



TEACHING SAFE AND EFFECTIVE PRESCRIBING IN UK MEDICAL SCHOOLS: A CORE CURRICULUM FOR TOMORROW'S DOCTORS

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SUMMARY

The pressure on prescribers has never been greater. New drugs, often with new indications, are emerging more rapidly. The patients being treated are older and sicker than previously, and are taking more drugs. Patients' expectations about safety and efficacy, and the information they will receive about drug treatments are rising. Adverse events and litigation related to the use of drugs is increasing. There is a widening gap between the demand for new drugs and the resources available to pay for them. In this environment, there is a pressing need for medical graduates to be fully prepared to take on the responsibilities of prescribing and to be able to respond to the rapid changes in therapeutics that will be inevitable in the coming years. The framework of the curriculum in UK medical schools was greatly influenced by the publication of *Tomorrow's Doctors* by the General Medical Council in 1993. These recommendations have recently been updated. While they highlight the importance of the management of disease processes and the use of drugs as key learning objectives, they offer little specific guidance. This document expands on these broad statements, provides a view of how these learning objectives might be achieved and identifies the key elements of a core curriculum.

Background

Prescribing is a major clinical activity of the National Health Service (NHS). The cost of prescribing has grown progressively throughout its existence and now amounts to a total annual expenditure in excess of £7bn, approximately 13% of the total budget. Each member of the

population now receives an average of 10 prescriptions per year. For most doctors drug therapy is the main tool at their disposal to influence the health of their patients. While drugs can offer great benefits to patients with a wide variety of diseases they also have the capacity to cause great harm, particularly if used inappropriately.

There are several important trends that will continue to increase the pressure on all NHS prescribers in the coming years:

- The number of licensed medicines is rapidly increasing as new drugs are continually introduced and, as a consequence, doctors are increasingly expected to prescribe medicines that are less familiar to them. The pace of new drug development is accelerating rapidly as a result of advances in molecular biology and mapping of the human genome.
- Patients are taking more medicines than before, increasing the complexity of their treatment regimen and the potential for drug interactions.
- Medication errors are a major avoidable source of morbidity.
- Adverse drug reactions are a major cause of morbidity and mortality.
- Patients who receive medicines are older and sicker and so more vulnerable to adverse events.
- Newer drugs, capable of targeting previously untreatable conditions, are often more powerful but also more toxic.
- The protocols for using the medicines, particularly in specialist practice, are ever more complicated.
- The throughput of patients in many areas of the NHS is increasing and is matched by a similar increase in prescribing episodes. The number of prescribers undertaking this workload has not increased at the same rate.
- There is increasing litigation associated with adverse outcomes related to the use of drugs, many of which are avoidable.
- The expansion of evidence-based medicine and health technology assessment has enabled the beneficial and adverse effects of drugs to be more accurately quantified. This knowledge has expanded the numbers of clinical guidelines defining norms of acceptable drug use.
- Patients increasingly expect their doctors to provide information about the drugs they are being prescribed to inform their own choices about treatment.

- There are more sources of opinion and ‘disinformation’ available to patients and doctors, largely as a result of the increasing access to the internet.
- The marketing activities of the pharmaceutical industry are a potential threat to cost-effective prescribing decisions. This activity may, in future, include the use of direct-to-consumer advertising.

All of these trends strengthen the need for newly qualified doctors to have a firm grounding in the principles of drug therapy to enable them to prescribe safely, effectively and cost-effectively within the resource restraints imposed upon them. Furthermore, prescribing remains an essential skill required by doctors in most medical specialties and is one of the ‘high risk’ components of clinical practice.

Safe Prescribing

Recent evidence suggests that serious adverse events and deaths related to drug prescribing have increased substantially in England and Wales during the last decade [1]. These adverse outcome cause personal misery and injury for the patients involved but also have significant consequences for the prescribers, impose considerable costs to the NHS (~£500M annually in litigation settlements [2]) and erode public confidence. Many of the trends above may have contributed to the rise but it comes at a time when public expectations about health outcomes have never been higher. Increased support from other healthcare professionals, particularly pharmacists, and the development of electronic prescribing might improve matters (if the resources can be found). However, it will be the education, instincts and, ultimately, the performance of prescribers themselves that will improve the safety of drug therapy.

Effective Prescribing

Advances in drug developments have increased the number of diseases and indications for drug therapy. Just as the number of drugs has increased, so too has our understanding of how to accurately quantify their benefits (and adverse effects) in clinical trials. This unprecedented expansion in the evidence base informing rational and effective drug use has undoubtedly benefited clinical practice. However, it has also increased the burden of knowledge required to prescribe optimally on a day to day basis. Many more decisions can now be scrutinized against reliable sources of evidence. At the same time the

availability of less reliable sources of evidence and opinion has increased. Many doctors still receive much of their information about drugs from representatives of the pharmaceutical industry. The modern doctor must now be able to inform their prescribing by the ability to rapidly access reliable evidence and opinion.

Cost-effective Prescribing

The NHS may not be able to afford to meet the demand for all available drugs, and it is likely that more drugs will emerge that are on the margins between healthcare and lifestyle which may not be considered a priority. In this environment, all prescribers must understand their role within the wider NHS and the need to utilize limited resources to greatest effect. They need to be aware of the ways medicines are managed within the NHS, the role of formularies, how to make a preliminary assessment of the evidence concerning new developments and the potential for marketing pressures from the pharmaceutical industry to distort priorities.

Prescribing as a Generic Skill

Although medicine is now a career with many branches and subspecialties, it remains a fact that prescribing is the primary intervention that most doctors offer to influence their patients' health, for better or for worse. In other words, whatever career or specialty that medical graduates decide to pursue, most will have to remain 'specialists' in drug prescribing throughout their careers. Most graduates can expect to be prescribers for up to 40 years and will require not only a knowledge of today's drugs but also a firm grounding in the principles of therapeutics, underpinned by a scientific knowledge of drug action, that will inform their learning about future developments.

In addition, prescribing rights have now been extended to other health professionals – to independent nurse prescribers working from an extended nurse formulary which includes prescription only drugs, to nurses and pharmacists, acting as supplementary prescribers monitoring and adjusting therapy in patients with chronic diseases. Doctors will increasingly need to be involved in training and in working collaboratively with these other prescribers.

Prescribing as a 'high risk' activity

Drugs are a powerful tool for improving health but can also be the cause of significant morbidity and mortality. Complaints about the adverse effects of drugs and, increasingly, about the failure to use effective drugs commonly result in

claims for negligence against individual doctors and their employing NHS Trusts. Although newly qualified doctors are usually protected from the requirement to undertake high-risk practical procedures, they are often expected to prescribe powerful drugs from their first day of clinical work. Indeed, these inexperienced doctors are commonly expected take the responsibility for a substantial proportion of prescribing in hospital wards. This is now being recognised as a 'high risk' area of practice and a major clinical governance issue for employers. They are increasingly looking to medical schools to ensure that their graduates have the necessary skills and knowledge to undertake such work.

For all of these reasons, a firm grounding in the principles of prescribing and therapeutics, and basic knowledge about commonly used drugs should be absolute pre-requisites for all medical graduates. These should be key learning outcomes in modern medical education and should be reliably assessed. That is the challenge that continues to face all medical schools. Medical education in the UK has undergone significant changes over the last decade in response to concerns over traditional methods of teaching and driven by recommendations from the General Medical Council (GMC). Now is an appropriate moment to consider whether the UK's graduates are being adequately prepared for their role as prescribers.

