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OPINION PAPER

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Towards a core curriculum in clinical pharmacology for undergraduate medical students in Europe

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Abstract Undergraduate medical education has been under the spotlight for many years in Europe. In the United Kingdom the General Medical Council, which validates the final medical examination in all UK Medical Schools, has been trying to influence the curriculum for at least the last 50 years. Following their publication of the document ''Tomorrow's Doctors'' in 1993 many medical schools in the UK have completely changed their curriculum design away from didactic learning and towards an integrated problem-orientated or problem-based approach. There has been concern that, as the process continues, some of the more traditional learning of pharmacology and clinical pharmacology may be lost with nothing to replace it. This manuscript describe two ways of developing a core curriculum for clinical pharmacology. The first uses a drug orientated approach (almost an essential drug list) where drugs are listed according to whether they are essential for students to know about with just over 120 chemical entities; and a shorter list of drugs that students would be expected to know about but not know in any detail. The second approach is a disease-orientated one with three types of disease process: a list of 67 disease states that students must know how to manage (category M), a list of 158 diseases that students must be able to diagnose (category D) and a list of 36 diseases that students should be aware of. The disease orientated approach, though designed in one EU country (the UK) has been field tested in a second (Germany) with little difficulty in transfer.

Keywords Core curriculum · Clinical pharmacology · Undergraduate medical education · Clinical pharmacology and therapeutics teaching

On behalf of the Education Sub-Committee of the European Association for Clinical Pharmacology and Therapeutics.

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Introduction

Undergraduate medical education has been under the spotlight for many years. In the UK the General Medical Council (GMC), which has the responsibility for validating the final medical examination, has been critical of the undergraduate curriculum for many years. This culminated in 1993 [1] with the production of the document ''Tomorrow's Doctors''. The main thesis of this document was that undergraduate medical education was too didactic and did not encourage learning, and it placed too much emphasis on knowledge rather than on the acquisition of skills and attitudes. The document recommended instead many changes to the curriculum including the development of a 'core curriculum' which all students would have to follow coupled with a range of options or 'selectives' which the student could choose to study.

The same process has been present in many European medical schools over the past 10–15 years and curricular innovation has led in several directions. The first move was often integration across clinical and basic sciences, or across the various clinical sciences and this led to concern that subjects common to many clinical disciplines, such as pathology and clinical pharmacology, would not get adequate representation and core skills and knowledge would be missing. The later development of problem-orientated or problem-based learning inevitably led to concerns that the traditional values in clinical pharmacology and therapeutics (CPT) teaching would become devalued and could produce graduates who were not well versed in the science and art of therapeutics [2]. Such fears are probably not justified as judged by studies from The Netherlands [3] but in order to define what should be learned there have been several attempts to produce a ''core curriculum'' in CPT. Perhaps the first attempt to do this was by Nierenberg [4] in the United States, and a Delphi approach in the UK [5] produced a very similar type of curriculum [6] with an emphasis on key concepts such as drug metabolism and drug use in pregnancy.

The European Association for Clinical Pharmacology and Therapeutics formed an Education Sub-Committee shortly after its congress in Berlin in 1997, and one of its first tasks was to look at the educational requirements of medical students as far as CPT is concerned. There were two initial tasks, one to deal with knowledge based matters and the other to deal with core skills and attitudes, which is the subject of a separate report.

Methodology

The first approach was to look at a different way of defining the core curriculum to that which had been used by Nierenberg [4] and Webb and Walley [6], which were based on a knowledge of the key concepts in the discipline such as clinical pharmacokinetics, drug handling in liver disease, drug interactions etc. We used a system based on the World Health Organisation concept of an 'essential drug list' in order to define a short list of drugs that we would expect medical students in most European countries to know about. After some discussion we had two categories of drugs: firstly, those that we expected medical students to know about in some detail and, secondly, a smaller group of drugs that we would expect students to be aware of and these consisted of third-line agents for some diseases and anticancer drugs. In terms of the first group of drugs, we would expect students to know the details of the mechanism of action of the drug (in broad pharmacological terms), its main indications, its adverse effects and any clinically significant drug interactions. We would not expect them to know the dose of any drug which they would be expected to look up in the appropriate national formulary. The total number of drugs in the first category is just over 120, and Appendix A contains a complete list of those drugs that we recommend should be in the list.

