Junior doctor-led 'near-peer' prescribing education for medical students

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WHAT IS ALREADY KNOWN ON THIS SUBJECT

- Avoidable adverse drug reactions and prescribing errors are common.
- Independent studies suggest that undergraduate prescribing education may be insufficient to meet the challenges of modern healthcare.
- Specific teaching in prescribing has been shown to improve prescribing performance, but most studies have focused on teaching by senior clinicians.

WHAT THIS STUDY ADDS

- 'Near-peer' prescribing tutorials increased the self-reported confidence, knowledge and prescribing skills of the participating students.
- Tutors reported that participation in the programme improved their prescribing and also their ability to teach.
- Most students preferred prescribing training delivered by junior doctors rather than their more senior colleagues.

AIMS

Prescribing errors are common and inadequate preparation of prescribers appears to contribute. A junior doctor-led prescribing tutorial programme has been developed for Edinburgh final year medical students to increase exposure to common prescribing tasks. The aim of this study was to assess the impact of these tutorials on students and tutors.

METHODS

One hundred and ninety-six tutorials were delivered to 183 students during 2010–2011. Each student completed a questionnaire after tutorial attendance which explored their previous prescribing experiences and the perceived benefits of tutorial attendance. Tutors completed a questionnaire which evaluated their teaching experiences and the impact on their prescribing practice. Student tutorial attendance was compared with end-of-year examination performance using linear regression analysis.

RESULTS

The students reported increased confidence in their prescribing knowledge and skills after attending tutorials. Students who attended more tutorials also tended to perform better in end-of-year examinations (Drug prescribing: $r = 0.16$, $P = 0.015$; Fluid prescribing: $r = 0.18$, $P = 0.007$). Tutors considered that participation enhanced their own prescribing knowledge and skills. Although they were occasionally unable to address student uncertainties, 80% of tutors reported frequently correcting misconceptions and deficits in student knowledge. Ninety-five percent of students expressed a preference for prescribing training delivered by junior doctors over more senior doctors.

CONCLUSIONS

A 'near-peer' junior doctor-led approach to delivering prescribing training to medical students was highly valued by both students and tutors. Although junior doctors have relatively less clinical experience of prescribing, we believe that this can be addressed by training and academic supervision and is outweighed by the benefits of these tutorials.

Introduction

Avoidable adverse drug reactions and prescribing errors are common in hospitals and are a threat to patient safety [1–4]. A study commissioned by the UK General Medical Council showed that nearly one out of every 10 hospital prescriptions contained errors, and that most are made by the most inexperienced doctors, recently graduated from medical school [5, 6].

There have been concerns that undergraduate medical education may not provide sufficient emphasis on the principles of clinical pharmacology, knowledge of drugs and therapeutics, practical prescribing skills and supervised experience to meet the demands of being a junior doctor prescriber in a busy hospital setting [7, 8]. This may make it hard for students to make the rapid transition from student learner to busy hospital prescriber and may contribute to the sense of uncertainty felt by many new graduates [6, 8, 9]. Systematic analysis of medication errors cites inadequate training as an important contributing factor [6, 10–14]. The increasing recognition of the importance of improving education in this area is supported by accumulating evidence that dedicated teaching for prescribing improves performance [15–21].

Recognizing that junior doctors take responsibility for writing the majority of prescriptions in UK hospitals and that final year students, who are their immediate successors, often fail to get practical experience of prescribing, a 'near-peer' prescribing education programme was established in South East Scotland to bring these two groups together [22]. This programme was developed 5 years ago by collaboration between junior doctors and medical education staff who developed a series of commonly encountered clinical cases which were then used to deliver practical prescribing tutorials to final year medical students in a classroom environment. This programme aims to provide experience of prescribing and build confidence amongst senior medical students, whilst empowering junior doctors to develop as clinical teachers and achieve the teaching requirements of the Foundation Programme curriculum.

