical Sciences (Pharmacology)	Queen Mary University of London
Prof	Matthew Harper	MA PhD FPhS	Director of Teaching, Department of Pharmacology	University of Cambridge
Prof	Michael Okorie	MBBS PhD FRCP FHEA FBPhS FFPM (Hon) FBIHS	Professor of Clinical Pharmacology and Therapeutics and Head of Department of	Brighton and Sussex Medical School & University Hospitals Sussex NHS Foundation Trust

			Medical Education	
Dr	Michalis Kostapanos	MD, PhD, FFPM, FRCP, FRSPH	Consultant Physician and Principal Investigator	Cambridge University Hospitals
Dr	Nick Toms	BSc PhD	Associate Professor of Pharmacology, BMBS Director Medical Science Learning	Peninsula Medical School, University of Plymouth
Miss	Patience Nimusiima	.	Assessment Delivery and Prescribing Safety Officer	British Pharmacological Society
Prof	Patricia McGettigan	BSc MD FRCPI FRACP SFHEA FBPhS	Professor of Clinical Pharmacology and Medical Education	Queen Mary University of London & Barts Health NHS Trust
Prof	Reecha Sofat	MBBS PhD	Professor	University of Liverpool
Dr	Reya Shah	MBBS BSc MRCP	Honorary Clinical Lecturer, lead for final year MBBS module in Clinical Pharmacology & Therapeutics; Specialty Trainee Registrar in Clinical Pharmacology and Therapeutics & General Internal Medicine	City St. George's, University of London & St. George's University Hospitals NHS Foundation Trust
Dr	Richard Bodington	MBBS BSc MRCP	Lead for undergraduate CPT education for MBBS phases 2 and 3	Hull-York Medical School
Miss	Shivani Patel	MRPharmS IPresc. MscAPP MscCPP PgCertClinEd FHEA	Senior Lecturer in Pharmacology and Prescribing	Kings College London University and King's College Hospital NHS Foundation Trust
Prof	Simon Maxwell	MD PhD FRCP FRCPE FBPhS FHEA	Professor of Student Learning/Clinical Pharmacology and Prescribing	University of Edinburgh
Dr	Soban Sadiq	MBBS, MPhil, PhD, SFHEA, FAcadMEd, FRSPH	Senior Lecturer, Vertical Theme Lead for Pharmacology & Therapeutics, Module Lead for Clinical Pharmacology & Therapeutics, Academic Lead for Prescribing Safety Assessment (PSA)	Kent and Medway Medical School, University of Kent

Dr	Steve Safrany	FBPhS FHEA	Lecturer in Biosciences	Keele University