Inevitably such a drug list represents a personal choice on behalf of those individuals selecting the drugs. To try to avoid this the list was first vetted by the three authors who come from different European countries and who canvassed local opinion within the country. The list was then further examined by members of the Education Sub-Committee of EACPT who initially represented opinion in a further six European countries. Some changes were made to the list of drugs and we feel that the list should now be subjected to a much wider selection of opinion throughout Europe by publication in this journal.

The drug list in Appendix A has avoided the use of combination products and where combination products are widely used (e.g. use of levodopa and a dopa-decarboxylase inhibitor) the drugs are recorded separately. In some cases we have chosen to highlight the class of drug rather than individual drugs, and such a case is seen with β-receptor blocking drugs. Drugs of this class are widely used throughout Europe for the treatment of angina pectoris and hypertension, but the choice of an individual β-blocking drug does vary considerably from country to country. Thus we have highlighted the term 'β-receptor blockers' and have chosen to give representative examples of the class in brackets. We would value opinion from colleagues across Europe as to how valuable such a list might be for them in setting a core curriculum for their medical students in letter form either to the journal or to any of the authors.

The second way of trying to establish a core curriculum in CPT was using a disease-based approach. This had first been used in the Medical School at Liverpool University, of which one of us (M.O.) was Dean during the development of a new problem-based undergraduate medical curriculum. The concept was to define three types of disease process to help the student know what was important. In the first group were diseases that were common, and which the student must know how to manage which includes the drug treatment of the disease. In the second group were a list of diseases which were less common in the community, but which were thought to be of sufficient importance for the student to be able to diagnose them after which the therapy could largely be looked up in the literature. Finally, there was a third group of diseases which were sufficiently rare for us to feel that the student did not need to know very much about them. They would, however, need to know of the existence of the disease so that appropriate specialist advice could be sought. A selection of the diseases in each of the three categories is shown in Appendix B. The full list is available for consultation on the World Wide Web (www.clinpharmacol-Germany.de/HannoverMedicalSchool).

The disease list developed in Liverpool was then transferred to Hannover, where after appropriate discussion with hospital and medical school staff it was incorporated into the teaching schedule for the medical students. In general, it was surprising how easy it was to transfer the list from one country to another with a different language and a different therapeutic tradition. The complete list has 262 disease states of which 67 are classified as being in the 'must know how to manage' category and 36 as being in the 'be aware of' category 'while the remainder (158) are in the 'must be able to diagnose' category.

Both approaches look separately at the diseases which may present as an emergency and at the drugs that may be needed to deal with emergency situations. Since one of the main aims of the undergraduate medical course is to prepare the medical student for their work as an intern it follows that emergency conditions must be given special attention. In the full disease list there are 70 conditions that may present as an emergency ranging from emergency surgical or obstetrics and gynaecological conditions to accidents and to acute medical situations in adults or children (see appendix B for a representative selection). As far as the emergency drugs are concerned, there are 19 drugs shown in Appendix A which the student must know in some detail, and where there are good arguments for the student to know the usual dose of the drugs which is not the case for the majority of drugs in Appendix A.

Discussion

The two methods of defining the 'core curriculum' for clinical pharmacology that are presented here are only part of the story, and it may be helpful to examine these alongside the other systems that have been presented elsewhere [4, 5]. These other systems present the key concepts that are important for medical students to know, without which it would be hard for them to understand future developments in drug therapy. The systems presented here would be key to effective functioning as a qualified physician, especially during the early years as junior hospital physician. One of the prime tasks of such a physician is to manage patients and to try to cure them or at least to improve their health, and this would be impossible without some knowledge of the drugs available. There are 67 diseases in the ''must know how to manage'' category, and some persons may feel this is too large a number. Similarly, there are 70 conditions listed that may present as an emergency, which may seem too many. We would respond that, a newly qualified physician may well be the first physician to be called to such patients, and therefore he or she must know how to initiate treatment.

Of course such physicians would also need to have prescribing skills which have been discussed elsewhere [3], but the systems here are presented as a topic for discussion. We would hope that they would be as useful in other European countries as we have found them to

be in a small selection of medical schools in three European countries. We would be interested in continuing discussion on this topic with the eventual aim of producing both a drug list and a disease list which can be relevant and useful in all European countries.

