The ‘top 100’ drugs and classes in England:

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The 'top 100' drugs and classes in England

An updated 'starter formulary' for trainee prescribers

Running title: Core drug list for prescribing training

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Abstract

Aims

Prescribing is a complex skill required of doctors and, increasingly, other healthcare professionals. Use of a personal formulary can help to develop this skill. In 2006-9, we developed a core list of the 100 most commonly prescribed drugs. Our aim in the present study was to update this 'starter formulary' to ensure its continued relevance for prescriber training.

Methods

We analysed large contemporary primary and secondary care datasets to identify the most frequently prescribed medicinal products. Items were classified into natural groups, broadly following their British National Formulary classification. The resulting drug groups were included in the core list if they comprised ≥0.1% prescriptions in both settings or ≥0.2-0.3% prescriptions in one setting. Drugs from emergency guidelines that did not qualify by prescribing frequency completed the list.

Results

Over 1 billion primary care items and approximately 1.8 million secondary care prescriptions were analysed. The updated list comprises 81 drug groups commonly prescribed in both settings; 6 from primary care; 7 from secondary care; and 6 from emergency guidelines. 88% of the formulary was unchanged. Notable changes include entry of newer anti-epileptics and dipeptidyl peptidase-4 inhibitors and exit of phenytoin and thiazolidinediones.

Conclusions

The relative stability of the core drug list over 9 years and the current update ensure that learning based on this list remains relevant to practice. Trainee prescribers may be encouraged to use this 'starter formulary' to develop a sound basis of prescribing knowledge and skills that they can subsequently apply more widely.

Keywords

Medical education, pharmacoepidemiology, general medicine

Structured summary

1: What is already known about this subject:

- Prescribing is a complex skill, acquisition of which can be facilitated by use of a personal formulary
- In 2006-9 we developed a 'starter formulary' of the 100 drugs most commonly prescribed in the UK
- This drug list remained stable over 2 years and was consistent with practice of new prescribers

2: What this study adds:

- We used primary and secondary prescribing data from 2015 to update the 'starter formulary'
- Most drugs in the list remain the same, with 12 differences attributable to changes in practice, disease prevalence and methodology
- The list is intended not to stifle trainees' inquisitiveness, but to provide an evidence-based starting point from which they can build their prescribing knowledge and skills

Introduction

In *Outcomes for Graduates*, the General Medical Council emphasises the safe, effective and economical prescription of drugs as a core skill for all new UK medical graduates [1]. The importance of prescribing skills is further emphasised by the UK Prescribing Safety Assessment, which all new doctors must pass as a requirement of the Foundation Programme [2,3]. Prescribing is a complex, multi-step process that includes defining the clinical problem and therapeutic objectives; identifying a suitable treatment; starting the treatment; giving appropriate information; and monitoring treatment success [4]. The challenge faced by trainee prescribers in acquiring this skill is compounded by the large number of drugs available. For example, in the UK, 1,603 drugs and 18,408 preparations are licensed for prescription [personal communication, British National Formulary (BNF) editorial team, October 2017].

To facilitate development and maintenance of prescribing competence, the World Health Organisation (WHO) recommends that prescribers develop a list of 'P' drugs – a personal formulary of drugs that they prescribe regularly and can become familiar with [4]. This is difficult for undergraduate medical students who are not yet prescribing and who may see diverse practice as they rotate through healthcare settings and specialties. De Vries and colleagues found that provision of any formulary, whether learner or teacher-led, helped students to improve their prescribing skills [5]. In 2011, we therefore developed a 'starter formulary' of the 100 drugs most commonly prescribed in the UK from analysis of primary and secondary care prescribing data [6]. This helped students to focus their initial

learning on drugs they would actually prescribe in practice and supported educators in developing learning resources and assessments [7].

Our original list was developed from analysis of primary and secondary care prescribing data from 2006-9. Over the last 5-10 years, there have been significant therapeutic advances, including the advent of direct oral anticoagulants and dipeptidyl peptidase 4 inhibitors. The aim of this study was to update the starter formulary by identifying the drugs most commonly prescribed in primary and secondary care in 2015, thereby supporting relevant modern-day learning for new prescribers.