Medical School Curriculum

For many decades UK medical schools based their education around a two year preclinical phase followed by three years of clinical training (Figure 1). The preclinical years involved established scientific disciplines such as anatomy, biochemistry, physiology, microbiology, pathology and pharmacology. The clinical years then used this background as a foundation for learning about diseases and their management, usually organized around the major clinical disciplines (eg. medicine, surgery, paediatrics), which were each separately assessed. As the rate of drug development increased in the 1960s, clinical pharmacology & therapeutics (CPT) emerged as a new discipline and many schools incorporated CPT into curricula as a distinct course. At the beginning of the last decade it was still common for medical schools to provide courses in both pharmacology and CPT, and for each to be individually assessed.

It was increasingly recognised that there were problems with these general arrangements. There was overcrowding, a high burden of factual information, a strong emphasis on science at the expense of other patient-centred activities, repetition of information, poor coordination across courses, interdisciplinary rivalry and protectionism, and an artificial divide between preclinical and clinical learning. There were also weaknesses in the learning process with an excess of didactic lectured-based teaching rather than active problem-based learning.

Against that background, the GMC published *Tomorrow's Doctors* in 1993 containing new recommendations on the structure and content of medical education [3]. The main goals were to reduce the factual burden with the development of a core curriculum, to improve integration with system-based learning and to move away from the disciplinary and pre-clinical/clinical divide (Appendix I). The emphasis was moved towards integration, problem-based education and the development of skills for lifelong learning. Learning outcomes in the form of knowledge, skills and attitudes were to be clarified. Schools were asked to draw on modern educational techniques and learning by self-directed exploration rather than didactic teaching would be encouraged. For many schools, this prompted a radical redesign of the medical curriculum.

Reasons for Concern

Although all of these objectives are worthy, an inevitable consequence of the seamless integration proposed by *Tomorrow's Doctors* has been the loss of dedicated courses in a variety of established disciplines, including basic pharmacology and CPT. Indeed the guidance stated explicitly that it 'avoided all reference to traditional subjects and disciplines urging the advantages of interdisciplinarity' (Para 42). This position substantially weakened the support for retention of pharmacology and CPT as recognizable disciplines in UK medical schools. A further concern was that, although *Tomorrow's Doctors* did identify 'the principles of therapy', including 'the actions of drugs, their prescription and their administration' among its knowledge objectives (Para 40.1(g)(ii)), there was no other mention of drugs. Indeed, use of drugs or prescribing was not even mentioned under 'skills objectives'. The document also fell short of making any specific recommendations on assessment.

The consequence has been that recognisable courses or modules in CPT that tackle generic issues relating to the use of drugs in a variety of clinical settings from the perspective of the prescriber have largely been abandoned, along with their associated assessments. In their place, learning about CPT has been devolved to system- or problem-based components of the medical curriculum. Although there is no objective data on how this change has impacted on learning outcomes, in practice it has made it harder to bring together the core principles of CPT that underpin prescribing in all areas. This has happened at a time when the pressures on prescribers and the training needs of graduates have never been greater. These concerns have been raised by many including medical students themselves [4,5]. The diminished presence of CPT in the new era of medical education is particularly ironic in that it remains one of the most 'integrated' of all clinical disciplines, its core principles applicable to almost all other areas of practice.

The concerns about the undergraduate curriculum arise at a time when GMC's own recommendations for early postgraduate medical education, *The New Doctor* [6], clearly identify the need for a sound education in therapeutics. They state that 'Practical skills frequently required by pre-registration house officers ... from the first day of the pre-registration year ... [and that] should not be undertaken without proper training ... [include the ability to] 'calculate a drug dosage', 'write a prescription', 'give intravenous injections', 'mix and inject drugs into an intravenous bag', 'use a pump to give drug treatment', [and] 'give intramuscular and subcutaneous injections'.

Tomorrow's Doctors 2002

The GMC published a revised version of *Tomorrow's Doctors* [7] in July 2002, taking into account the findings of visits to UK medical schools between 1998 and 2001, a review of strengths and weaknesses of the existing recommendations, and further developments in educational theory and professional practice. The new guidance aimed to identify the knowledge, skills, attitudes and behaviour expected of new graduates (Appendix II). It also identified the need to be clear about what students will study and be assessed on during undergraduate education, and the requirement for all UK medical schools to set appropriate standards and provide rigorous assessments.

The revised recommendations also provide rather more direction about teaching and assessment of therapeutics (Appendix III). While the original version identified the need for knowledge and understanding about the broad ‘principles of treatment’, the latest guidance is more explicit in this section (item 16) and now makes specific reference to effective and safe use of medicines as a basis of prescribing, including side effects, harmful interactions, antibiotic resistance and genetic indicators of the appropriateness of drugs. It also addresses evaluation of effectiveness against evidence, and incorporates surgical and perioperative care. Also new is the recognition of the need to take account of patients’ own views and beliefs, and of the growing use of alternative therapies and their potential for interaction with conventional medicines (item 18). The section on clinical skills (item 19) now also makes it clear that graduates must be able to go beyond a management plan, based on history, examination and relevant investigations, to work out drug doses, record outcomes, and write safe prescriptions for different types of drugs. In addition, they are expected to gain practical skills in cannulating veins, and giving intravenous, subcutaneous and intramuscular injections. Importantly, and of undoubted practical relevance in therapeutics, they are expected to know how errors can happen in practice and to apply these principles in risk management (items 4 and 26). The need for a firm grounding in the principles of CPT and knowledge about common drugs is strengthened by the expectation that graduates will be able to provide enough information about conditions and possible treatments to allow patients to make informed decisions about their care (item 30). The guidance also clarifies need for students to be adequately prepared to prescribe drugs at the point of graduation (item 52).

These stated learning outcomes are now supported by clear recommendations on effective assessment. Medical schools are expected have valid and reliable schemes of assessment in place to ensure that students to prove that they have achieved the curricular outcomes (items 62-64). They are also expected to provide a clear indication of how the scheme of assessment deals with all the curricular outcomes and how individual assessments and examinations contribute to the overall assessment. For individual examinations and assessments, there should be a clear indication of how the targeted curricular outcomes have been met (item 66).

An Integrated Core Curriculum in Clinical Pharmacology & Therapeutics

The 2002 revision of *Tomorrow’s Doctors* does not provide any support for the reemergence of CPT as a specific discipline in the medical curriculum. However, the increasing emphasis on many learning outcomes that are at the heart of the clinical specialty of CPT is to be welcomed, as well as the clearly stated principle that all UK graduates should be demonstrably safe prescribers. While the specific details of this objective are not spelt out, we believe that it must involve most of the generic knowledge, skills and attitudes suggested later in this paper, as well as specific knowledge about the drugs to be prescribed. The real challenge now for all medical schools is to be able to deliver and assess these learning objectives within the framework of an integrated discipline-free curriculum.

There have been previous recommendations about the delivery of CPT within the curriculum both in the UK [8] and US [9]. The principle recommendations of these documents remain valid and their core learning objectives should be re-emphasized. There is now a need to re-interpret them in context of the widespread emergence of new curricula and in line with the latest GMC recommendations.

The purpose of the remainder of this document is:

- To interpret the general objectives with regard to CPT into more specific learning outcomes
- To prioritise the core learning objectives in CPT within the curriculum
- To identify the minimum knowledge students should possess to prescribe safely and effectively at the time of graduation
- To indicate how these objectives can be achieved in the setting of an integrated medical curriculum
- To provide a template for quality assurance for those who have the task of reviewing the undergraduate medical curriculum in UK medical schools
- To support the development of assessments of learning outcomes
- To highlight the continued importance of strong leadership in therapeutics in all medical schools as the best way to ensure successful integration of the core content into the curriculum and the development of effective assessments

- To provide direction for curriculum developers, particularly in the schools where CPT departments or specialists are absent.

