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PHARMACOEPIDEMIOLOGY AND PRESCRIPTION

Do medical students copy the drug treatment choices of their teachers or do they think for themselves?

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Abstract
Purpose Although the importance of rational prescribing is generally accepted, the teaching of pharmacotherapy to undergraduate medical students is still unsatisfactory. Because clinical teachers are an important role model for medical students, it is of interest to know whether this extends to therapeutic decision-making. The aim of this study was to find out which factors contribute to the drug choices made by medical students and their teachers (general practitioners and clinical specialists).
Methods Final-year medical students (n=32), and general practitioners (n=29), lung specialists (n=26), orthopaedic surgeons (n=24), and internists (n=24) serving as medical teachers from all eight medical schools in the Netherlands participated in the study. They were asked to prescribe treatment (drug or otherwise) for uncomplicated (A) and complicated (B) written patient cases and to indicate which factors influenced their choice of treatment, using a list of factors reported in the literature to influence drug prescribing.
Results Final-year medical students primarily based their drug choice on the factors 'effectiveness of the drugs' and 'examples from medical teachers'. In contrast, clinical teachers primarily based their drug choice on the factors 'clinical experience', 'effectiveness of the drugs', 'side effects of the drugs', 'standard treatment guidelines', and 'scientific literature'.
Conclusions Medical teachers would appear to base their drug choice mainly on clinical experience and drug-related factors, whereas final-year medical students base their drug choice mainly on examples provided by their medical teachers. It is essential that medical teachers clearly explain to their students how they arrive at a specific choice of medication since medical students tend to copy the therapeutic drug choices from their teachers, mainly because of a lack of experience. Presenting students with clinical therapeutic problems early during undergraduate training will not only give them a chance to gain experience in solving medical problems but will also give meaning to what they are studying as opposed to merely reproducing what they learn or copying what they are told.

Keywords Therapeutic reasoning · Drug treatment choice · Undergraduate teaching · Medical students · Pharmacotherapy

Introduction

Unlike diagnostic reasoning [1, 2], little is known about therapeutic reasoning, the process by which doctors make a choice of treatment [3]. This part of the consultation is often regarded simply as a matter of knowing which drug to prescribe for a certain condition rather than as a reasoned choice [4]. Experienced doctors rely on their knowledge when prescribing drugs for common ailments [4, 5], often having two to five potential drug and non-drug treatments for the disease or symptom(s) in their mental 'standard treatment guideline'. They make their choice of these options heuristically [6]. This means that doctors may not be conscious of the assumed value judgement and logic underlying their therapeutic decision. In turn, this lack of awareness may make it difficult for medical teachers to explain to medical students how they arrive at a certain therapeutic choice. In addition, teaching in clinical disciplines tends to be focussed on symptoms and making an appropriate

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diagnosis, and relatively little attention is paid to the principles of drug treatment or pharmacotherapy [3]. This may explain in part why many graduates feel under-prepared to take on prescribing responsibilities after graduation [7].

In order to gain insight into the therapeutic decision-making process, we investigated whether there are differences in the factors contributing to the drug choices of final-year medical students and their teachers (general practitioners and clinical specialists).

Materials and methods

Final-year medical students and medical teachers in four clinical specialities (general practice, pulmonology, orthopaedics, and internal medicine) from all eight medical schools in the Netherlands participated in this study. The heads of the above-mentioned departments were asked to select five specialists to participate and in addition the heads of the departments of general practice were asked to select randomly eight final-year medical students (because general practice medicine is the last clerkship before graduation).

Three clinical patient cases (bronchial asthma, osteoarthritis and essential hypertension) with two levels of complexity (A and B) were developed in consultation with clinical specialists and clinical pharmacologists from the VU University Medical Center in Amsterdam, the Netherlands (Table 1). Cases identified as A were uncomplicated, whereas B was a more complicated version of A involving comorbidity and comedication. The participants recorded their choice of drug and/or non-drug treatment on a form. The pulmonology, orthopaedics and internal medicine specialists completed the patient cases for their own specialty only, whereas the general practitioners and the final-year medical students completed all three patient cases.

After the participants had made their treatment choice, they were given a list of drug choice-related factors (see below) that are mentioned in the literature as contributing to therapeutic decision-making [5, 6, 8–11]. The participants were asked to indicate to what extent each of the 14 factors had contributed to the choice of treatment for each patient case (0 = to no extent at all, 1 = to some extent, 2 = to a considerable extent, 3 = to a decisive extent).