The aims of this study were (i) to evaluate the impact of this near-peer prescribing tutorial programme on the confidence and prescribing abilities of final year medical students and (ii) to explore the experience of junior doctor tutors in providing tutorials and the benefits and challenges of delivering this teaching.

Methods

Description of programme

Interactive small group tutorials were delivered by first and second (Foundation) year doctors to final year medical students at the University of Edinburgh. Junior doctor volunteers were first required to attend a tutor training day

consisting of focused training workshops in teaching (including the principles of how people learn, clinical teaching, small group teaching and academic feedback), and simulation of prescribing tutorial sessions under the guidance of expert tutors from previous academic years. The tutorials were based on 10 acute clinical prescribing scenarios (Table 1). Tutorials lasted 1 h and were delivered throughout the academic year. Foundation doctors decided in advance which of the 10 scenarios they wished to deliver and then advertised tutorials for medical students to sign-up to on their online learning environment. A maximum of eight students were allowed to attend each tutorial in order to maximize the educational value for each. Participation in the tutorial scheme was voluntary and students attended whenever they did not have formal teaching elsewhere. Each tutorial began with discussion of a clinical vignette (an example is provided in Figure 1), which included the history, examination and investigations, before agreement was reached on the principles of clinical management. Students were then invited to prescribe their management on the drug administration and fluid prescription charts. These charts were then reviewed by the tutor and individual feedback was provided to each student to optimize all aspects of their prescribing for the given scenario (including drug choices, dose, route, frequency, duration, legibility, consideration of allergy status and completion of therapeutic plan). Tutors also provided general feedback to the group on prescribing practice, in particular with reference to a local guideline on gold standard prescription writing [23] which reflects the British Pharmacological Society's 'Ten Principles of Good Prescribing' [24]. The tutorials concluded with a discussion about further patient management and relevant prescribing principles.

Programme evaluation

Students were asked to complete a questionnaire at the end of each tutorial delivered during 2010–2011. This contained their student matriculation number (for further analysis) although it was not possible to reveal the identity of students from these data. The questionnaire explored their prior experiences and attitudes towards prescribing,

Table 1

The 10 different tutorial topics that were covered by the prescribing tutorials

Acute medical emergencies	Acute surgical emergencies
Acute dyspnoea	Acute appendicitis
Acute left ventricular failure	Gastrointestinal bleeding
Anaphylaxis	Intestinal obstruction
Diabetic ketoacidosis	Road traffic accident (major trauma)
Hyperkalaemia	
Paediatric prescribing	

Diabetes ketoacidosis

You are the FYI doctor on the medical admissions unit and are seeing a 19 year old girl who has come in with shortness of breath, abdominal pain and vomiting. She is too confused to give you much history, but her mother tells you she has recently been in bed with a diarrhoeal infection, and has been passing large volumes of urine.

Examination *She looks dehydrated and is taking rapid, deep breaths*

Findings *There is an unusual smell on her breath. GCS 14 (E₄ V₄ M₆)*

Observations *SpO₂ 98% (R/A), RR 30, HR 128, BP 104/68, T 38.2°C*

Capillary blood glucose 'high', i.e. unrecordable

Urinalysis *Ketones +++*

ABG *H⁺ 52 nmol l⁻¹, PaO₂ 18 kPa, PaCO₂ 3.9 kPa, HCO₃⁻ 14.2 mmol l⁻¹,*

Bloods *Hb 143 g l⁻¹, WCC 13.4×10⁹/l (neutrophils 11×10⁹/l), Plt 324×10⁹/l*

Urea 5.4 mmol l⁻¹, Cr 101 μM, Na 136 mmol l⁻¹, K 5.0 mmol l⁻¹

LFTs, amylase normal. CRP 29 mg l⁻¹

ECG *Sinus tachycardia*

Figure 1

Example case vignette for a patient with diabetes ketoacidosis. The students discussed the clinical management before being asked to prescribe relevant medications and fluids

their experience of participating in the tutorial and the perceived impact of this training on their future prescribing. Tutors were asked to complete an anonymized questionnaire about their experience of teaching on the prescribing programme at the end of the academic year. This explored their experiences of the tutor training day prior to delivering teaching, their experience of teaching over the year and the perceived impact of their participation on their future teaching and prescribing practice. All questionnaire data were collected using a five point Likert scale and the mean for each question was calculated (out of a total of five).