Methods

Overview

NHS Prescription Cost Analysis (PCA) data was used to identify all items dispensed in the community in England in 2015 [8]. Electronic prescription records were used to identify all items prescribed in the University Hospital Birmingham NHS Foundation Trust in 2015. Medicinal products identified in each healthcare setting were formed into natural groups, guided by their classification in the British National Formulary (BNF) [9]. The most commonly prescribed drug groups in both or either setting were combined with drugs identified from emergency guidelines to generate the final core drug list.

Study approvals

This study did not require ethical approval as it was based wholly on aggregate data, with no linkage to patient-level data

Data collection

Primary care

NHS PCA data for England 2015 was obtained. This is based on information obtained from prescriptions sent to the Prescription Pricing Division of the NHS Business Services Authority. All prescriptions dispensed in the community are included, the majority of which are written by general practitioners. Analysis was based on the frequency with which each medicinal product was dispensed.

Secondary care

A list of all items prescribed in University Hospital Birmingham NHS Foundation Trust in 2015 was obtained from their electronic prescribing system. Analysis was based on the frequency of medicinal product prescription.

Emergency drugs

A review of hospital guidelines generated a list of all emergency drugs used in hospital emergency settings [10].

Compiling the core list

In accordance with a prospectively defined analysis plan, the PCA dataset was cleaned to remove items that fell outside the definition of a medicinal product [11] (e.g. sunscreens, camouflages, appliances and nutritional supplements). We also removed intravenous fluid preparations and vaccines because, although they fall within the definition of medicinal products, we judged that they represent educationally distinct groups. Finally, we planned to apply clinical–educational judgment to remove drugs used in highly specialised practice that fell outside the scope of a core drug list for trainee prescribers.

The PCA data was used to develop natural drug groups. Medicinal products were first classified by BNF sub-paragraph. The products within each sub-paragraph were then classified by chemical name to identify and separate individual drug classes. Where several chemical entities fell naturally into a drug class, this was used as a group for analysis purposes. Conversely, where a chemical entity fell into a class of

its own, it was named and analysed as such. For example, the BNF sub-paragraph '*Lipid-regulating drugs'* was separated into statins, fibrates and ezetimibe. In a few cases, e.g. '*Nicotine replacement and related drugs'*, the BNF sub-paragraph was retained as the basis for the drug group. Where necessary, clinical judgment was applied to ensure groupings were natural and clinically applicable. The drug groups developed from the PCA data were then used to sort drugs in the secondary care data.

Compound products were not included as distinct items if their constituent ingredients were already captured in the top 100 list. Where different members of drug classes were used for more than one indication the drug class was included only once (e.g. H_1 receptor antagonists for nausea, allergy) and the frequencies summed.

Prescribing frequency

For the PCA data, the number of items dispensed for all medicinal products within each drug group was summed and expressed as a percentage of the total number of items dispensed.

For the secondary care data, the number of prescriptions written for all medicinal products within each drug group was summed and expressed as a percentage of the total number of prescriptions.

Generating the top 100 drug list

Prior to the analysis it was decided that the list would contain 100 drug groups as a number that was educationally attractive, sufficient to cover most prescribing by foundation doctors [6] and limited enough to be considered core.

Drug groups qualified for the top 100 list if they comprised ≥0.1% prescriptions in both primary and secondary care; ≥0.2% prescriptions in primary care but <0.1% prescriptions in secondary care; or ≥0.3% prescriptions in secondary care but <0.1% prescriptions in primary care. These definitions were chosen to optimise inclusion of drugs that were widely prescribed across healthcare systems and to reduce the inclusion of more specialist drugs e.g. those with high use by a single specialist team in secondary care but not commonly prescribed by non-specialist doctors. As the number of drug groups meeting these criteria exceeded 100, clinical and educational judgement was used to review the less commonly prescribed drugs from these lists, selecting those considered to be prescribed by generalists over those requiring more specialist expertise. In addition drugs from emergency guidelines that did not qualify by prescribing frequency but were considered to be clinically important were identified and room was made for them on the list by removing more specialist drugs.