Core Learning Objectives

A key objective of medical education, identified by *Tomorrow's Doctors* (2002) [7], should be to produce graduates who are competent to prescribe safely and effectively. In addition, their learning should provide the appropriate framework to be able to assimilate information about new drug developments that will occur throughout a professional career. These general objectives can be further refined into more specific outcomes that can be divided into knowledge and understanding, skills and attitudes and form the core content of CPT within the curriculum (Appendix IV). Although this content is identified here as 'CPT', owing to tradition and its association with the clinical specialty of the same name, that specific label is not a prerequisite for the successful delivery of the content. Most of these outcomes are generic requirements for the safe and effective use of drugs in most areas of clinical practice. Linked to these core objectives are a number of specific drugs and therapeutic problems that might be used to provide relevant clinical examples of the principles of CPT. An example of a core drug list is provided in Appendix V.

A sound knowledge of the basic principles of CPT should allow students to take a logical approach to learning about any of the drugs they encounter during the course. For that reason, they should be introduced at an early stage of the curriculum. The core curriculum should be available to the students who should be able to identify where the relevant learning objectives can be achieved (a 'curriculum map').

Core Drugs and Therapeutic Problems: the Student Formulary

Medical students are often overwhelmed by the large number of drugs that they encounter during their clinical attachments. This can be rather demoralizing and may lead to lack of clarity and objectivity in learning. In an attempt to tackle this problem, schools should draw together a list of core drugs that could be considered as the 'student formulary' and would help to prioritise learning. The list should comprise of approximately 100 key drugs that are in common usage, used to treat common illnesses, representative of important drug classes, and that a newly qualified doctor might be expected to initiate or prescribe under

the direction of a senior doctor. For each of the drugs or its class, students might be expected to:

- know the name and class
- have an understanding of the mechanism of action
- recognize the appropriate indication for use
- know the appropriate route, frequency and duration of administration
- know the important contra-indications, potential interactions and adverse effects
- know how to monitor the drug's effects
- be able to explain the salient features of all the above to the patient.

Although students should not be expected to know specific drug doses as part of core knowledge it might be reasonable to expect students to identify dangerously inappropriate doses of very commonly used drugs. An example of such a list is provided in Appendix V. As well as being a list of core drugs, this document also includes a list of therapeutic problems for which those drugs might be expected to be used. Both lists have been set out in relation to the potential clinical modules in which those learning objectives are likely to be met. This arrangement emphasizes the suitability of a problem-based approach to develop learning about CPT and the ease with which CPT can be vertical integrated with most other elements of the curriculum.

The intention of the student formulary is to provide learning objectives that are realistic and attainable. A student who achieves these outcomes should be able to cope effectively and safely with most of the prescribing challenges that they are likely to face them in their early post-graduate years whether in hospital or in general practice.

The core curriculum in CPT also includes over the counter drugs and an awareness of 'alternative' therapies. The latter have been included because students are now expected to be aware of the existence and range of such therapies, why some patients use them, and how these might affect other types of treatment that patients are receiving. It is logical for them to be considered as part of the overall theme of therapeutics and in this context their impact can be reviewed with regard to the other principles above.

Delivering the Curriculum

The structure of medical courses in the UK differs considerably. While some retain a degree of boundaries between preclinical and clinical, courses in scientific disciplines including pharmacology, and courses based around medical specialties including CPT, others have removed these barriers to produce a truly integrated curriculum, often with an emphasis on problem-based learning. It is clearly possible to achieve all of the above CPT learning objectives in either setting. It might be argued that this may be easier in practice in discipline-based courses where there is curriculum time set aside to focus on CPT objectives. When all learning becomes integrated, these objectives must compete simultaneously with many others, which presents some challenges. For instance, the absence of protected time to focus on issues relating to drugs necessitates the coordinating of CPT learning opportunities that may be dispersed across many different modules and through several years of the course. This arrangement presents practical difficulties and reduces the opportunity to emphasize recurrent patterns of thought that can be offered during a series of discipline centred activities. In these circumstances, it is necessary to provide clear leadership for the ‘theme’ throughout the curriculum.

Whether pursuing a traditional or integrated curriculum (Figure 1), learning about drugs should be built up throughout the course. In the first two years, the major emphasis should be on understanding where drugs act and how they have their effects on body systems using core drugs as illustrative examples. The emphasis should then move to clinical aspects such as when drugs are indicated, how drugs are prescribed and administered, what doses should be used, how their effects can be measured, what contraindications exist, what adverse effects are known and the wider public health aspects of drug therapy. Curriculum developers might see the benefit of providing a module in the early years of the medical course that highlights aspects of drug use that are widely applicable. Students need to be familiar with appraisal of the risk-benefit ratio, understand how to monitor the impact of a prescribed drug, recognise the effects of drugs beyond the target system, understand the reasons for variability in drug response, recognize the need to base prescribing choices on sound evidence and able to write a prescription. With these key principles established, much of the learning about drugs can be undertaken under

within system-based modules to provide both horizontal and vertical integration.

Leadership

A key factor in the successful implementation of the core curriculum described will be clear leadership in prescribing and therapeutics. *Tomorrow’s Doctors* 2002 emphasizes the need to ‘involve individuals with an appropriate range of expertise and knowledge’ to ‘plan curricula and associated assessments, put them into practice and review them’ (item 42 [7]). All medical schools should be able to identify an individual who will oversee this area of the curriculum and ensure that the generic principles of safe and effective use of medicines are highlighted throughout. This role might ideally be undertaken by an individual with a training and background in CPT. Many medical schools will recognize that such individuals are ideally suited to supervising the delivery and assessment of these learning objectives. However, the role is not their sole preserve and, indeed, several UK medical schools have no specialists in CPT or departments of pharmacology. The key requirements are enthusiasm for ensuring that principles of CPT are prominent throughout the curriculum.

The coordination of CPT learning opportunities may be devolved to many teachers across the course, often within organ-based specialties. They too should be encouraged to emphasize these principles and remind students about the effects of drugs beyond individual organ systems. Simply providing a link between drugs and clinical conditions is insufficient to develop an appreciation of the complex considerations that surround the decision to initiate a prescription. All schools should ensure that, in each case, students are helped to tackle the practical issues of weighing the risks and benefits of drug therapy, prescribing the drug, and monitoring the impact of therapy.

Learning Styles

The successful acquisition of specific core knowledge, skills and attitudes in the core curriculum will depend on a variety of modes of learning. Their mix will vary in different schools according to local preference but the content but should increasingly be based around inquisitive rather than passive learning. There should be an appropriate balance of teaching in large groups with small groups, practical classes and opportunities for self-directed learning. Although the didactic lecture-style still has a role in delivering a broad overview of individual topics,

it is should now be just one of several approaches to learning.

The core curriculum in CPT is ideally suited to take advantage of the increasingly popular style of problem-based learning. Most prescribing episodes are a direct attempt to solve a clinical problem and require the appropriate knowledge, skills and attitudes outlined in Appendix IV. Several schools have developed a series of ‘therapeutic case discussions’ that offer students a case vignette and pose direct problems relating to prescribing and therapeutics. These may be undertaken in live time, even within relatively large groups, or researched and discussed at intervals over several weeks. There are also several initiatives to develop case-based computer-assisted learning packages as an aid to CPT learning and self-assessment. Computer-assisted learning can be a helpful support for mechanistic elements such as understanding mechanisms of drug action and calculating drug doses, and may also contribute in the delivery and assessment of key cases to promote consideration of prescribing.

Many of the opportunities for students to learn about drugs will arise while they are undertaking clinical attachments. This learning opportunity should be recognised and students should be encouraged to make the most of these occasions. They should be expected to observe the process of prescribing from the perspective of other health care professionals such as nurses and pharmacists (e.g. participate in a ward ‘drug round’). They might be asked to review drug sheets, make self-assessments about their level of knowledge about specific core drugs (Appendix VI), look for potential interactions and scrutinize prescriptions. Students should receive instruction in small groups about the practical aspects of writing a legal prescription.