The association between tutorial attendance and end-of-year examination performance in 2010–2011 was assessed by linking the student matriculation numbers with summative assessment outcomes. The undergraduate administration provided an anonymized spreadsheet with results broken down by individual components of the final assessments (drug prescribing station, fluid prescribing station, an on-line examination 'Safety in Practice and Prescribing', history taking station, clinical examination station and an oral examination which assessed 'vertical

themes' within the curriculum including clinical communication and medical ethics). The prescribing stations assessed the same principles of prescribing which were reviewed in tutorials, although the clinical scenarios differed. The students' examination performance was analysed using linear regression which has been presented as a correlation coefficient with two-tailed *t*-test (*P* < 0.05 was considered statistically significant). Approval for this study was granted by the University of Edinburgh's Advisory Committee on the use of Student Volunteers.

Results

Student participation

One hundred and eighty-three (81%) of final year medical students at the University of Edinburgh attended at least one of the 196 tutorials which were delivered between September 2010 and May 2011. Students attended between one and 10 tutorials throughout the academic year. An average of 6.1 students attended each tutorial.

One thousand and thirteen questionnaires were returned by attendees in total (86% response rate).

Overall quality of tutorials

Students were asked to rate the overall quality of prescribing tutorials: 75% reported them as 'excellent', 23% as 'very good', 2% as 'good' and no students reported them to be either 'average' or 'poor'.

Student benefits from tutorial attendance (Table 2)

Few students reported that they felt confident in prescribing for a given scenario before attending that tutorial. However, after attending the tutorial most students reported improved confidence in prescribing for that scenario. The students also felt that attendance improved their prescribing knowledge and skills in general. Almost all students reported that the tutorials provided useful revision. Students also reported feeling happy with the feedback given to them. They also perceived a benefit from their teachers being junior doctors with 95% of students reporting that they believe junior doctors are the best group of staff to deliver these prescribing tutorials compared with senior doctors.

Impact of tutorial attendance on future prescribing practice (Table 2)

Most students had already written a drug administration chart under supervision in a clinical setting. Following attendance at prescribing tutorials, students reported that they felt more likely to write drug administration charts before graduating. Ninety-nine percent of students were keen to attend further prescribing tutorials, and the

majority reported that attendance had made them more interested in teaching others in the future.

Student examination performance

Over 60% of students reported that their primary reason for attending the prescribing tutorials was to pass their examinations. At the end of the academic year the association between tutorial attendance and examination performance was analysed and students attending more tutorials tend to perform better in the prescribing components of their final examinations (a weak but significant association, Figure 2). Students attending more tutorials also tended to perform better in some assessments not directly related to prescribing (history taking $r = 0.17$, $P = 0.009$ and examination skills $r = 0.17$, $P = 0.011$ stations). However this was not significant for the viva examination where statistical significance was not reached ($r = 0.11$, $P = 0.090$).

Tutor participation

Thirty-seven junior doctors (30 Foundation year 1 and 7 Foundation year 2 doctors) delivered 196 prescribing tutorials over 2010–2011, with an average of 5.3 tutorials delivered per tutor (range 1–20 tutorials). All tutors returned their questionnaire at the end of the year.

Preparation and practicalities of delivering teaching (Table 3)

In preparation for teaching on the programme tutors attended a compulsory tutor training day. Eighty-one percent reported that this improved their teaching skills, although 24% would have liked additional teacher training. All tutors reported being able to teach at a time convenient to them. However, this was mostly in their own time as only 14% of tutors were able to teach during working hours. Of those who were able to teach during their working hours 64% were able to leave their 'bleep' (pager) with a colleague whilst teaching.