Comparison of methodology between 2006-9 and 2015

Prescription cost analysis data was used to analyse items dispensed in the community in both 2006-9 and 2015 using broadly similar approaches. Minor changes in 2015 included a pre-planned decision to exclude intravenous fluids and vaccines from the analysis and to exclude combination products (e.g. analgesia, inhalers) from the final list where the constituent drugs were already included.

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The main difference between studies was in the methods used to obtain the secondary care data. In 2006-9, a by-hand audit of paper drug charts of inpatients in two London hospitals was used to identify 7705 individual prescriptions. In 2015, a list of all (2.129 million) items prescribed that year in a single large teaching hospital was obtained from their electronic prescribing system. The 2015 secondary care data gives a much more comprehensive picture of secondary care prescribing, albeit from a single hospital with some distinct tertiary practice.

Results

The PCA 2015 dataset comprised 1.037 billion dispensed items, of which 24.775 million items were ineligible for inclusion (figure 1). The Birmingham hospital data set comprised 2.129 million prescriptions, of which 360,000 prescriptions were ineligible for inclusion. The primary and secondary care analysis datasets therefore comprised 1.013 billion items dispensed and 1.779 million prescriptions respectively.

Core drug list

Eighty one drug groups that made up ≥0.1% items dispensed in primary care and prescriptions in secondary care comprised the majority of the list (table 1). Two drugs that met these criteria (nicorandil, 0.1% hospital prescriptions, 0.3% primary care items; hydroxychloroquine 0.1% hospital prescriptions, 0.1% primary care items) were considered more for specialist than generalist use and therefore not included in the final list.

All 5 drug groups that made up ≥0.2% items dispensed in primary care alone were included in the core drug list (table 2). In addition, '*drugs for breast cancer*', comprising 0.19% items dispensed) was included.

Eleven drug groups made up ≥0.3% prescriptions in secondary care alone and 7 of these were included in the final list (table 3). The 4 drug groups excluded from the ~~not included in~~ the core final list because they were considered to require more specialist than generalist expertise were *N*-Methyl-D-aspartate receptor antagonists (e.g. ketamine), 1.9% prescriptions; immunosuppressants (e.g. tacrolimus, ciclosporin), 1.3% prescriptions; drugs for human immunodeficiency virus (HIV)

infection (e.g. ritonavir), 1.1% prescriptions; and carbapenems (e.g. meropenem), 0.5% prescriptions.

Six drugs from emergency guidelines that did not qualify by prescribing frequency were considered clinically important and completed the list (table 4).

Changes in core drug list from 2006-2009 to 2015

There were 12 changes to the core list in 2015 from 2006-9 (table 5). Some of the drugs dropping out of the core drug list did so due to changes in qualification rules set in the prospectively defined analysis plan. Compound products were not included as distinct items if their constituent ingredients were already captured in the top 100 list (compound beta 2 agonist/corticosteroid inhalers; opioids, compound preparations). Where different members of drug classes were used for more than one indication the drug class was included only once (anti-histamine anti-emetics and H_1 receptor antagonists were separate in the old list and combined in the new list). Vaccines and antisera were excluded because, although they fall within the definition of medicinal products, we judged that they were educationally distinct. Electrolytes were split and analysed as their constituents (e.g. oral potassium, oral magnesium, intravenous electrolytes), which didn't individually make the list based on prescribing frequency.

Other drugs dropping out of the core list did so due to a fall in prescribing frequency relative to new entrants. These were anti-emetics, phenothiazines; dipyridamole; diuretics, potassium-sparing diuretics with other diuretics; laxatives, bulk forming, phenytoin and thiazolidinediones. Nicorandil was borderline for inclusion on the

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basis of prescribing frequency, but was excluded from the final list to make room for emergency medicines as it was judged more specialist than generalist compared to other borderline drugs.

All new entrants to the list qualified through an increase in relative prescribing frequency. For some drugs this represents a genuine increase in use e.g. direct oral anticoagulants, DPP-4 inhibitors, levetiracetam. For others, drug use may have remained constant but increased relative to some of those leaving the list (e.g. thiazolidinediones, phenytoin) where use has decreased.

