

Anthony J Avery, Sarah Rodgers, Bryony Dean Franklin, Rachel A Elliott, Rachel Howard, Sarah P Slight, Glen Swanwick, Richard Knox, Gill Gookey, Nick Barber and Aziz Sheikh

Research into practice:

safe prescribing

AJ Avery, DM, FRCGP, professor of primary health care, University of Nottingham, Nottingham. **S Rodgers**, BSc(Hons), PhD, senior research fellow, University of Nottingham, Nottingham. **B Dean Franklin**, BPharm, MSc, PhD, executive lead pharmacist (research) & director, Centre for Medication Safety and Service Quality, Imperial College Healthcare NHS Trust, and UCL School of Pharmacy, London. **RA Elliott**, MPharm, PhD, Lord Trent professor of medicines and health, University of Nottingham, Nottingham. **R Howard**, BPharmHon, PhD, independent research pharmacist, Isle of Wight. **SP Slight**, MPharm, PhD, PGDip, senior lecturer in pharmacy practice, Durham University, Durham.

G Swanwick, public and patient representative, University of Nottingham, Nottingham. **R Knox**, BMedSc, MMedSc(Med Edu), MBChB, clinical lecturer, University of Nottingham, Nottingham.

G Gookey, BPharm, primary care pharmacist, NHS Rushcliffe CCG, Nottingham, Nottingham.

N Barber, BPharm, PhD, FRPharms, director of research, The Health Foundation, London.

A Sheikh, BSc, MBBS, MSc, MD, professor of primary care research & development, University of Edinburgh, and Visiting Professor of Medicine, Harvard Medical School, Boston, MA, US.

Address for correspondence

Anthony Avery, Division of Primary Care, School of Medicine, University of Nottingham Medical School, Queens Medical Centre, Nottingham, NG7 2UH.

E-mail: tony.avery@nottingham.ac.uk

Submitted: 30 March 2014; **final acceptance:** 3 April 2014.

©British Journal of General Practice 2014; 64: 259–261.

DOI: 10.3399/bjgp14X679895

PREVALENCE, NATURE, AND CAUSES OF PRESCRIBING ERRORS IN GENERAL PRACTICE

Over the past 10 years our team has been involved in a wide range of studies of prescribing in general practice, but one we feel that has really made a difference is the PRACTiCe study, which was funded by the General Medical Council.^{1,2} In this study we took a sample of 15 general practices across England and did a retrospective review of the clinical records of a random sample of over 1700 patients, and over 6000 prescription items. Using a definition of error that focused on clinically important problems,¹ we found that one in 20 (5%) prescription items was associated with one or more prescribing or monitoring errors, and that one in 550 prescription items contained what we regarded as a severe error¹ (with seriously inadequate monitoring of patients taking warfarin the biggest culprit). We found that per prescription item, errors were more common in children and older people, and that nearly half of patients receiving >10 items over the course of a year were the recipients of an error. The commonest types of error related to incomplete information on the prescription, dose-strength errors, and timing-frequency errors.

Using interviews, root cause analyses and focus groups, we explored the underlying causes of the errors and, not surprisingly, found them to be multifactorial.² Of the various underlying causes, we felt that several were amenable to intervention, including improving safety systems in general practices; making best use of our electronic prescribing systems, including computerised clinical decision support; improving prescribing and monitoring at the interface between primary and secondary care, and better training for GPs in therapeutics and safe prescribing (accepting that most GPs already have good therapeutic knowledge and are highly committed to patient safety). We made

a number of recommendations from our research and have taken several of these forward as described later in this article, and in Box 1.