Experience of teaching (Table 3) All tutors enjoyed teaching and most felt confident when teaching on this programme. All tutors felt equipped to deliver useful feedback to their students. 80% of tutors frequently addressed important misunderstandings or deficits in student knowledge. However 32% of tutors were asked questions that they did not know the answer to throughout the year.

Tutor benefits from teaching (Table 3) Ninety-four percent of tutors perceived that their prescribing knowledge had improved and 80% considered their prescribing practice to be better as a result of teaching on this programme. All tutors reported feeling generally more confident as a clinical teacher and 94% felt more prepared to

Table 2

Mean Likert scores of perceived benefits of tutorial attendance for students and impact of tutorial attendance on future activities

I felt confident about prescribing for this scenario before the tutorial	2.80
I now feel confident about prescribing for this topic	4.38
The tutorial advanced my knowledge	4.55
The tutorial advanced my skills	4.46
The tutorial was useful revision	4.57
I was happy with the feedback given	4.50
Junior doctors are the best people to deliver these tutorials	4.48
I have written a drug chart on the ward before, under supervision	4.22
I am now more likely to help write a drug chart before graduating	4.32
I want to attend more tutorials	4.49
Attending these tutorials makes me interested in teaching others	4.73

Likert scores were 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree.

Figure 2

Correlation between tutorial attendance and performance in the end of year examinations (the three examinations which directly assessed prescribing skills: A) $r = 0.16$, $P = 0.015$; B) $r = 0.18$, $P = 0.007$; C) $r = 0.22$, $P = 0.001$

Table 3

Mean Likert scores of tutor training feedback, scheduling and experience of delivering tutorials, and perceived benefits of teaching

I found the tutor training day improved my teaching skills	4.12
I would have liked more teacher training than was provided	2.94
I was able to teach at a time convenient to me	4.25
I was able to teach during allocated work shifts	2.14
I was able to leave my 'bleep' (pager) with a colleague	2.26
I enjoyed teaching on this programme	4.69
I felt confident teaching final year medical students	4.28
I was able to provide good feedback to my students	4.31
I frequently addressed important misunderstandings or deficits in student knowledge	3.81
I was asked questions that I did not know the answer to	2.94
I have improved my prescribing knowledge by teaching	4.42
I have improved my prescribing practice by teaching	4.17
I feel more confident as a clinical teacher	4.47
I feel more prepared to teach	4.47
I have more enthusiasm for prescribing teaching	4.42
I want to do more to improve my teaching skills	4.56

Likert scores were 1 = Strongly disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, 5 = Strongly agree.

teach in the future. Ninety-one percent reported that they now have more enthusiasm for prescribing teaching and 97% would like to do more to improve their teaching skills.

Discussion

The major findings of our study were that (i) students and junior doctors both considered that their prescribing confidence had improved as a result of attending prescribing tutorials; ii) there was evidence of a positive association between tutorial attendance and examination performance; (iii) misconceptions and deficits in student knowledge seem to have been frequently addressed; (iv)

students expressed a preference for prescribing training delivered by junior doctors compared with senior doctors; and (v) the tutorials harnessed enthusiasm for future teaching for both students and tutors.

This prescribing tutorial programme seems to be greatly valued by local medical students and junior doctors. There are several benefits perceived by students from participating in prescribing tutorials. Firstly, their confidence in prescribing for specific scenarios and prescribing in general is improved. This helps to address previously expressed concerns about prescribing confidence as students make the transition to graduated prescribers [25]. Students also reported that they were more likely to prescribe under supervision for real patients following attendance at tutorials to consolidate learning. Our data provide evidence of an association between tutorial attendance and improved examination performance. This was particularly true of assessments which directly assessed prescribing skills, but also of other examinations which assessed history taking and clinical examination skills. This may be explained by the structure of prescribing tutorials which incorporate discussion of relevant history taking and clinical examination skills as part of the tutorial experience. However, the Viva examination results did not correlate with tutorial attendance in a statistically significant fashion, which is not surprising given that this assessment does not cover any of the principles or skills acquired during attendance at prescribing tutorials. Although this association exists, we cannot attribute a causal relationship and it is feasible that better performing students were more likely to attend tutorials. This is in keeping with previous literature [15–21]. However further research is required to determine to what extent such educational interventions directly influence subsequent prescribing performance. Tutors also seem to benefit from improved knowledge and confidence in both prescribing and teaching. This is partly related to the preparation undertaken