Other styles of learning might involve writing case reports containing discussion about therapeutic aspects (e.g. portfolio cases), discussing prescribing decisions with patients as part of communicating skills, critique of clinical trials involving drugs, appraising claims for new drugs, and searching the web for information about drugs.

Assessment of the Core Curriculum

It is widely recognized that assessment drives learning and has an important role in consolidating the acquisition of core knowledge and skills. The recent recommendations by the

GMC state that medical schools are expected have valid and reliable schemes of assessment in place to ensure that students to prove that they have achieved the curricular outcomes (items 62-64 [7]). They are also expected to provide a clear indication of how the scheme of assessment deals with all the curricular outcomes and how individual assessments and examinations contribute to the overall assessment. For individual examinations and assessments, there should be a clear indication of how the targeted curricular outcomes have been met (item 66). Safe and effective use of medicines is also a major factor in clinical governance and risk management within the NHS. For these reasons, a robust assessment of prescribing competence should be mandatory. It is to be hoped that its presence will be verified when the GMC make future visits to medical schools. The appointment of external examiners with CPT expertise might also help to ensure that appropriate standards are being met. All examiners should have clear guidelines for marking CPT assessments, which indicate how performance against targeted curricular outcomes should be rewarded.

Relatively few schools now have a traditional ‘CPT examination’ as curriculum changes bring the assessments of diverse learning objectives together in integrated examinations. In an integrated curriculum, the learning process in CPT spans the length of the course and involves the synthesis of numerous learning opportunities in various elements of the course. It is, therefore, logical to reserve important summative assessments that assess learning outcomes for a later stage in the course, preferably the final year. At this stage the students can bring together knowledge gained from most of the curriculum, and can be expected to demonstrate expertise in many different areas of therapeutics (similar to real clinical life). The assessment should identify students with poor knowledge about drugs and who will be inadequately prepared for the responsibility of prescribing.

Even within an integrated assessment scheme, there should be a clear, identifiable and robust component devoted to the knowledge and skills that support the prescribing of drugs. Furthermore, whether assessment is integrated or part of a collection of discipline-based assessments, it is inappropriate that any student should be able to compensate for a poor performance in prescribing or therapeutics with good performances in other assessments. The GMC guidance is unequivocal about the need for

students to have competence at the point of qualification and to be adequately prepared to prescribe drugs at the point of graduation (item 52). Students might also be provided with formative assessments and the chance for self-assessment at regular intervals during the medical course.

The mode of assessments may vary but should test knowledge, skills and attitudes that are identified in the core curriculum. These should be relevant to early clinical practice. Although knowledge and understanding can be examined by essays and multiple choice questions, assessments should increasingly focus on testing the acquisition of practical skills. These may be more adequately assessed in the format of an OSCE and might include tasks such as writing a prescription, preparing drugs for injection, offering information to a patient about a drug, and spotting potentially dangerous prescriptions.

Conclusion

Medical education in the UK has undergone considerable change in response to guidance issued by the GMC. Although many of the results have led to substantial improvements in the quality of education, they have posed considerable

challenges for those wishing to ensure that the learning outcomes, which were previously the responsibility of individual disciplines, are met within a fully integrated curriculum. Meeting this challenge in the delivery of what has traditionally been known as CPT assumes greater importance as the complexities of being a prescriber in the NHS continue to grow. The medical curriculum should offer all students a firm grounding in the core knowledge and understanding about drugs, skills in prescribing and attitudes towards the use of drugs. These principles should be applied to a limited and identifiable list of common drugs. Although specialists in CPT have an important role to play in leading this area of the curriculum it should be accepted that this role can be successfully played by teachers from other professional backgrounds.

This document is intended as a support to those who are charged with overseeing the development of this area of the curriculum. The GMC indicate that ‘medical schools have a responsibility to the public, to employers and to the profession to make sure that graduates are fit to practise’ (item 84 [7]). Prescribing drugs is a key component of medical practice. It is to be hoped that all of tomorrow’s doctors will be adequately prepared.

Principal Recommendations

- Prescribing and therapeutics should be identified as an important ‘theme’ that runs vertically through the medical curriculum integrating with and identifiable within relevant horizontal modules.
- Core learning objectives should be clearly identified including knowledge and understanding about drugs, skills related to the prescribing of drugs and attitudes towards drug therapy.
- The factual burden posed by the increasing number of prescription drugs should be eased by prioritizing learning around a core list of commonly used drugs (a ‘student formulary’).
- There should be an identifiable and robust assessment that indicates whether the above learning objectives have been met. This might form part of an integrated assessment but it should not be possible to compensate for a poor performance in this area by a good performance in other items.
- Each medical school should identify an individual teacher to oversee this area of the curriculum and to ensure that the learning objectives set out within the core curriculum are met. The background of that individual is not important but they should offer strong leadership and enthusiastic support for the objectives of the core curriculum. They will also play a key role in developing and overseeing the assessment process.

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Appendix I. The Principal Recommendations of *Tomorrow's Doctors* (1993).

1. The burden of factual information imposed on students in undergraduate medical curricula should be substantially reduced.
2. Learning through curiosity, the exploration of knowledge, and the critical evaluation of evidence should be promoted and should ensure a capacity for self-education; the undergraduate course should be seen as the first stage in the continuum of medical education that extends throughout professional life.
3. Attitudes of mind and of behaviour that befit a doctor should be inculcated, and should imbue the new graduate with attributes appropriate to his/her future responsibilities to patients, colleagues and society in general.
4. The essential skills required by the graduate at the beginning of the pre-registration year must be acquired under supervision, and proficiency in these skills must be rigorously assessed.
5. A 'core curriculum' encompassing the essential knowledge and skills and the appropriate attitudes to be acquired at the time of graduation should be defined.
6. The 'core curriculum' should be augmented by a series of 'special study modules' which allow students to study in depth areas of particular interest to them, that provide them with insights into scientific method and the discipline of research, and that engender an approach to medicine that is questioning and self-critical.
7. The 'core curriculum' should be system-based, its component parts being the combined responsibility of basic scientists and clinicians integrating their contributions to a common purpose, thus eliminating the rigid pre-clinical/clinical divide and the exclusive departmentally based course.
8. There should be emphasis throughout the course on communication skills and the other essentials of basic clinical method.
9. The theme of public health medicine should figure prominently in the curriculum, encompassing health promotion and illness prevention, assessment and targeting of population needs, and awareness of environmental and social factors in disease.
10. Clinical teaching should adapt to changing patterns in health care and should provide experience of primary care and of community medical services as well as of hospital based services.
11. Learning systems should be informed by modern educational theory and should draw on the wide range of technological resources available; medical schools should be prepared to share these resources to their mutual advantage.
12. Systems of assessment should be adapted to the new style curriculum, should encourage appropriate learning skills and should reduce emphasis on the uncritical acquisition of facts.
13. The design, implementation and continuing review of curricula demand the establishment of effective supervisory structures with interdisciplinary membership and adequate representation of junior staff and students.
14. The Education Committee of the General Medical Council should ensure the implementation of its Recommendations through regular progress reports from medical schools, continuing dialogue on the basis of informal visits and, when necessary, by the exercise of the statutory powers given to it under the Medical Acts.

Appendix II. The Main Recommendations of *Tomorrow's Doctors* (2002).

Attitudes and behaviour that are suitable for a doctor must be developed. Students must develop qualities that are appropriate to their future responsibilities to patients, colleagues and society in general.

The **core curriculum** must set out the essential knowledge, skills and attitudes students must have by the time they graduate.

The core curriculum must be supported by a series of **student-selected components** that allow students to study, in depth, areas of particular interest to them.

The core curriculum must be the responsibility of clinicians, basic scientists and medical educationalists working together to **integrate** their contributions and achieve a common purpose.