PREVENTABLE DRUG-RELATED HOSPITAL ADMISSIONS

Not all prescribing errors in general practice lead to patient harm, but some of the most serious errors are associated with preventable drug-related hospital admissions. In a study of over 4000 patients admitted to a large teaching hospital in Nottingham, UK, we found that 6.5% of these admissions were judged to be drug-related and two-thirds to be preventable.³ We did a systematic review of similar studies across the world which showed a median of 3.7% (range 1.4–15.4) of admissions were drug-related and preventable.⁴

As part of this study we also identified the types of drug most commonly associated with preventable hospital admissions. What is striking about these findings is that just four classes of drug (antiplatelet agents, diuretics, non-steroidal anti-inflammatories, and anticoagulants) accounted for over 50% of preventable drug-related admissions, and these, together with opioid analgesics, beta-blockers, drugs acting on the renin-angiotensin system, drugs used in diabetes, positive inotropes such as digoxin, and corticosteroids, accounted for 75% of these admissions. This provides useful information for GPs wanting to know which drugs they need to prescribe and monitor with particular care.

PRESCRIBING SAFETY INDICATORS

Our team has done a lot of work to identify prescribing safety indicators for use in general practice. These are scenarios which represent potentially unsafe (or inappropriate) prescribing, and examples are shown in Box 2. Their purpose is to improve safety by identifying patients at risk so that prescribing problems can be tackled before patients come to harm.

Box 1. Selected recommendations from GMC-funded PRACTiCe study, and actions taken

Recommendation	Action taken
Review the RCGP curriculum to give greater prominence to therapeutic knowledge, and the skills and attitudes needed for safe prescribing	Revisions made to 2013 RCGP curriculum with five new learning objectives added and revisions made to two existing learning objectives.
Develop an educational package highlighting key learning points from the PRACTiCe Study to support reflection and, where appropriate, for use in identifying GPs' personal development needs.	Educational package entitled 'Prescribing in General Practice' developed and launched on RCGP website January 2014: http://elearning.rcgp.org.uk/
Develop an educational package to enable GPs in training to assess the safety of their prescribing (for example, by structured examination of, and reflection on, a sample of their prescription items).	We are currently piloting and evaluating a pharmacist-led initiative to provide educational feedback on the prescribing of '100 prescriptions' for a sample of GPs in training.
Develop strategies for improving prescribing safety systems in general practices.	With the NIHR Greater Manchester Primary Care Patient Safety Translational Research Centre we are investigating how prescribing safety systems can be improved in general practices.
Help general practices to identify patients at risk from prescribing errors by conducting audits using prescribing safety indicators; correct problems identified using evidence-based approaches (such as support from pharmacists, as demonstrated in the PINCER trial ⁶).	Prescribing safety indicators from the PINCER trial made available to general practices to download and run on their GP computer systems: http://www.nottingham.ac.uk/primis/tools/audits/pincer.aspx
Make improvements to the prescribing safety features of GP computer systems.	The GP computer system, TPP SystmOne, introduced a raft of changes in response to the PRACTiCe report. ¹³

Box 2. Selection of prescribing safety indicators used in the PINCER trial⁶

1. Patients with a history of peptic ulcer who have been prescribed a non-selective non-steroidal anti-inflammatory drug without co-prescription of a proton-pump inhibitor.
2. Patients with a history of asthma who have been prescribed a beta-blocker.
3. Patients aged ≥ 75 years who have been prescribed an angiotensin converting enzyme inhibitor or a loop diuretic long term who have not had a computer-recorded check of their renal function and electrolytes in the previous 15 months.
4. Women with a past medical history of venous or arterial thrombosis who have been prescribed combined hormonal contraceptives.
5. Patients receiving methotrexate for at least 3 months who have not had a recorded full blood count or liver function test within the previous 3 months.
6. Patients receiving warfarin for at least 3 months who have not had a recorded check of their international normalised ratio within the previous 12 weeks.
7. Patients receiving lithium for at least 3 months who have not had a recorded check of their lithium concentrations in the previous 3 months.
8. Patients receiving amiodarone for at least 6 months who have not had a thyroid function test within the previous 6 months.

We have searched the literature for these prescribing safety indicators and used consensus building techniques with GPs to identify those considered appropriate for assessing the safety of prescribing in UK general practice.