before teaching now that tutor training has become compulsory prior to delivering tutorials. This was made compulsory to provide further support to our tutors, to improve their teaching [26] and ensure best practice as per the General Medical Council recommendations [27, 28] on teacher training.

Tutors are encouraged to provide feedback to students, which students appreciate as this tutorial programme provides the opportunity for tailored feedback on prescribing practice which may not be available elsewhere during the curriculum. Many tutors reported that they frequently addressed student misconceptions and deficits in knowledge throughout the year that might otherwise have been carried through to clinical practice. This highlights the strength of these tutorials in identifying areas of uncertainty which could potentially otherwise predispose to medication errors. However, around one-third of tutors were asked questions by students which they were unable to answer at some stage over the academic year. As part of training, tutors are encouraged to be aware of their own limitations [29] and where unable to provide a definitive answer to students are advised where to direct the students to answer their query or to find out the answer and contact the students again at a later date.

Another benefit of this tutorial programme is that most medical students indicated that they preferred junior doctors to deliver this prescribing teaching compared with more senior colleagues, and these benefits of using junior doctors as teachers have been recognized elsewhere [30]. Possible reasons for this include the recent experience of junior doctors in the student's curriculum (most of the tutors had been through the same examinations only a year or two previously), the approachability of junior staff and ease with which students can ask questions, and the insights provided from junior doctors which they have recently learned 'on the job'. Furthermore junior doctors are responsible for most hospital based prescribing [31] and are perhaps the most appropriate group of doctors to deliver this form of teaching.

The tutorial programme also encourages the development of other professional skills amongst both students and tutors. Students reported that they are more interested in teaching as a result of participation in tutorials. Tutors feel more confident as clinical teachers and report being more prepared to teach in the future. They also reported more enthusiasm for prescribing teaching, which will help with ensuring the future sustainability of this programme. This may also encourage and promote the development of new initiatives which will further improve prescribing practice. However, most tutors are teaching in their own time outside of working hours and this may limit the opportunities for students to benefit from attending these tutorials, not only in terms of the number of potential tutorials being offered but also the timing students can attend. We encourage local education providers and edu-

cational deaneries to consider allocating dedicated teaching time for junior doctors to deliver prescribing education to medical students particularly as this is likely to improve patient safety, though we also recognize the challenges and priority of clinical service delivery.

A potential concern regarding our 'near-peer' model of prescribing training is that the junior doctor tutors lack professional teaching and prescribing experience and training and are a group known to perpetrate prescribing errors. We have taken several steps to mitigate these concerns. These include standardization of clinical vignettes, implementing a compulsory teacher training day and using post-tutorial student feedback to identify perceived limitations from the learner's perspective. In addition, the university lead for clinical pharmacology and prescribing education (SM) has provided academic supervision from the inception of this prescribing tutorial programme including review of tutorial content and tutor training. A further important point is that senior clinicians also make prescribing errors on a regular basis [5]. We believe that any concerns about the slightly higher error rate found between junior and senior prescribers is more than offset by the potential of junior doctor-led teaching to provide greatly enhanced workplace-based prescribing experience. Other potential strategies for ensuring quality in the future might include greater external review of the tutorials by senior trainers, better assessment of outcomes and enhanced tutor-tutor contact and discussion during the tutorial programme.

This study has several important limitations. First, although 81% of final year students attended tutorials, they were self-selected and so may not necessarily be representative of their year group. Factors which may have accounted for not all students attending these tutorials include the availability and timing of tutorials, some students preferring only staff teaching and some students feeling that the tutorials were not necessary. Second, questionnaires were completed immediately after each tutorial and, although responses would not have been attributable to a specific student, were collected by the tutor and so this may have influenced student responses. Third, we report the opinions of the tutors and students about the value of this programme but cannot know what the actual benefits are to tutors, students or patients.