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Appendix A: list of essential drugs for medical student teaching

Names in italics indicate drugs that the student must know about in some detail (see text). Names in ordinary type face indicate drugs that the student should be aware of. Drugs in square brackets are mentioned elsewhere in the list:

- Antianginal agents
  - *Glyceryl trinitrate*
  - *Isosorbide di- (or mono-)nitrate*
  - *β-Receptor blocking drugs (e.g. propranolol, metoprolol, atenolol, carvedilol)*
  - *Calcium channel blockers (dihydropyridines, e.g. nifedipine, amlodipine;* plus *verapamil and diltiazem*)
- *Antihypertensive drugs*
  - *Thiazide diuretics*
  - *β-Receptor blocking drugs (e.g. propranolol, atenolol, metoprolol, carvedilol)*
  - *Angiotensin-converting enzyme (ACE) inhibitors (e.g. captopril, lisinopril)*
  - *[Calcium channel blockers]*
  - Centrally acting drugs (e.g. clonidine, reserpine)
  - α-Receptor blocking drugs (e.g. prazosin, doxazosin)
  - Angiotensin 1 (AT-1) receptor antagonists (e.g. losartan)
- *Drugs for heart failure*
  - *Loop diuretics (e.g. furosemide)*
  - *[ACE inhibitors]*
  - *Cardiac glycosides (e.g. digoxin,)*
  - *[β-Receptor blockers]*
  - *Sympathomimetics (e.g. dopamine, dobutamine)*
- *Antiarrhythmic drugs*
  - *Membrane stabilising drugs (e.g. quinidine, disopyramide)*
  - *Lidocaine*
  - *Sotalol*
  - *[Verapamil]*
  - *[β-Receptor blockers (e.g. atenolol, metoprolol)]*
  - *Adenosine*
  - Amiodarone
- *Hyperlipoproteinaemias*
  - *Statins (e.g. lovastatin, pravastatin)*
  - *Fibrates (e.g. gemfibrozil)*
  - Ion-exchange resins (cholestyramine)
- *Pain relief*
  - *Paracetamol*
  - *Non-steroidal anti-inflammatory drug (e.g. ibuprofen, diclofenac)*
  - *Codeine*
  - *Tramadol*
  - *Opioids (e.g. morphine)*
  - *Pethidine*
  - *Buprenorphine*
- *Anaesthetic agents*
  - Inhalation agents (e.g. N_2O, enflurane)
  - Thiopental
  - Muscle relaxants (e.g. pancuronium, atracurium, suxamethonium)
- *Anxiolytics*
  - *Benzodiazepines (e.g. diazepam, oxazepam)*
  - *Hypnotics (e.g. temazepam)*
  - *Benzodiazepine-inhibitors (e.g. flumazenil)*
- *Anticonvulsant drugs*
  - *Carbamazepine*
  - *Diphenylhydantoin*
  - *Valproic acid*
  - *Ethosuximide*
  - *Phenobarbital*
- *Neuroleptics*
  - *Phenothiazines (e.g. chlorpromazine, promethazine)*
  - *Haloperidol*
  - Clozapine
- *Antidepressants*
  - *Amitryptyline*
  - *Imipramine*
  - *Lithium*
  - *Serotonin-reuptake inhibitors (e.g. fluoxetine)*
  - Doxepine
- *Antiparkinsonian drugs*
  - *Levo-dopa*
  - *Dopa-decarboxylase inhibitors (e.g. benserazide)*
  - *Anticholinergic drugs (e.g. biperiden, benzhexol)*
  - Monoamine-oxidase inhibitors (e.g. selegiline)
- *Drug dependence*
  - *Cocaine*
  - *Ethanol*
  - *LSD-25*
  - *[Opioids (e.g. morpine, heroin, methadone)]*
  - *Amphetamine*
  - *Naloxone*
  - *Cannabis*

- Clomethiazole
- Tetrahydrocannabinol

- *Antibiotics*
  - *Penicillins (e.g. penicillin V and G)*
  - *Penicillins with special properties (e.g. amoxycillin, flucloxacillin)*
  - *Clavulanic acid*
  - *Gyrase inhibitors (e.g. ciprofloxacin)*
  - *Tetracyclines*
  - *Trimethoprim*
  - *Metronidazole*
  - *Chloramphenicol*
  - *Aminoglycosides (e.g. gentamycin)*
  - Macrolides (e.g. clarithromycin)
  - Vancomycin

- *Drugs for tuberculosis*
  - *Isoniazid*
  - *Rifampicin*
  - *Ethambutol*
  - *Streptomycin*