~~Drug groups that dropped out of the list included those used with decreasing frequency (e.g. thiazolidinediones, phenytoin, potassium-sparing diuretics) or excluded by new list criteria (e.g. compound products for which the constituent drugs were already part of the list, vaccines, combining entries of drugs used in more than one therapeutic area). Drugs entering the list were those where frequency of prescription or dispensing had increased relative to other drugs used in primary and secondary care settings.~~

Comparison of core drugs list to the World Health Organisation list of essential medicines

The World Health Organisation (WHO) compiles and updates a core list of minimum medicines required for a basic health-care system and a complementary list of essential medicines for priority diseases where some specialist facilities, care or training are needed for their use [12]. Together these lists contain around 438 individual drugs. To determine the applicability of the core drug list to trainee prescribers working in healthcare systems outside England we compared our list to

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the World Health Organisation list of essential medicines [12]. Seventy eight percent of our core drugs were on the WHO essential list and 4% were on the complementary list. Drugs not on the WHO list or on the complementary list only are shown in table 6.

Discussion

We have identified the drug groups most commonly prescribed in England in primary and secondary care settings in 2015. We have used this analysis to develop a 'top 100 drugs' list to provide a starting point for trainee prescribers being introduced to pharmacology for the first time. This new list updates our previous analysis of 2006-9 prescribing data [6]. Reassuringly, only 12% of drugs in the list have changed, indicating that learning based on this resource could have long term relevance for prescribing in practice.

Some of the changes in the updated list reflect changes in qualification rules, such as removal of separate entries for compound preparations and drug groups used in more than one therapeutic area. Other changes however are likely to reflect genuine changes in prescribing guidelines and practice. For example, in 2010 the European Committee on Medicinal Products for Human Use recommended suspension of the marketing authorisation of rosiglitazone, a thiazolidinedione, due to emerging evidence of cardiovascular risk [13]. Another thiazolidinedione, troglitazone, had previously been withdrawn from the British market in 1997 due to hepatotoxicity [14]. Although pioglitazone, remains available for prescription and is still included in English guidelines produced by the National Institute for Health and Care Excellence (NICE) for the management of type 2 diabetes [15], concerns about the safety of this drug class and adoption of alternatives, including the dipeptidyl peptidase-4 inhibitors (entering the list in 2015), likely account for the fall in thiazolidinedione prescribing. Another example is change in antiepileptic drug prescribing. Phenytoin, which was included in the 2006-9 list, was put on a 'potential signals of serious risks'

list by the United States Food and Drug Administration (FDA) in 2008 and is no longer recommended as either first line or adjunctive therapy for the prevention of any seizure type by NICE [16]. Carbamazepine and sodium valproate (in both old and new lists), as well as lamotrigine and levetiracetam (entering the list in 2015), are preferred. Phenytoin remains on the World Health Organisation List of essential medicines [12] and is still listed in NICE guidelines as adjunctive treatment to benzodiazepines for status epilepticus. There is therefore a case to include it in the top 100 list as an emergency drug. As trials seek to replace its use even for status epilepticus with safer alternatives [17], we have made the judgement to leave it out of our list. Other educators and learners may wish to include it in theirs.

~~We can only speculate on the reasons for changes in prescribing frequency. They may reflect shifts in prescribing practice, such as less frequent use of phenytoin in favour of better tolerated antiepileptic agents such as levetiracetam and lamotrigine.~~ Other changes in the list may be due to increasing disease prevalence or diagnosis. For example increasing rates of diagnosis of dementia and prescription of anti-dementia drugs [~~12~~18] could be responsible for the entry of acetylcholinesterase inhibitors to the list. Differences in data collection between the two analyses may also have had an effect. In 2006-9, secondary care prescribing data was collected by hand and so only included approximately 7,500 prescriptions, whereas in 2015 use of electronic prescribing data allowed inclusion of nearly 1.8 million secondary care prescriptions.

Our list was developed using prescribing and dispensing data from England. To determine its relevance to an international audience we reviewed it against the

WHO essential and complementary medicines lists [12]. Over three quarters of drugs on our list are considered essential for a basic healthcare system and are therefore likely to be used worldwide. We considered the WHO list in its entirety (438 drugs) to be overwhelming for a beginner prescriber and feel that our core list has an important place in helping novice prescribers to direct most of their initial attention to the most commonly prescribed drugs.