In conclusion, this near-peer prescribing programme is a highly valued model for teaching clinical prescribing to medical students. The programme helps to address a significant unmet need for prescribing practice at a time when this has become more difficult due to busy clinical environments, and where job plans mean that senior clinicians are less able to provide a large number of small-group practical prescribing tutorials. The programme also encourages the development of additional professional skills, including interest in teaching others, which is important in ensuring the future sustainability of this teaching programme.

Competing Interests

All authors have completed the Unified Competing Interest form at http://www.icmje.org/coi_disclosure.pdf (available on request from the corresponding author) and declare no support from any organization for the submitted work, no financial relationships with any organizations that might have an interest in the submitted work in the previous 3 years and no other relationships or activities that could appear to have influenced the submitted work.

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REFERENCES

- 1 National Patient Safety Agency. Safety in Doses: Improving the Use of Medicines in the NHS. London: National Patient Safety Agency, 2009.
- 2 Bates DW, Cullen DJ, Laird N, Petersen LA, Small SD, Servi D, Laffel G, Sweitzer BJ, Shea BF, Hallisey R, Vleit MV, Nemeskal R, Leape LL, Bates D, Hojnowski-Diaz P, Petrycki S, Cotugno M, Patterson H, Hickey M, Kleeefield S, Cooper J, Kinneally E, Demonaco HJ, Clapp MD, Gallivan T, Ives J, Porter K, Thompson BT, Hackman JR, Edmondson A. Incidence of adverse drug events and potential adverse drug events. Implications for prevention. ADE Prevention Study Group. JAMA 1995; 274: 29–34.
- 3 Davies EC, Green CF, Taylor S, Williamson PR, Mottram DR, Pirmohamed M. Adverse drug reactions in hospital in-patients: a prospective analysis of 3695 patient-episodes. PLoS ONE 2009; 4: e4439.
- 4 Tully MP. Prescribing errors in hospital practice. Br J Clin Pharmacol 2013; 74: 668–75.
- 5 Dornan T, Ashcroft D, Heathfield H, Lewis P, Miles J, Taylor D, Tully M, Wass V. An in Depth Investigation into Causes of Prescribing Errors by Foundation Trainees in Relation to Their Medical Education. EQUIP Study. London: General Medical Council, 2009.
- 6 McLellan L, Tully MP, Dornan T. How could undergraduate education prepare new graduates to be safer prescribers? Br J Clin Pharmacol 2012; 74: 605–13.
- 7 Heaton A, Webb DJ, Maxwell SR. Undergraduate preparation for prescribing: the views of 2413 UK medical students and recent graduates. Br J Clin Pharmacol 2008; 66: 128–34.
- 8 Rothwell C, Burford B, Morrison J, Marrow G, Allen M, Davies C, Baldauf B, Spencer J, Johnson N, Peile E, Illing J. Junior doctors prescribing: enhancing their learning in practice. Br J Clin Pharmacol 2012; 73: 194–202.
- 9 Ellis A. Prescribing rights: are medical students properly prepared for them? BMJ 2002; 324: 1591.
- 10 Dean B, Schachter M, Vincent C, Barber N. Causes of prescribing errors in hospital inpatients: a prospective study. Lancet 2002; 359: 1373–8.
- 11 Leape LL, Bates DW, Cullen DJ, Cooper J, Demonaco HJ, Gallivan T, Hallisey R, Ives J, Laird N, Laffel G, Nemeskal R, Petersen LA, Porter K, Servi D, Shea BF, Small SD, Sweitzer BJ, Thompson BT, Vleit MV, Bates D, Hojnowski-Diaz P, Petrycki S, Cotugno M, Patterson H, Hickey M, Kleeefield S, Kinneally E, Clapp MD, Hackman JR, Edmondson A. Systems analysis of adverse drug events. ADE Prevention Study Group. JAMA 1995; 274: 35–43.