Data collection and statistical analysis

The generic names of drugs were used, and prescribed drugs were classified into groups according to the Dutch Pharmacotherapy Compendium [12]. The primary outcome scores on drug choice-related factors were described by means including 95% confidence intervals. A one-way ANOVA in combination with a least-squared difference test was performed to investigate the differences in each drug choice-related factor among the students, general practitioners

Table 1 Summary of the written patient cases presented to the participants for choosing a (drug) treatment

Patient case	Uncomplicated (A) vs complicated (B)	Situated in general practice or the outpatient clinic
Bronchial asthma	A	Woman, age 22. History: -
		Currently: Acute asthma attack a few hours ago, lasting about 5min. Works in pet shop. Working diagnosis: bronchial asthma
	B	Woman, age 22. History: migraine for 6months. Takes acetaminophen 2×500mg and metoclopramide supp. 20mg during migraine attack. No attacks since using propranolol tab. 80mg daily
		Currently: Acute asthma attack a few hours ago, lasting about 5min. Works in pet shop. Working diagnosis: bronchial asthma
Osteoarthritis	A	Woman, age 63. History: -
		Currently: increasing pain in right knee for a few weeks. Working diagnosis: osteoarthritis
	B	Woman, age 61. History: osteoarthritis in right knee for 10years. Ibuprofen tab. 400mg when necessary for 1year; no pain
		Currently: stomach pain for 7days. Working diagnosis: NSAID-related gastric symptoms
Essential hypertension	A	Woman, age 52. History: -
		Currently: high blood pressure detected during a sports physical examination. No complaints. Now: BP 160/105 mmHg. Working diagnosis: essential hypertension
	B	Man, age 62. History: myocardial infarction in 1999. Since then: atenolol 50mg daily, acetosal 80mg daily. Six weeks ago: recurrent high blood pressure 170/105mmHg; diet and exercise advice
		Currently: control visit: BP 170/100mmHg. Working diagnosis: essential hypertension, after 6weeks of not responding to diet, exercise advice and atenolol

Table 2 The treatments prescribed (%) by students, general practitioners and specialists for the uncomplicated (A) and complicated (B) cases

			Final-year medical students (n=32)	Percentage	General practitioners (n=29)	Percentage	Clinical specialists (n=26, 24, 24)	Percentage
Bronchial asthma	A	1	β_2 agonist	90	β_2 agonist	94	β_2 agonist	52
		2	β_2 agonist + steroid	5	β_2 agonist + steroid	6	β_2 agonist + steroid	44
		3	Other	5			Other	4
	B	1	β_2 agonist	40	β_2 agonist	41	β_2 agonist + steroid	40
		2	Steroid	25	β_2 agonist + steroid	24	β_2 agonist	20
		3	B_2 agonist + steroid	20	β_2 agonist + steroid + stop beta antagonist	24	β_2 agonist + stop beta antagonist	8
		4	Other	15	Other	11	β_2 agonist + steroid + stop beta antagonist	8
							β_2 agonist + steroid + prednisone	8
							Other	16
Osteoarthritis	A	1	Prostaglandin inhibitor	60	Non-opioid analgesics	53	Prostaglandin inhibitor	70
		2	Non-opioid analgesics	25	Prostaglandin inhibitor	30	Prostaglandin inhibitor + PPI	13
		3	Prostaglandin inhibitor + PPI	15	Prostaglandin inhibitor + PPI	17	Non-opioid analgesics	13
							Other	4
	B	1	PPI	40	Non-opioid analgesics	61	PPI	35
		2	Prostaglandin inhibitor + PPI	35	Prostaglandin inhibitor + PPI	17	Non-opioid analgesics	22
		3	Prostaglandin inhibitor	10	Prostaglandin inhibitor	11	Prostaglandin inhibitor + PPI	17
		4	Opioid	5	PPI	11	Prostaglandin inhibitor	13
		5	Other	10			Other	13
Essential hypertension	A	1	Diuretics	50	Diuretics	42	Beta antagonist	36
		2	Beta antagonist	41	Lifestyle advice	27	Diuretics	28
		3	Lifestyle advice	9	Beta antagonist	26	Lifestyle advice	24
					ACE inhibitor	5	ACE inhibitor	8
							Calcium antagonist	4
	B	1	Diuretics	46	Beta antagonist	48	Beta antagonist	44
		2	ACE inhibitor	23	Diuretics	26	ACE inhibitor	24
		3	Beta antagonist	18	ACE inhibitor	21	Diuretics	12
		4	Lifestyle advice	9	Lifestyle advice	5	Beta antagonist + diuretics	12
		5	Other	4			Other	8

PPI Proton pump inhibitor

and clinical specialists. We also compared the students versus medical teachers (i.e. general practitioners and specialists). The model assumptions were investigated by residual analysis. A P-value <0.05 was considered statistically significant. Statistical analyses were performed using SPSS 15.0 (SPSS, Chicago, IL).