A list of drugs to learn about perhaps seems an old fashioned concept in an era where healthcare education seeks to be patient-centred, integrated and problem-based and curricula are moving to define and assess higher level competencies. Learning to prescribe is a complex process, well suited to a spiral curriculum where learners acquire understanding of the principles of clinical pharmacology, knowledge of drugs and therapeutics, and skills in prescribing in parallel, through multiple 'visits' to the topic of increasing complexity [19]. A core drug list gives trainee prescribers a tool to focus their acquisition of knowledge around drugs that they will use in early clinical practice. It allows them to build their learning from knowledge of the pharmacology of individual drugs, through understanding how these drugs are used in the management of common diseases to prescribing them in simulated, then real, clinical scenarios. The principles and skills developed can then be applied to unfamiliar drugs encountered in practice. A core drug list can also help educators to design useful learning resources [7] and assessments that are relevant to practice. For example learners could be assessed on their knowledge of drugs on the core list, but on their skills in information gathering to support safe prescribing of an unfamiliar drug.

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Limitations

Our analysis has several limitations. The primary care data reflects English prescribing practice only, although we consider that it should be broadly representative of UK practice. With an appropriate overlay of local clinical–educational judgement, it may have broader generalisability. Our finding that over three quarters of drugs on the core list were also on the WHO essential medicines list supports this. Secondary care data was obtained from a single hospital, and may therefore be affected by local prescribing patterns, population characteristics, and specialist services. However, it is reassuring that the large majority of items ~~i~~on the list were prescribed frequently in both primary and secondary care, suggesting that most do not reflect specialist or centre-specific practice. Moreover, we applied clinical–educational judgment to exclude drugs considered to be mainly for specialist use and beyond the scope of a new prescriber.

The method of analysis and definition of drug groupings also had potential to influence the results. The complex process of screening BNF sub-paragraphs, classes and individual drugs requires some subjective judgement. However, this was informed by considerable experience of both clinical practice and prescriber training, aiming to produce educationally useful, clinically relevant groups. These are fully described so that educators using the list may also apply their own judgment.

Conclusion

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Personal formularies are ~~a~~ valuable tools to improve prescribing skills, but can be difficult to develop without help for the trainee prescriber. We have produced a core drug list of the most commonly prescribed drug groups in ~~the~~ England to assist in this process. We consider that it should be generalisable to UK practice and – if supported by appropriate clinical–educational judgement – more widely. Updating this formulary has resulted in 12 changes from 2006-9, keeping the list up to date with contemporary prescribing practice. This core drug list is not intended to restrict the scope of teaching or to stifle students' inquisitiveness. Rather, it should be considered as a 'starter formulary' to help novice prescribers to direct most of their early attention to the most commonly prescribed drugs.

Acknowledgements

The analysis presented in this paper used the “NHS Business Services Authority Prescription cost analysis data 2015, NHSBSA Copyright 2018” This information is licenced under the terms of the Open Government Licence.

Conflict of interest statement

Professor Baker described the top 100 most commonly prescribed drugs in 2006-9 in the British Journal of Clinical Pharmacology [Reference Baker E, Roberts AP, Wilde K, Walton H, Suri S, Rull G, Webb A. Development of a core drug list towards improving prescribing education and reducing errors in the UK. Br J Clin Pharmacol. 2011;71:190-8].

Subsequently, Drs Hitchings, Lonsdale and Burrage and Professor Baker published a text book with Elsevier entitled 'The top 100 drugs, clinical pharmacology and practical prescribing'. This was based on the 2006-9 top 100 drugs list and these authors were paid royalties by the publisher. The same authors have already produced a second edition (2E) of the Top 100 drugs book, based on the updated 2015 analysis reported in this paper. Top 100 2E will be published in 2018 and these same authors will receive further royalties for this work.