- 12 Schachter M. The epidemiology of medication errors: how many, how serious? Br J Clin Pharmacol 2009; 67: 621–3.
- 13 Velo GP, Minuz P. Medication errors: prescribing faults and prescription errors. Br J Clin Pharmacol 2009; 67: 624–8.
- 14 Fitzgerald RJ. Medication errors: the importance of an accurate drug history. Br J Clin Pharmacol 2009; 67: 671–5.
- 15 Garbutt JM, DeFer TM, Highstein G, McNaughton C, Milligan P, Fraser VF. Safe prescribing: an educational intervention for medical students. Teach Learn Med 2006; 18: 244–50.
- 16 Scobie SD, Lawson M, Cavell G, Taylor K, Jackson SH, Roberts TE. Meeting the challenge of prescribing and administering medicines safely: structured teaching and assessment for final year medical students. Med Educ 2003; 37: 434–7.
- 17 Langford NJ, Martin U, Kendall MJ, Ferner RE. Medical errors. Medical schools can teach safe drug prescribing and administration. BMJ 2001; 322: 1424.
- 18 Vollebregt JA, Metz JC, de Haan M, Richir MC, Hugtenburg JG, de Vries TP. Curriculum development in pharmacotherapy: testing the ability of preclinical medical students to learn therapeutic problem solving in a randomized controlled trial. Br J Clin Pharmacol 2006; 61: 345–51.
- 19 Likic R, Maxwell SR. Prevention of medication errors: teaching and training. Br J Clin Pharmacol 2009; 67: 656–61.
- 20 Sandilands EA, Reid K, Shaw L, Bateman DN, Webb DJ, Dhaun N, Kluth DC. Impact of a focused teaching programme on practical prescribing skills among final year medical students. Br J Clin Pharmacol 2010; 71: 29–33.
- 21 Ross S, Loke YK. Do educational interventions improve prescribing by medical students and junior doctors? A systematic review. Br J Clin Pharmacol 2009; 67: 662–70.
- 22 Rodrigues J, Sengupta A, Mitchell A, Kane C, Kane C, Maxwell S, Cameron H, Ross M, Ford M. The Southeast Scotland Foundation Doctor Teaching Programme—is ‘near-peer’ teaching feasible, efficacious and sustainable on a regional scale? Med Teach 2009; 31: e51–7.
- 23 NHS Lothian Drug and Therapeutics Committee. Golden Rules for Prescription Writing. In: Prescribing Bulletin 1. Edinburgh: NHS Lothian, 2002.
- 24 British Pharmacological Society. Ten Principles of Good Prescribing. London: British Pharmacological Society, 2010.

- 25** Lempp H, Seabrook M, Cochrane M, Rees J. The transition from medical student to doctor: perceptions of final year students and preregistration house officers related to expected learning outcomes. *Int J Clin Pract* 2005; 59: 324–9.
- 26** Steinert Y, Mann K, Centeno A, Dolmans D, Spencer J, Gelula M, Prideaux D. A systematic review of faculty development initiatives designed to improve teaching effectiveness in medical education: BEME Guide No. 8. *Med Teach* 2006; 28: 497–526.
- 27** General Medical Council. *Developing Teachers and Trainers in Undergraduate Medical Education*. London: General Medical Council, 2011.
- 28** General Medical Council. *Tomorrow's Doctors*. London: General Medical Council, 2009.
- 29** Busari JO, Scherpbier AJ. Why residents should teach: a literature review. *J Postgrad Med* 2004; 50: 205–10.
- 30** Remmen R, Denekens J, Scherpbier AJ, Hermann I, van der Vleuten C, Royen PV, Bossaert L. An evaluation study of the didactic quality of clerkships. *Med Educ* 2000; 34: 460–4.
- 31** Smith J. *Building A Safer NHS for Patients: Improving Medication Safety*. London: Department of Health, 2004.