Factual information must be kept to the essential minimum that students need at this stage of medical education.

Learning opportunities must help students explore knowledge, and evaluate and integrate (bring together) evidence critically. The curriculum must motivate students and help them develop the skills for self-directed learning.

The **essential skills** that graduates need must be gained under supervision. Medical schools must assess students' competence in these skills.

The curriculum must stress the importance of **communication skills** and the other essential skills of medical practice.

The health and safety of the public must be an important part of the curriculum.

Clinical education must reflect the **changing patterns of healthcare** and provide experience in a variety of clinical settings.

Teaching and learning systems must take account of modern educational theory and research, and make use of modern technologies where evidence shows that these are effective.

Schemes of assessment must take account of best practice, support the curriculum, make sure that the intended curricular outcomes are assessed and reward performance appropriately.

When designing a curriculum, putting it into practice and continually reviewing it, medical schools must set up effective **supervisory structures** which use an appropriate range of expertise and knowledge.

Selection, teaching and assessment must be **free from unfair discrimination**.

Appendix III. Recommendations of *Tomorrow's Doctors* (2002) specifically relating to prescribing and therapeutics.

Good clinical care (Item 4)

Graduates must be able to show that they can meet the following outcomes.

- a. Know about and understand the following.
 - i. Our guidance on the principles of good medical practice and the standards of competence, care and conduct expected of doctors in the UK.
 - ii. The environment in which medicine is practised in the UK.
 - iii. How errors can happen in practice and the principles of managing risks.
- b. Know about, understand and be able to apply and integrate the clinical, basic, behavioural and social sciences on which medical practice is based.
- c. Be able to perform clinical and practical skills safely.
- d. Demonstrate the following attitudes and behaviour.
 - i. Recognise personal and professional limits, and be willing to ask for help when necessary.
 - ii. Recognise the duty to protect patients and others by taking action if a colleague's health, performance or conduct is putting patients at risk.

Treatment (Item 16)

Graduates must know about and understand the principles of treatment including the following.

- a. How to evaluate effectiveness against evidence.
- b. How to take account of patients' own views and beliefs when suggesting treatment options.
- c. The effective and safe use of medicines as a basis for prescribing, including side effects, harmful interactions, antibiotic resistance and genetic indicators of the appropriateness of drugs.
- d. Providing surgical and perioperative care.
- e. Recognising and managing acute illness.
- f. The care of people with recurrent and chronic illnesses and people with mental or physical disabilities.
- g. Rehabilitation, and care within institutions and the community.
- h. Relieving pain and distress.
- i. Palliative care, including care of the terminally ill.

Alternative Therapies (Item 18)

They must be aware that many patients are interested in and choose to use a range of alternative and complementary therapies. Graduates must be aware of the existence and range of such therapies, why some patients use them, and how these might affect other types of treatment that patients are receiving.

Clinical and Practical Skills (Item 19)

Graduates must be able to do the following safely and effectively.

- a. Take and record a patient's history, including their family history.
- b. Perform a full physical examination, and a mental-state examination.
- c. Interpret the findings from the history, the physical examination, and the mental-state examination.
- d. Interpret the results of commonly used investigations.
- e. Make clinical decisions based on the evidence they have gathered.
- f. Assess a patient's problems and form plans to investigate and manage these, involving patients in the planning process.
- g. Work out drug dosage and record the outcome accurately.
- h. Write safe prescriptions for different types of drugs.
- i. Carry out the following procedures involving veins.
 - i. Venepuncture.
 - ii. Inserting a cannula into peripheral veins.
 - iii. Giving intravenous injections.
- j. Give intramuscular and subcutaneous injections.
- k. Carry out arterial blood sampling.
- l. Perform suturing.
- m. Demonstrate competence in cardiopulmonary resuscitation and advanced life-support skills.
- n. Carry out basic respiratory function tests.
- o. Administer oxygen therapy.
- p. Use a nebuliser correctly.
- q. Insert a nasogastric tube.
- r. Perform bladder catheterisation.

General skills (Item 26)

Graduates must be able to do the following.

- a. Manage their own time and that of others.
- b. Prioritise tasks effectively.
- c. Reflect on practice, be self-critical and carry out an audit of their own work and that of others.
- d. Use research skills to develop greater understanding and to influence their practice.
- e. Follow the principles of risk management when they practise.
- f. Solve problems.
- g. Analyse and use numerical data.
- h. Take account of medical ethics when making decisions.

Medico-legal and Ethical Issues (Item 30)

Graduates must understand the principles of good practice set out in our publication *Seeking patients' consent: the ethical considerations*. These include:

- a. providing enough information about conditions and possible treatments to allow patients to make informed decisions about their care;
- b. responding to questions;
- c. knowing who is the most appropriate person to ask for consent;
- d. finding out about a patient's ability to make their own decisions and to give their consent; and
- e. statutory requirements that may need to be taken into account.

Preparing for practice by shadowing a PRHO (Item 52)

52. These attachments must include opportunities for students to refresh the practical and clinical skills that they will be expected to carry out on their first day as a PRHO. These include the ability to prescribe drugs under the supervision of a qualified doctor and to carry out procedures involving veins.

The principles of assessment (Items 62-65)

62. Schemes of assessment must support the curriculum and allow students to prove that they have achieved the curricular outcomes. This means assessments must allow students to demonstrate the breadth and depth of their knowledge, and to show what they can do. Professional attitudes and behaviour must also be assessed.

63. Student performance in both the core and SSC parts of the curriculum must be assessed and must contribute to their overall result. Students who have not satisfied the examiners in both parts of the curriculum must not be allowed to graduate.

64. Medical schools should use a range of assessment techniques that are appropriate for testing the curricular outcomes. Medical schools should determine the most appropriate scheme of assessment for their curriculum. However, schemes must meet best practice in assessment, and medical schools must be able to provide evidence that the schemes are valid and reliable, and that they have processes for setting standards and making decisions about student performance.

65. When students get close to graduating, their knowledge, skills, attitudes and behaviour must be thoroughly assessed to determine their fitness to practise as PRHOs.

Assessment procedures (Item 66)

66. Schemes of assessment must be open, fair and meet appropriate standards. Medical schools must make sure that:

- a. there is a clear indication of how the scheme of assessment deals with all the curricular outcomes;
- b. there is a clear indication of how individual assessments and examinations contribute to the overall assessment of the curricular outcomes;
- c. when they design individual examinations and assessments, there is a clear indication of how the targeted curricular outcomes have been met;
- d. students have clear guidance about what is expected of them in any examination or assessment;
- e. examiners are trained to carry out their role and to apply the medical school's assessment criteria consistently;
- f. examiners have clear guidelines for marking assessments, which indicate how performance against targeted curricular outcomes should be rewarded;
- g. systems are in place to determine the pass mark; and
- h. external examiners are employed to make sure that standards are met.

Appendix IV. Core knowledge and understanding, skills and attitudes concerning the use of drugs for the medical curriculum.

These should be key learning outcomes of the curriculum and are required by all graduates to enable them to prescribe safely and effectively at the point of qualification. These core objectives are generic and applicable to most areas of therapeutics. They should be considered in association with the list of core drugs and therapeutic problems to which they apply (Appendix V). In each case their relevance to clinical practice should be illustrated with appropriate examples.