Drs Audi and Pontefract and Professor Coleman have no conflicts of interest relating to this paper

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453 **Table 1. Drugs, classes and BNF groupings comprising ≥0.1% of both primary and**

454 **hospital prescriptions**

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Overall rank	Drug, class or BNF grouping	Most commonly prescribed example(s)	Hosp. rank	PCA rank	Hosp. %	PCA %
1	Proton pump inhibitors	omeprazole, lansoprazole	3	2	3.0%	5.5%
2	Statins	simvastatin, atorvastatin, pravastatin	9	1	2.3%	6.5%
3	Paracetamol		1	11	6.2%	2.3%
4	Beta-blockers	bisoprolol, atenolol, propranolol	17	5	1.8%	3.6%
5	Calcium and vitamin D		11	12	2.1%	2.1%
6	Calcium-channel blockers	amlodipine, felodipine, diltiazem, nifedipine, lercanidipine	21	4	1.8%	3.7%
7	H_1 receptor antagonists	cyclizine, cetirizine, loratadine, fexofenadine, chlorphenamine	6	19	2.7%	1.6%
8	Aspirin		18	8	1.8%	2.8%
9	Opioids: weak/moderate	tramadol, codeine, dihydrocodeine	5	21	2.8%	1.4%
10	Opioids: strong	morphine	2	27	5.2%	1.2%
11	$Beta_2$ agonists	salbutamol, salmeterol	22	10	1.5%	2.3%
12	Angiotensin-converting enzyme inhibitors	ramipril, lisinopril, perindopril	30	3	1.1%	4.3%
13	Diuretics, loop	furosemide, bumetanide	12	22	2.1%	1.4%
14	Vitamin K antagonists	warfarin	6	28	2.5%	1.1%
15	Vitamins	folic acid, thiamine hydrochloride, vitamin B group	16	20	1.8%	1.5%
16	Non-steroidal anti-inflammatory drugs	naproxen, ibuprofen	28	13	1.1%	2.1%
17	Penicillins, broad spectrum	amoxicillin, co-amoxiclav	19	24	1.8%	1.4%
18	Laxatives - osmotic	macrogol, lactulose	13	33	2.1%	0.9%
19	Anti-depressants, selective serotonin re-uptake inhibitors	citalopram, sertraline, fluoxetine	42	6	0.7%	3.2%
20	Corticosteroids, systemic	prednisolone	10	38	2.1%	0.8%
21	Laxatives, stimulant	senna, docusate sodium	7	41	2.5%	0.7%
22	Corticosteroids, inhaled	beclometasone, fluticasone, budesonide	39	14	0.8%	2.0%
23	Thyroid hormones	levothyroxine	50	7	0.6%	2.9%
24	Benzodiazepines	diazepam, temazepam, lorazepam	26	32	1.2%	1.0%

25	Alpha-adrenoceptor blocking drugs	doxazosin, tamsulosin	34	25	0.8%	1.3%
26	~~Metformin~~Biguanides	metformin	45	15	0.7%	1.9%
27	Insulin		24	43	1.3%	0.7%
28	Angiotensin-II receptor antagonists	losartan, candesartan, irbesartan	54	16	0.5%	1.8%
29	Corticosteroids, topical	hydrocortisone	63	9	0.4%	2.4%
30	Gabapentin and pregabalin		43	29	0.7%	1.0%
31	Anti-depressants, tricyclic and related drugs	amitriptyline	56	19	0.4%	1.6%
32	Anti-platelet drugs	clopidogrel	41	34	0.7%	0.9%
33	Anti-fungal drugs	clotrimazole, ketononazole	31	45	1.0%	0.6%
34	Histamine (H_2)-receptor antagonists	ranitidine	25	51	1.3%	0.5%
35	Diuretics, thiazide and thiazide-like	Bendroflumethiazide, indapamide	65	18	0.3%	1.7%
36	Emollients		58	31	0.4%	1.0%
37	Nitrates	isosorbide mononitrate, glyceryl trinitrate	48	42	0.6%	0.7%
38	Trimethoprim		35	55	0.8%	0.4%
39	Iron	ferrous fumarate, ferrous sulfate	51	40	0.6%	0.7%
40	Bisphosphonates	alendronic acid	57	36	0.4%	0.8%
41	Penicillins, penicillinase-resistant	flucloxacillin	46	54	0.6%	0.4%
42	Sulfonylureas	gliclazide	67	35	0.3%	0.8%
43	Macrolides	clarithromycin	53	49	0.5%	0.5%
44	Gout and hyperuricaemia	allopurinol	60	48	0.4%	0.5%
45	Alginates and antacids		59	50	0.4%	0.5%
46	Anti-depressant drugs, other	venlafaxine, mirtazapine	80	30	0.2%	1.0%
47	Z drugs	zopiclone	66	46	0.3%	0.6%
48	Ocular lubricants (artificial tears)	hypromellose	75	39	0.3%	0.8%
49	Anti-emetics, dopamine (D_2)-receptor antagonists	metoclopramide, domperidone	27	88	1.2%	0.2%
50	Anti-muscarinics, cardiovascular and gastrointestinal uses	atropine, hyoscine butylbromide	52	64	0.1%	0.5%
51	Anti-psychotics: 2nd	quetiapine, olanzapine, risperidone	81	37	0.2%	0.8%