We have recently published our latest set of 54 prescribing safety indicators in the *BJGP*.⁵ Practices can use these indicators to identify patients at risk from prescribing; we have also used this approach in the PINCER trial.⁶

GP COMPUTER SYSTEMS

Clinical computer systems have considerable potential to improve the safety of prescribing⁷ and yet research we did around 10 years ago for the National Patient Safety Agency showed major deficiencies in the safety features of the most commonly-used GP computer systems used at the time.⁸ We also showed that GP training was often inadequate in terms of learning about the safety features of clinical computer systems,⁹ and that GPs commonly admitted to overriding computerised alerts without properly checking them.¹⁰ This led us to work with the National Programme for IT in the NHS to identify evidence to support the use of computerised alerts and prompts to improve clinicians prescribing behaviour;⁷ reach consensus on the most important safety features for GP computer systems,¹¹ and advise on the best ways of designing and implementing medication safety alerts in clinical information systems.¹² We cannot be certain what impact this has had, but there have certainly been significant improvements in the safety features of GP computer systems in the past decade, with the leading systems taking note of suggestions made by ourselves and others. For example, as a result of the PRACTiCe study, TPP SystmOne implemented a range of new safety features to take account of our recommendations, such as warnings for clinicians who issue a repeat medication without appropriate tests.¹³

REDUCING PRESCRIBING ERRORS: THE PINCER TRIAL APPROACH

On the basis of our earlier research, we developed a pharmacist-led IT-based intervention aimed at reducing prescribing errors in general practices and evaluated this in the PINCER trial.⁶ The study involved searching GP computer systems to identify patients at risk from specific prescribing problems; examples of these are shown in Box 1. Seventy-two general practices were recruited to the study and all received feedback on the patients at risk with suggestions of how to deal with the problems identified. In the pharmacist-intervention arm of the trial, a pharmacist met with the practice and used educational outreach techniques to discuss the importance of the problems identified. The pharmacist then worked with the practice over a 12-week period to tackle the safety problems. The study showed that the pharmacist-led intervention was effective at reducing a range of medication errors at 6 and 12 months after the intervention, although the effects were less at 12 months.

Embedded qualitative work demonstrated that GPs and their teams trusted the pharmacists to be able to address the important prescribing and monitoring problems identified.¹⁴ Economic analysis has shown that the intervention is likely to be cost-effective.^{6,15}

There has subsequently been a lot of interest from a range of organisations, including the English Department of Health, in rolling out the PINCER intervention. In response to this, we have made a selection of the computer queries used in the PINCER trial (Box 1) freely available to UK general practices. At the time of writing, 1271 GP practices across 173 clinical commissioning groups have downloaded these computer queries to identify patients at risk. The tool is available at: <http://www.nottingham.ac.uk/primis/tools/audits/pincer.aspx>. In addition, the computer queries used in the PINCER trial have been incorporated into the clinical decision support software used in a number of GP clinical computer systems. We are currently conducting follow-on research to refine the PINCER intervention and further enhance its clinical and cost effectiveness.

IMPROVING GP EDUCATION AND TRAINING IN THERAPEUTICS AND SAFE PRESCRIBING

One of the recommendations from our PRACtICE study^{1,2} was to identify ways of improving GP education and training in therapeutics and safe prescribing. We have subsequently worked closely with the Royal College of General Practitioners (RCGP) and the NIHR Greater Manchester Primary Care Patient Safety Translational Research Centre (GMPCPSTRC) to address this.

The most important thing we have done is to draw on all the work we have done to date in order to develop learning materials for GPs. We produced six articles which were published in the August 2013 edition of *InnovAiT*, the RCGP journal for GPs in training. Subsequently, with support from the Medical Defence Union and NIHR GMPCPSTRC, we have developed e-learning materials on 'prescribing in general practice' which are hosted by the

RCGP e-learning site: <http://elearning.rcgp.org.uk/>. Five lessons are available, each emphasising a different aspect of safe prescribing. In the 6 weeks following the launch of the e-learning materials in January 2014, over 1200 GPs had accessed the course and the feedback so far has been very positive.

In addition, we have worked with the RCGP to make changes to the RCGP Curriculum in order to put greater emphasis on therapeutics and safe prescribing. These changes were introduced in August 2013. Furthermore, we have worked with MRCGP examiners to identify ways in which there might be greater emphasis on assessing therapeutic knowledge and prescribing skills, particularly in the Clinical Skills Assessment.