Results

Thirty-two final-year medical students, 29 general practitioners and 74 clinical specialists (26 lung specialists, 24 orthopaedic surgeons and 24 internists) participated in the study. They prescribed 128, 116 and 148 drug and non-drug treatments respectively (see Table 2). In general, the drugs prescribed by medical students and general practitioners were similar, whereas clinical specialists prescribed relatively more potent drugs out of a broader range of drug classes.

The contribution of the various factors to the drug choice of the students, general practitioners and clinical specialists is shown in Table 3. Since there was no difference in the factors influencing the choice of treatment for A and B cases, the scores of the two versions were pooled. Students based their drug choice to a considerable extent (mean score ≥2 on a scale of 0–3) on the factors 'effectiveness of the drugs' and 'examples from clinical teachers'. In

Table 3 Importance of factors affecting drug choice, as rated by students, general practitioners and clinical specialists

	Final-year medical students (n=32)	General practitioners (n=29)	Clinical specialists (n=26, 24, 24)	ANOVA overall p-value
Practice-related factors				
Own clinical experience	1.59 (1.40–1.79)	2.32 (2.19–2.45)[b]	2.06 (1.94–2.17)[b]	<0.001
Easy administration of the drug(s)	1.00 (0.83–1.17)	1.08 (0.88–1.29)	0.92 (0.77–1.07)	0.34
Patients' convenience	1.57 (1.39–1.76)	1.90 (1.73–2.06)[b]	1.83 (1.70–1.96)[b]	0.013
Compliance of the patient	1.44 (1.28–1.60)	1.79 (1.62–1.96)[b]	1.78 (1.64–1.91)[b]	0.002
Drug-related factors				
Effectiveness of the drug(s)	2.19 (2.07–2.31)	2.28 (2.14–2.41)	2.50 (2.40–2.60)[b]	<0.001
Side effects of the drug(s)	1.55 (1.38–1.73)	2.19 (2.01–2.37)[b]	2.00 (1.86–2.13)[b]	<0.001
Costs of the drug(s)	0.88 (0.72–1.04)	1.40 (1.21–1.59)[b]	0.96 (0.83–1.09)	<0.001
Therapeutic spectrum of the drug(s)	1.05 (0.89–1.21)	1.64 (1.44–1.84)[b]	1.67 (1.52–1.82)[b]	<0.001
Information-related factors				
Standard treatment guidelines (STG)	1.98 (1.82–2.14)	2.17 (1.99–2.35)	1.73 (1.58–1.87)[b]	<0.001
Scientific literature	1.23 (1.05–1.48)	1.51 (1.31–1.71)	2.10 (1.98–2.23)[b]	<0.001
The opinion of colleagues	1.18 (1.02–1.34)	0.78 (0.60–0.95)[b]	1.10 (0.97–1.24)	0.001
Information from the pharmaceutical industry	0.60 (0.45–0.74)	0.34 (0.23–0.46)[b]	0.81 (0.69–0.93)[b]	<0.001
Teaching-related factors				
Examples from clinical teachers	2.06 (1.93–2.20)[a]	0.60 (0.45–0.76)	1.08 (0.93–1.23)	<0.001
Education and postgraduate education	1.30 (1.11–1.48)	1.68 (1.50–1.86)[b]	1.30 (1.15–1.44)	0.003

Pooled data are presented as mean (95% CI). Differences among groups were analysed by means of the least-squared difference test: [a] $P<0.05$ students vs. general practitioners and clinical specialists, [b] $P<0.05$ vs. students

Factors with a score of score ≥2 on a scale of 0–3 were considered to have contributed to a considerable extent to the drug choice

contrast, both general practitioners and clinical specialists based their drug choice to a considerable extent on the factors 'clinical experience', 'effectiveness of the drug(s)', and 'side effects of the drug(s)'. In addition, general practitioners based their drug choice to a considerable extent on 'standard treatment guidelines' and clinical specialists on 'scientific literature'.

Students attached significantly more importance to 'examples from clinical teachers' when making their treatment choice than did the general practitioners and clinical specialists, whereas general practitioners and clinical specialists placed more emphasis on three practice-related factors ('own clinical experience', 'patients' convenience' and 'compliance of the patient') and two drug-related factors ['side effects of the drug(s)' and 'therapeutic spectrum of the drug(s)']. Besides this, the general practitioners attached significantly more importance to the drug choice-related factors 'costs of the drug(s)' and 'education and postgraduate education' compared to the students, whereas the clinical specialists rated the drug-related factors 'effectiveness of the drug(s)', 'scientific literature', and 'information from the pharmaceutical industry' significantly higher than the students.