- *Antimycotics*
  - *Amphoteracin B*
  - *Nystatin*
  - Ketoconazole

- *Antimalarial drugs*
  - *Chloroquine*
  - *Quinine*
  - Mefloquine
  - Halofantrine

- *Antiviral agents*
  - *Acyclovir*
  - *Zidovudine*
  - *Interferon* α
  - Saquinavir

- *Respiratory drugs*
  - *Glucocorticoids, inhaled (e.g. beclomethasone, budenoside)*
  - *β_2-Agonists (e.g. salbutamol, salmeterol)*
  - *Ipratropium*
  - *Theophylline*
  - *[Codeine]*
  - Leukotriene antagonist (e.g. montelukast)
  - Cromoglycate
  - Acetylcysteine

- *Anticoagulants and fibrinolytics*
  - *Heparin – low molecular weight*
  - *Heparin, sodium*
  - *Coumarin (e.g. warfarin, phenprocoumon)*
  - *Vitamin K*
  - *Fibrinolytics (e.g. streptokinase, tPA)*
  - Recombinant hirudine

- *Gastrointestinal drugs*
  - *Antacids*
  - *H_2-antagonists (e.g. ranitidine)*
  - *Proton pump inhibitors (e.g. omeprazole, lanzoprazole)*
  - *Metoclopramide*
  - *Sulphasalazine*
  - *[Anticholinergics (e.g. butylscopolamine)]*
  - *Bisacodyl*
  - *Lactulose*
  - *Loperamide*
  - *[Codeine]*
  - Cisapride

- *Non-steroidal anti-inflammatory drugs*
  - *Aspirin (acetylsalisylic acid)*
  - *[Ibuprofen]*
  - *[Diclofenac or equivalent]*
  - *Cox-2 selective NSAID (e.g. celecoxib)*

- *Corticosteroids*
  - *Mineralocorticoids (e.g. fludrocortisone)*
  - *Glucocorticoids (e.g. prednisolone, dexamethasone, [beclomethasone])*

- *Diuretics*
  - *[Thiazides (e.g. bendrofluazide, hydrochlorthiazide)]*
  - *[Loop diuretics (e.g. furosemide)]*
  - *Spironolactone*
  - *Amiloride/triamterene*
  - *Mannitol*

- *Anti-rheumatic drugs*
  - [NSAIDs]
  - *Methotrexate*
  - *[Chloroquine]*
  - [Sulphsalazine]
  - Penicillamine
  - Gold compounds (e.g. auranofin, aurothiomalate gold)

- *Bone diseases*
  - *Calcium*
  - *Vitamin D*
  - *Bisphosphonates (e.g. alendronate, etidronate)*

- *Gout*
  - *Allopurinol*
  - *[NSAIDs]*
  - Probenecid

- *Cytostatic drugs*
  - Cyclophosphamide
  - [Methotrexate]
  - Cisplatin
  - Vincristine