	generation					
52	Anti-muscarinics, bronchodilators	tiotropium, ipratropium bromide	73	47	0.3%	0.6%
53	~~Digoxin~~Cardiac glycosides	digoxin	61	61	0.4%	0.3%
54	Methotrexate		44	79	0.7%	0.2%
55	Anti-muscarinics, genitourinary uses	solifenacin, tolterodine, oxybutynin	92	44	0.2%	0.6%
56	Anti-proliferative immunosuppressants	azathioprine	32	104	1.0%	0.1%
57	Tetracyclines	doxycycline	90	52	0.2%	0.4%
58	Aldosterone antagonists	spironolactone	76	66	0.3%	0.3%
59	Metronidazole		64	81	0.4%	0.2%
60	Dipeptidyl peptidase-4 inhibitors	sitagliptin, linagliptin	95	57	0.2%	0.4%
61	Anti-motility drugs	loperamide	68	84	0.3%	0.2%
62	Quinine sulfate		97	56	0.2%	0.4%
63	Dopaminergic drugs used in parkinsonism	co-careldopa (carbidopa / levodopa)	99	58	0.2%	0.4%
64	Lamotrigine		101	59	0.2%	0.4%
65	Direct oral anticoagulants	rivaroxaban, apixaban, dabigatran	94	69	0.2%	0.3%
66	Anti-psychotics: 1st generation	haloperidol	69	94	0.3%	0.1%
67	Mucolytics	carbocisteine	81	78	0.2%	0.2%
68	Levetiracetam		74	90	0.3%	0.2%
69	Prostaglandin analogues	latanoprost	112	53	0.1%	0.4%
70	Penicillin	benzylpenicillin, phenoxymethylpenicillin	93	75	0.2%	0.2%
71	Valproate		107	63	0.1%	0.3%
72	5 α -reductase inhibitors	finasteride	109	62	0.1%	0.3%
73	Chloramphenicol		115	65	0.1%	0.3%
74	Aminosalicylates	mesalazine	103	77	0.1%	0.2%
75	Nitrofurantoin		113	73	0.1%	0.2%
76	Carbamazepine		117	72	0.1%	0.2%
77	Antivirals	aciclovir	84	105	0.2%	0.1%
78	Cephalosporins	ceftriaxone, cefalexin	85	106	0.2%	0.1%
79	Local anaesthetics	lidocaine	116	92	0.1%	0.1%
80	Amiodarone		100	108	0.2%	0.1%
81	Drugs used in substance	nicotine, methadone	111	100	0.1%	0.1%

	dependence

Abbreviations: BNF, British national formulary; PCA, prescription cost analysis; Hosp., hospital.

For each drug the prescribing frequency in terms of rank and percentage of prescriptions are shown for both primary (PCA) and secondary (hosp.) care. The average rank in both healthcare settings was calculated and determined the overall rank.