Core Knowledge and Understanding

Basic pharmacology

- the general mechanisms of action of drugs at a molecular, cellular, tissue and organ level
- the ways in which these actions produce therapeutic and adverse effects
- the receptor as a target of drug action and related concepts such as agonism, antagonism, partial agonism and selectivity
- the development of tolerance to drugs

Clinical pharmacokinetics

- the mechanisms of drug absorption, distribution, metabolism and excretion
- the concepts of volume of distribution, clearance and half-life and their clinical relevance
- how these factors determine the optimal route, dose and frequency of drug administration

Factors that determine inter-individual variation in drug response

- pharmacokinetic handling of drugs
- pharmacogenetic variation
- pharmaceutical variation

Therapeutic drug monitoring

- the importance of monitoring the impact of drug therapy
- the ways that this can be achieved (measuring plasma drug concentrations or assessing pharmacodynamic responses)
- the variable relationship between plasma drug concentration and drug effect

Adverse drug reactions

- the frequency of adverse reactions in primary and secondary care
- recognition of the predisposing factors and how risks can be minimized
- the importance of reporting adverse reactions and the role of the yellow card scheme

Drug interactions

- the potential for drugs to interact to cause beneficial and harmful effects
- the mechanisms by which drugs interact (eg. pharmacokinetic, pharmacodynamic)
- the ways in which interactions can be predicted and avoided

Medication errors

- the common reasons medication errors can occur in practice
- the ways in which individual prescribers can reduce the risk of a medication error

Poisoned patients

- the assessment of poisoned patients
- the recognition and treatment of common presentations (eg. paracetamol)

- the principles of removing or counteracting the effects of toxic substances after ingestion

Prescribing for patients with special requirements because of their altered physiology, pharmacokinetic handling and pharmacodynamic responses including

- elderly patients
- children
- women of child-bearing potential
- pregnant and breast-feeding women
- patients with renal disease
- patients with liver disease

Legal aspects of prescribing drugs

- categorization of drugs as over-the-counter preparations, prescription-only medicines, controlled drugs
- the prescribing of ‘unlicensed’ preparations
- the responsibilities associated with prescribing controlled drugs

Developing new drugs

- drug development including clinical trials (Phase I to Phase IV)
- the approval process and major regulatory authorities in UK and Europe
- the requirements of good clinical trial design
- consent, ethics, bias, statistics, dissemination of information

Medicines management

- the role of local formularies
- the role of drug & therapeutics committees
- the influences that affect individual prescribing choices
- the rational assessment of new drugs based on safety, efficacy and cost-effectiveness

Ethics of prescribing

- informed patient consent and concordance

Commonly used drugs

- the mechanism of action, the indications for use, the appropriate route of administration, and the important contra-indications and side-effects of a selected list of commonly used drugs (Appendix V)

Common therapeutic problems

- the management of common acute and chronic therapeutic problems (Appendix V)

Alternative therapies

- the motivations that lead patients to seek alternative therapies
- some common indications and appraisal of the evidence for their efficacy
- how such therapies might interact with prescription drugs that patients are receiving

Core Skills

Taking a drug history

- taking accurate information about current prescription and non-prescription drugs
- making an assessment of adherence to a medication regimen
- recording current and past adverse drug reactions and allergies

Prescription writing

- choosing a safe and effective drug and an appropriate dose
- writing accurate, legible, and legal prescriptions including controlled drugs
- keeping accurate records of prescriptions and response
- calculating drug doses based on patient weight or a nomogram
- calculating the strength of an infusion based on the required rate of drug administration
- prescribing oxygen (flow rate, delivery) and intravenous fluids

Drug administration

- selecting the appropriate route of administration
- administering subcutaneous, intra-muscular and intravenous injections
- preparing drugs for parenteral administration including mixing and dissolving drugs
- preparing and administering drugs by an infusion pump
- preparing and administering nebulised drugs
- advising patients about special modes of drug delivery eg. topical, inhaled, insulin

Prescribing drugs in special groups

- elderly, paediatric, pregnancy and breast-feeding, renal and liver failure

Prescribing drugs to relieve pain and distress

- palliation of pain and other distressing symptoms

Adverse drug reactions and interactions

- assessing drugs as a possible cause of symptoms and signs
- recognising the potential for adverse interactions
- reporting adverse drug reactions and interactions

Drug allergy

- recognising allergic drug reactions and taking a history of allergic reaction
- treating allergic reactions, emergency treatment of acute anaphylaxis

Clinical pharmacokinetics

- using core knowledge of pharmacokinetics to inform safe prescribing

Therapeutic drug monitoring

- identifying which therapeutic effect to observe
- using measurements of plasma drug concentrations appropriately (which and when)
- acting appropriately with the results

Analysing new evidence

- practicing evidence-based prescribing
- assessing the validity of evidence presented on new drugs or therapies
- reading, assessing and criticising clinical studies
- spotting methodological flaws including sources of bias
- recognizing the difference between clinical and surrogate end-points

Obtaining accurate objective information to support safe and effective prescribing

- using the British National Formulary
- accessing reliable drug information from medical journals and medical databases
- accessing Poisons Information Services
- discriminating between the reliability of varying sources of evidence and opinion

Obtaining informed consent to treatment

- providing patients with enough information about drugs to allow them to make informed decisions about their treatment
- discussing benefits and risks of drug therapy with the patients
- exploring patients' own views and wishes in relation to drug treatment

Core Attitudes

A rational approach to prescribing and therapeutics

- identifying the correct clinical diagnosis
- understanding the pathophysiological processes involved
- knowing the drugs that might beneficially influence these processes
- establishing the end-points with which to monitor therapeutic response
- assessing the potential risks and benefits of treatment
- communicating with the patient in making the decision to treat

Risk-benefit analysis

- recognizing that there are risks and benefits associated with all drug treatments
- recognizing these may differ between patients depending on a variety of factors
- recognizing that doctors should monitor the impact of the drugs they prescribe

Recognizing the responsibilities of a doctor as part of the prescribing community

- avoidance of wasteful prescribing and consumption of limited resources
- recognizing the need to report adverse drug reactions for the common good
- controlling the availability of restricted drugs
- adhering to therapeutic guidelines and drug formularies as appropriate
- avoidance of indiscriminate antibiotic prescribing

Recognizing personal limitations in knowledge

- recognizing the need to seek further information about drugs when faced with unfamiliar prescribing problems

Responding to the future

- recognizing the need to update prescribing practices
- ensuring that patients benefit where possible from advances in medical knowledge
- recognizing the need to assess the benefits and hazards of new therapies
- knowing the limitations of applying clinical trial data to individual patients

Appendix V. Core drugs and therapeutic problems for the medical curriculum.

These lists suggest specific drugs for which graduates should be expected to have an understanding of the mechanism of action, recognize the appropriate indications for use, know the appropriate route(s) of administration, and know the important contra-indications and side-effects. In some cases a drug class is listed with a commonly used member of the class as an example. The list of drugs might be viewed as a 'student formulary'. The drugs have been categorized according to the organ system to reflect the move towards system-based learning advocated in *Tomorrow's Doctors*. Some drugs may appear twice if they are considered to form core learning in relation to more than one system.

This list is only indicative of an approach to a formulary and is not intended to be prescriptive.