- *Immunosuppressants*
  - [Glucocorticoids]
  - Cyclosporine
  - Azathioprine
- *Cytokines*
  - Filigastrim (GCSF)
  - *Epoetin*
  - *[Interferon α]*
  - *Interferon β*
- *Sex hormones*
  - *Combined oral contraceptive drugs (e.g. ethinylo-estradiol plus levonorgestrel)*
  - *Progesterone only drugs (e.g. norethisterone)*
  - *Menopausal preparations*
  - Finasteride
  - Sildenafil
- *Antidiabetic drugs*
  - *Sulponylurea (e.g. glibenclamide, glipizide)*
  - *Metformin*
  - α-Glucosidase inhibitors
  - *Insulins (rapid, intermediate, and prolonged action)*
- *Thyroid disease*
  - *Thyroxine*
  - *[β-Receptor blocking drugs (e.g. propranolol)]*
  - *Antithyroid drugs (e.g. carbimazole)*
- *Antiplatelet drugs*
  - *[Aspirin]*
  - Clopidogrel
  - Abciximab
- *Skin preparations*
  - *Acne therapy (e.g. retinoic acid derivatives)*
  - *[Glucocorticoids]*
  - *[Tetracycline]*
  - Dithranol
- *Vitamins and minerals*
  - *Iron preparations (e.g. ferrous sulphate)*
  - *Potassium supplements*
  - *Vitamin D_3*
  - *Vitamin B_1*
  - *[Vitamin K]*
  - *Vitamin B_{12}*
  - *Folic acid*
- *Anti-migraine drugs*
  - *[Aspirin]*
  - *[Paracetamol]*
  - *[Propranolol]*
  - *Metoclopramide*
  - *5HT1 Antagonist (e.g. sumatriptan, zolmitriptan)*
  - Domperidone
- *Drugs in obstetrics and gynaecology*
  - *Ergometrine*
  - *Oxytocin*
  - Bromocryptine
- *Anti-emetic drugs*
  - *[Metoclopramide]*
  - *Scopolamine*
  - [Domperidone]
  - Ondansetron
  - *[Antihistamines (e.g. promethazine)]*
  - *[Phenothiazines (e.g. prochlorperazine)]*
- *[Antihistamines]*
  - *Cetirizine*
  - *Clemastine*
- *[Anticholinergic drugs]*
  - *Atropine*
- *Drugs for emergency use*
  - *Glucose*
  - *Adrenaline*
  - *Phenoxybenzamine*
  - *Naloxone*
  - *Flumazenil*
  - *Diazepam*
  - *Lidocaine*
  - *Heparin*
  - *Hydrocortisone*
  - *Insulin*
  - *Antihistamines*
  - *Morphine*
  - *Anti-hypertensives (e.g. labetalol, urapidil)*
  - *Aminophylline*
  - *Salbutamol*
  - *Furosemide*
  - *Aspirin*
  - *Verapamil*
  - *Streptokinase*

Appendix B: disease orientated approach to core curriculum for medical students

The list contains a representative selection of disease processes according to the body system and using three categories: M, diseases that the student must know how to treat; D diseases that the student must be able to suspect the diagnosis; A diseases that the student needs to be aware of (to refer to a specialist): ○Cardiovascular system

- Acute myocardial infarction, M
  - Angina pectoris, M
  - Atrial flutter, D
  - Cardiac failure (left ventricular or congestive), M
  - Deep vein thrombosis, M
  - Bacterial endocarditis, D

- Hypertension, M
- Pericardial effusion, D
- Ventricular tachycardia, D

- Endocrine system/deficiency diseases
  - Addison's syndrome, A
  - Cushing' syndrome, A
  - Diabetes mellitus, M
  - Iron deficiency anaemia, M
  - Hypoparathyroidism, D
  - Hyperthyroidism, M
  - Phaeochromcytoma, A
- Gastro-intestinal diseases
  - Acute/chronic diarrhoea, M
  - Ascites, D
  - Carcinoma of colon, D
  - Gallstones, D
  - Gastro-intestinal reflux, M
  - Hepatitis, acute/chronic, D
  - Obesity, M
  - Pancreatitis acute/chronic, D
- Genito-urinary system
  - Bladder cancer, A
  - Cervical cancer, D
  - Dysmenorrrhoea, M
  - Glomerulonephritis, acute, D
  - Infertility, male/female, A
  - Renal colic, M
  - Renal failure, acute/chronic, D
  - Urinary tract infection, M
- Infections
  - Pneumococcal pneumonia, M
  - Atypical pneumonia, M
  - AIDS/HIV, A
  - Malaria, M
  - Meningitis, M
  - Schistosomiasis, A
  - Tuberculosis, D
- Musculo-skeletal system
  - Fractures, D
  - Osteoarthritis, M
  - Gout, chronic, D
  - Rheumatoid arthritis, M
- Central nervous system
  - Anxiety, M
  - Dementia, D
  - Depression, D
  - Epilepsy, chronic, M
  - Migraine, M
  - Multiple sclerosis, A
  - Parkinson's disease, D
  - Stroke (cerebro-vascular accident), M
- Respiratory system
  - Asthma, M
  - Chronic obstructive airways disease, M
  - Cystic fibrosis, A
  - Pleural effusion, D
  - Broncial carcinoma, D
- Emergency conditions
  - Bleeding, M
  - Haematemesis, M
  - Heroin/morphine poisoning, M
  - Thrombembolism, M
  - Diabetic coma, M
  - Hypoglycaemic coma, M
  - Anaphylactic shock, M
  - Myocardial infarction, M
  - Acute pneumothorax, M
  - Ureteric colic, M
  - Biliary colic, M
  - Febrile convulsions, M
  - Acute epileptic seizure, M
  - Meningitis, M

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