Table 2. Drugs, classes and BNF groupings comprising ≥0.2% prescriptions in primary care but <0.1% prescriptions in secondary care

	Drug, class or BNF grouping	Most commonly prescribed example(s)	PCA rank	PCA (%)
1	Oestrogens and progestogens	combined ethinylestradiol, desogestrel, estradiol	27	1.2%
2	Phosphodiesterase (type 5) inhibitors	sildenafil	61	0.3%
3	Acetylcholinesterase inhibitors	donepezil	72	0.2%
4	Serotonin ($5HT_1$)-receptor agonists	sumatriptan	75	0.2%
5	Leukotriene receptor antagonists	montelukast	79	0.2%
6	Drugs for b~~B~~reast cancer	tamoxifen	83	0.19%

Abbreviations: BNF, British national formulary; PCA, prescription cost analysis

Table 3. Drugs, classes and BNF groupings comprising ≥0.3% prescriptions in secondary care but <0.1% prescriptions in primary care

	Drug, class or BNF grouping	Most commonly prescribed example(s)	Hosp. rank	Hosp %
1	Heparins	enoxaparin, heparin	4	2.9%
2	Serotonin ($5HT_3$)-receptor antagonists	ondansetron	8	2.4%
3	Oxygen		21	1.7%
4	Quinolones	ciprofloxacin, moxifloxacin	37	0.8%
5	Penicillins, anti-pseudomonal	piperacillin sodium/tazobactam sodium	38	0.8%
6	Vancomycin		48	0.6%
7	Aminoglycosides	gentamicin	72	0.3%

Abbreviations: BNF, British national formulary; Hosp., hospital.

Table 4. Drugs identified from emergency guidelines not qualifying for the core list by prescribing frequency but considered to be core learning for new prescribers

1	Activated charcoal
2	Adrenaline (epinephrine)
3	Adenosine
4	Acetylcysteine
5	Fibrinolytics e.g. alteplase
6	Naloxone

Drugs from emergency guidelines are in alphabetical order

Table 5. Changes in core drug list between 2006-9 and 2015

Drugs dropping out of the core list	New entrants to the list
Anti-emetics, phenothiazines[2]	Acetylcholinesterase inhibitors
Compound (beta-2 agonist corticosteroid) inhalers[1]	Antiproliferative immunosuppressants
Dipyridamole[2]	Antivirals
~~Potassium, oral~~ Electrolytes e.g. potassium, magnesium[1]	Sex hormone antagonists for breast cancer
Laxatives, bulk forming[2]	Chloramphenicol
Nicorandil[3]	Dipeptidyl peptidase-4 inhibitors
Opioids, compound preparations[1]	Lamotrigine
Phenytoin[2]	Leukotriene receptor antagonists
~~Diuretics, potassium-sparing~~ Potassium sparing diuretics with other diuretics (e.g. co-amilofruse)[2]	Levetiracetam
Thiazolidinediones[2]	Direct oral anticoagulants
Vaccines and antisera[1]	Serotonin ($5HT_1$)-receptor agonists
Anti-histamine anti-emetics combined with H_1 receptor antagonists in the new list[1]	Mucolytics

1. Drugs dropping out of the list due to changes in qualification rules
2. Drugs dropping out of the list due to reduction in relative prescribing or dispensing frequency
3. Drug with more specialist use making way for drugs for more generalist use

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Table 6. Drugs in the English top 100 starter formulary that are not in the World Health Organisation's essential medicines list

1	Alpha-adrenoceptor blocking drugs
2	Gabapentin and pregabalin
3	Emollients
4	Alginates and antacids
5	Anti-depressant drugs, other (venlafaxine, mirtazapine)
6	Z drugs
7	Ocular lubricants (artificial tears)
8	Anti-muscarinics, genitourinary uses
9	Dipeptidyl peptidase-4 inhibitors
10	Direct oral anticoagulants
11	Mucolytics e.g. carbocisteine
12	Levetiracetam
13	5α-reductase inhibitors
14	Phosphodiesterase (type 5) inhibitors
15	Acetylcholinesterase inhibitors
16	Serotonin ($5HT_1$)-receptor agonists
17	Leukotriene receptor antagonists

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18	Adenosine
	On the complementary list
19	Anti-proliferative immunosuppressants e.g. azathioprine
20	Amiodarone
21	Drugs for breast cancer e.g. tamoxifen
22	Fibrinolytics e.g. streptokinase

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Figure legends

Figure 1

Flow diagram showing acquisition, exclusion and processing of prescribing data from primary and secondary care and emergency guidelines to produce the core drug list

Word count

Abstract 246 words

Body of manuscript ~~1977~~ 3106 words