Core Therapeutic Problems

Core Drugs

Gastrointestinal System

Peptic ulceration, Gastro-oesophageal reflux disease, Dyspepsia, Diarrhoea (acute and chronic), Constipation, Irritable bowel syndrome, Inflammatory bowel disease (ulcerative colitis, Crohn's disease), Liver failure, Ascites
Prescribing in liver impairment

Antacids, alginates, H₂-Antagonists (eg. cimetidine), Proton pump inhibitors (eg. omeprazole), misoprostol, codeine, loperamide, sulphasalazine, Corticosteroids (eg. prednisolone), Laxatives (eg. bran, senna, lactulose), Antispasmodics (eg. mebeverine), spironolactone, metronidazole

Cardiovascular System

Hypertension, Angina pectoris (stable and unstable), Acute myocardial infarction, Acute pulmonary oedema, Chronic heart failure, Arrhythmias (atrial fibrillation, ventricular tachycardia), Cardiac arrest, Deep vein thrombosis, Pulmonary embolus, Hypertension, Hyperlipidaemia

Thiazide diuretics (eg. bendroflumethazide), Loop diuretics (eg. furosemide), Potassium-sparing diuretics (eg. amiloride, spironolactone), β -Blockers (eg. propranolol, atenolol, carvedilol), Calcium antagonists (eg. nifedipine, diltiazem, verapamil), ACE inhibitors (eg. enalapril), AT₁-blockers (eg. losartan), α -Blockers (eg. doxazosin), methyldopa, Nitrates (glyceryl trinitrate, isosorbide mononitrate), digoxin, adenosine, amiodarone, lignocaine, aspirin, clopidogrel, Thrombolytics (eg. streptokinase), Heparins (unfractionated, low molecular weight), Oral anticoagulants (eg. warfarin), Statins (eg. simvastatin)

Respiratory System

Asthma (acute and chronic), Chronic obstructive pulmonary disease, Cor pulmonale, Pneumonia (bacterial, atypical), Respiratory failure, Lung cancer, Cystic fibrosis
Administering drugs to the respiratory tract (using inhalers and nebulisers)

oxygen, β_2 -Agonists (e.g. salbutamol), cromoglycate, ipratropium bromide, theophylline, Corticosteroids (eg. beclomethasone)

Nervous System

Stroke treatment and prevention, Parkinson's disease, Epilepsy (status epilepticus), Migraine, Vertigo and Meniere's disease, Dementia, Muscle spasm, Meningitis

L-Dopa and Dopa decarboxylase inhibitors (eg. co-careldopa), bromocriptine, Antimuscarinic drugs (eg. procyclidine), Anti-convulsant therapy (eg. diazepam, phenytoin, carbamazepine, valproate), 5-HT₁-Agonists (e.g. sumatriptan), Anti-emetics (e.g. metoclopramide, domperidone), pizotifen, betahistine, benzylpenicillin, Corticosteroids (e.g. dexamethasone)

Psychiatric Disease

Anxiety, Panic, Depression, Mania, Insomnia,

Benzodiazepines (e.g. diazepam, temazepam),

Schizophrenia, Neuroses, Acute behavioural disturbance, Eating disorders, Drug dependence (alcohol, nicotine, opiates)

Tricyclic antidepressants (e.g. amitriptyline), Selective serotonin reuptake inhibitors (e.g. fluoxetine), Monoamine oxidase inhibitors (e.g. phenelzine), Antipsychotic drugs (e.g. chlorpromazine, haloperidol, clozapine), Mood stabilisers (e.g. lithium), procyclidine, propranolol, disulfiram, chlordiazepoxide, methadone, nicotine, cannabis, amphetamine, ethanol, cocaine
Depot injections

Infectious Disease

Chest infection (community-acquired/atypical), Gastroenteritis, Urinary tract infection, Meningitis, Septicaemia, Tuberculosis, Eye and ear infections, Cellulitis, Malaria

Infection in an immunocompromised host

Penicillins (e.g. benzylpenicillin, amoxicillin, flucloxacillin), Cephalosporins (e.g. cephalexin), tetracycline, trimethoprim, Aminoglycosides (e.g. Gentamicin) Vancomycin), Macrolides (e.g. erythromycin) chloramphenicol, fusidic acid, Quinolones (e.g. ciprofloxacin), metronidazole, Antituberculous drugs (e.g. isoniazid + pyridoxine, rifampicin, ethambutol), Antifungal drugs (e.g. amphotericin), Antiviral drugs (e.g. aciclovir), Antimalarial drugs (e.g. quinine, chloroquine)

Endocrine System

Diabetes mellitus (ketoacidosis, hypoglycaemia), Thyroid disease (hyperthyroidism, hypothyroidism), Osteoporosis

insulin, Sulphonylureas (e.g. gliclazide), metformin, thyroxine, propranolol, carbimazole, Bisphosphonates (e.g. alendronic acid), calcium, vitamin D, Corticosteroids (e.g. prednisolone), glucose

Renal Disease

Chronic renal failure
Acute renal failure
Urinary tract infection

Prescribing in renal impairment

Immunosuppressants (e.g. ciclosporin, azathioprine, cyclophosphamide), Corticosteroids (e.g. prednisolone), erythropoietin

Urological System

Benign prostatic hypertrophy, Prostate Cancer
Incontinence/bladder instability, Urinary tract infection,
Renal colic, Impotence

Alpha-blockers (e.g. doxazosin), finasteride
Gonadorelin analogues (e.g. goserelin)
Anti-androgens (e.g. cyproterone acetate)
oxybutinin, diclofenac, sildenafil

Elderly Care Medicine

Falls, Immobility, Acute and chronic cognitive failure,
Stroke, Urinary incontinence, Faecal incontinence, Leg
ulceration

Prescribing in elderly patients

Drugs as a cause of illness

Drug interactions

vitamin D, calcium, quinine, corticosteroids,
Bisphosphonates (eg. alendronate)

Obstetrics & Gynaecology

Contraception, Menopause, Gynaecological infections,
Urinary incontinence, Menstrual disorders (menorrhagia,
dysmenorrhoea), Endometriosis, Hypertensive pregnancy,
Infertility, Induction of labour, Post-partum haemorrhage
Spinal and epidural anaesthesia

Prescribing in pregnancy and breast-feeding

Oestrogens, Progestogens, combined oral
contraceptives, clotrimazole, tetracyclines,
metronidazole, oxybutynin, methyl dopa, clomiphene,
oxytocics (prostaglandins, ergometrine, oxytocin),
mefenamic acid, tranexamic acid, anti-D
immunoglobulin, bromocriptine, danazol, local

anaesthetics, inhalational anaesthetics, iron, folic acid, Corticosteroids (e.g. dexamethasone)

Genitourinary Disease

Genital herpes, Gonorrhoea
Non-specific genital infection
Genital warts, HIV infection

aciclovir, azithromycin, podophyllotoxin, fluconazole, Reverse transcriptase inhibitors (e.g. zidovudine)

Haematological Disease

Anaemia (iron deficiency, macrocytic),
Thrombocytopenia, Leukopenia, Acute leukaemia,
Chronic leukaemia, Lymphoma

iron, folic acid, hydroxycobalamin, vitamin K, erythropoietin, interferon-alpha

Oncology

Control of cancer-related pain and other modes of palliation, Nausea and vomiting and other problems related to cancer chemotherapy, Breast Cancer, Lung Cancer

Non-steroidal anti-inflammatory drugs, Opiates (e.g. morphine), Anti-emetics (e.g. metoclopramide, ondansetron), Alkylating drugs (e.g. cyclophosphamide), Cytotoxic antibiotics (e.g. doxorubicin), Anti-metabolites (e.g. methotrexate), Anti-oestrogens (e.g. tamoxifen, anastrozole)

Locomotor System

Osteoarthritis, Rheumatoid arthritis Gout, Temporal arteritis, Polymyalgia rheumatica

aspirin, paracetamol, Non-steroidal anti-inflammatory drugs (e.g. ibuprofen), penicillamine, gold, sulphasalazine, methotrexate, colchicine, allopurinol, Corticosteroids (e.g. prednisolone). vitamin D, calcium

Dermatology

Eczema, Psoriasis, Acne, Cellulitis, Urticaria, Pruritis
Administration of drugs to the skin

topical corticosteroids, coal tar, dithranol, benzoyl peroxide, Retinoids (eg. isotretinoin), emollient aqueous cream, Antifungal agents, tetracycline, flucloxacillin, fucidic acid

Ophthalmology

Glaucoma, Eye infection, Acute iritis
Administration of drugs to the eye

chloramphenicol, betamethasone, timolol, cyclopentolate, tropicamide, pilocarpine

Otolaryngology

Ear wax, Otitis externa, Allergic rhinitis, Vertigo
Administration of drugs to the ear and nose

sodium bicarbonate eardrops, Antihistamines, ephedrine, simple linctus, codeine linctus