Discussion

We found that medical teachers base their drug choice mainly on the factors 'clinical experience', 'effectiveness of the drug(s)', 'side effects of the drug(s)', 'standard treatment guidelines' and 'scientific literature', whereas final-year medical students base their drug choice mainly on the factors 'effectiveness of the drug(s)' and 'examples from clinical teachers'. That medical teachers base their choice mainly on 'clinical experience' is consistent with theories from cognitive psychology about how clinical (diagnostic) expertise is achieved [2, 3, 13]. During everyday practice, doctors build up so-called cognitive networks of organised (therapeutic) knowledge and expertise [3], generating readily accessible treatment scripts. When a doctor is presented with a patient with one or more ailments, a specific treatment script is selected, depending on the level of complexity of the problem and the doctor's prior experience. This selection is done subconsciously when the medical problem is simple but occurs in a conscious and analytical way when the medical problem is complex.

While both medical teachers and medical students based their choice of treatment on the 'effectiveness of the drug (s)', students' knowledge of drug effectiveness is mainly theoretical, since they have little or no prescribing experience, whereas medical teachers' knowledge of drug effectiveness is both theoretical and practical, based on the response of other patients to the medication in question. The same also holds for drug side effects: students have theoretical knowledge whereas medical teachers have both theoretical and practical knowledge. This practical knowledge gained through experience is probably why medical teachers rated this factor significantly higher than medical students.

Clinical specialists, in contrast to the general practitioners, rated the drug choice-related factor 'scientific literature' significantly higher than medical students. This might reflect a difference in patient populations seen by the two groups of medical teachers. Clinical specialists are accustomed to treating more complicated and severely ill patients who are, for the most part, referred by the general practitioner. In these cases, they frequently prescribe more potent and newer drugs [14]. Clinical specialists learn about these new drugs (mostly before their launch) from drug company advertising, the literature or at meetings [15]. This could account also, at least partly, for the significantly higher value assigned by clinical specialists to the drug choice-related factor 'information from the pharmaceutical industry'. General practitioners, in contrast to clinical specialists, based their drug choice to a considerable extent on the drug choice-related factor 'standard treatment guidelines'. These guidelines, which have been formulated for many common ailments and diseases, provide evidence-based recommendations for the treatment of 'standard' patients. In the Netherlands, general practitioners have a so-called gatekeeper function with regard to specialist care, and the use of national guidelines ensures a more uniform referral practice. Conversely, clinical specialists might possibly adhere more to international guidelines.

That students nearing graduation based their treatment choices on the example of their medical teachers is consistent with the copying behaviour of medical students [16, 17]. Medical students have little opportunity to gain therapeutic experience, and so their reliance on the example of their teachers is not surprising. This means that clinical teachers need to explain the arguments underlying their treatment choice explicitly to their students [18, 19].

Before interpreting the results, the strengths and limitations of this study need to be addressed. As far as we know, this is the first nationwide study to investigate whether there are differences between medical students and their teachers in how they choose a medication. While we included 103 clinical teachers, we had only 32 final-year students. This was unfortunately inevitable because data collection occurred at one moment during the students' final clerkship, general practice. However, the students were recruited from all eight medical schools in the Netherlands, and since there were no significant differences in baseline characteristics (i.e. gender, age, etc.) or mean examination score during training, it is very likely that the included population was representative. Lastly, it may not be possible to generalise these results to medical students and teachers in other countries because of differences between medical curricula in various countries. However, our findings may be generalisable to medical students in countries that have a sequentially designed medical curriculum as in the Netherlands.

In conclusion, we found that final-year medical students base their prescribing choices on the examples of their teachers. To improve rational prescribing, medical curricula should pay more attention not only to diagnostic reasoning but also to therapeutic reasoning. Incorporation of specific clinical pharmacology and therapeutics courses into the medical curriculum [20] may help students bridge the gap between (pre-clinical) theoretical learning and (clinical) practical learning, and between undergraduate and post-graduate training. Presenting students with clinical therapeutic problems early during undergraduate training will not only give them a chance to gain experience in solving medical problems but will also give meaning to what they are studying as opposed to merely reproducing what they learn or copying what they are told [21, 22]. Replication of our findings in further studies might provide more insight into the process of therapeutic reasoning and contribute to optimisation of the therapeutic training of our future doctors.

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