Surgery, Anaesthetics & Intensive Care

Preparation of a patient for surgery, Thromboprophylaxis, Surgery in a diabetic patient, Post-operative pain and fluid replacement,
Antibiotic prophylaxis, Management of wound infections/peritonitis, Gallstone disease, Acute intestinal obstruction, Acute pancreatitis, Haemorrhoids, Acute and chronic limb ischaemia
Patient-controlled analgesia
Local anaesthetic infiltration
Calculating drug doses for infusions

Heparins, Penicillins, Cephalosporins, Aminoglycosides, metronidazole, Opioids (codeine, pethidine, morphine), Short-acting anaesthetics, atropine, Intravenous fluids (e.g. saline, dextrose), Blood products, Local anaesthetic drugs (e.g. lignocaine), General anaesthetic drugs (e.g. halothane), Muscle relaxants (e.g. suxamethonium), Sympathomimetics (eg. dopamine, dobutamine), Anti-emetics

Paediatric Medicine

Neonatal hypoglycaemia and jaundice
Epilepsy in children, Epiglottitis
Gastro-oesophageal reflux in children
Tonsillitis, Otitis media, Asthma, Eczema
Urinary tract infection, Type I diabetes mellitus
Idiopathic thrombocytopenic purpura
Juvenile chronic arthritis, Allergy, Scalds
Chronic diarrhoea (ulcerative colitis, Crohn's disease,
coeliac disease)

Prescribing in Children

Vaccination

Accident & Emergency Medicine

Overdoses (paracetamol, opiate, benzodiazepine), Alcohol
withdrawal, Allergic emergencies, Hypoxia,
Hypovolaemia, Oliguria, Septicaemia

activated charcoal, N-acetylcysteine, naloxone,
flumazenil, thiamine, adrenaline, Antihistamines (e.g.
chlorpheniramine),
oxygen, Intravenous fluids, Local anaesthetic drugs
(eg. lignocaine), morphine, salbutamol,
hydrocortisone

Alternative Therapy

Homeopathy, Herbalism, Acupuncture, Aromatherapy

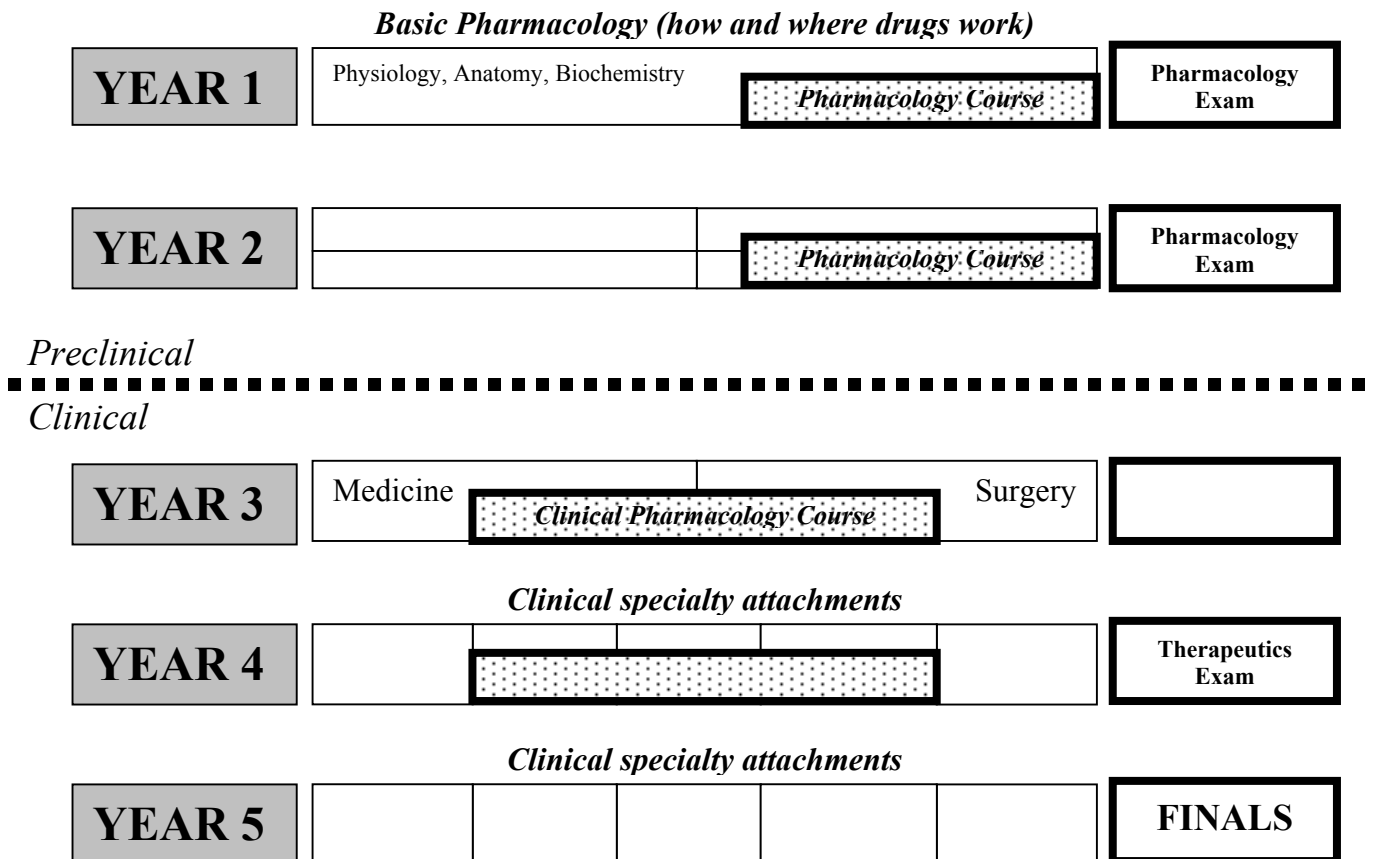
Appendix VI. What should I know about this drug?

Medical students regularly have the opportunity to review prescriptions in the context of individual cases during their clinical attachments. They should be prepared to use these as an opportunity for self-directed learning. The following series of questions might help to focus the questions they should tackle.

- 1. Drug Name.** Is this the approved or generic name?
- 2. Drug Class.** To what class does each drug belong (e.g. beta-blocker, benzodiazepine)? Is this one of the core drugs or drug classes in the 'student formulary'? If not, is it closely related to other core drugs?
- 3. Indication.** For what reason was the drug prescribed? What problem is the drug meant to correct, or what symptom is to be relieved?
- 4. Alternatives.** What other treatments might have been chosen instead of the drug? Is it a good choice considering its efficacy, safety, and cost?
- 5. Route and dose.** By what route, in what dose and at what intervals is the drug being given? What factors about the drug/patient might influence these choices?
- 6. Monitoring.** What observations/measurements can be made to judge whether the aim of treatment has been achieved? When should they be made and by whom?
- 7. Duration.** For how long should treatment continue? What factors will determine when treatment should be stopped?
- 8. Elimination.** How is the drug eliminated? Will the patient's illness change the usual pattern of distribution and effects of the drug?
- 9. Adverse effects.** What adverse effects may occur from this drug? How will they be apparent? How serious and frequent are they? What is their approximate frequency?
- 10. Interactions.** Are there any other drugs that the patient is receiving that might interact with this drug? If yes, what in the nature of the interaction and should they be avoided?
- 11. Patient.** What does the patient believe about the drug? What have they been told about it and what has he remembered? What additional information is necessary for the patient?

Figure 1. Traditional and integrated patterns of delivery of clinical pharmacology and therapeutics in the undergraduate medical curriculum.

(a) Traditional Curriculum



(b) Integrated Curriculum