PATIENT SAFETY TOOLKIT PROJECT

With funding from NIHR School for Primary Care Research we have done a systematic review to identify tools used for assessing patient safety in primary care. Using an international expert panel, and the knowledge and experience of our project team, we have identified and piloted those tools that we think are most suitable for use in UK general practice. We are about to roll these tools out in 50 practices across England and then hope to make tools more widely available to other practices in the UK.

Provenance

Commissioned; not externally peer reviewed.

Competing interests

The authors have declared no competing interests.

Acknowledgements

We thank Rosie Hunt for her help with the submission of this manuscript.

Discuss this article

Contribute and read comments about this article: www.bjgp.org/letters

REFERENCES

1. Avery AJ, Ghaleb M, Barber N, *et al*. The prevalence and nature of prescribing and monitoring errors in UK general practice: a retrospective case note review. *Br J Gen Pract* 2013; DOI: 10.3399/bjgp13X670679.
2. Slight SP, Howard R, Ghaleb M, *et al*. The causes of prescribing errors in English general practices: a qualitative study. *Br J Gen Pract* 2013; DOI: 10.3399/bjgp13X673739.
3. Howard RL, Avery AJ, Howard PD, Partridge M. Investigation into the reasons for preventable drug related admissions to a medical admissions unit: observational study. *Qual Saf Health Care* 2003; **12**: 280–285.
4. Howard RL, Avery AJ, Slavenburg S, *et al*. Which drugs cause preventable admissions to hospital? A systematic review. *Br J Clin Pharmacol* 2007; **63**: 136–147.
5. Spencer R, Bell B, Avery AJ, *et al*. Identification of an updated set of prescribing-safety indicators for GPs. *Br J Gen Pract* 2014; DOI: 10.3399/bjgp14X677806.
6. Avery A, Rodgers S, Cantrill J, *et al*. Pharmacist-led information technology-enabled intervention for reducing medication errors: multi-centre cluster randomised controlled trial and cost-effectiveness analysis (PINCER Trial). *Lancet* 2012; **379**: 1310–1319.
7. Schedlbauer A, Prasad V, Mulvaney C, *et al*. What evidence supports the use of computerized alerts and prompts to improve clinicians' prescribing behavior? *J Am Med Inform Assoc* 2009; **16**(4): 531–538.
8. Fernando B, Savellych BSP, Avery AJ, *et al*. Prescribing safety features of general practice computer systems: evaluation using simulated test cases. *BMJ* 2004; **328**(7449): 1171–1172.
9. Morris CJ, Savellych BSP, Avery AJ, *et al*. Patient safety features of clinical computer systems: questionnaire survey of GP views. *Qual Saf Health Care* 2005; **14**: 164–168.
10. Magnus D, Rodgers S, Avery AJ. GPs' views on computerised drug interaction alerts: questionnaire survey. *J Clin Pharm Ther* 2002; **27**: 377–382.
11. Avery AJ, Savellych BSP, Sheikh A, *et al*. Identifying and establishing consensus on the most important safety features of GP computer systems: e-Delphi study. *Inform Prim Care* 2005; **13**(1): 3–12.
12. Phansalkar S, Edworthy J, Hellier E, *et al*. A review of human factors principles for the design and implementation of medication safety alerts in clinical information systems. *J Am Med Inform Assoc* 2010; **17**(5): 493–501.
13. TPP upgrades practice systems in wake of GMC prescribing error report. <http://www.pulsetoday.co.uk/tpp-upgrades-practice-systems-in-wake-of-gmc-prescribing-error-report/14447023.article#.UzHxEqhtdU> [accessed 14 Apr 2014].
14. Cresswell KM, Sadler S, Rodgers S, *et al*. An embedded longitudinal multi-faceted qualitative evaluation of a complex cluster randomised controlled trial aiming to reduce clinically important errors in medicines management in general practice. *Trials* 2012; **13**: 78.
15. Elliott RA, Putman KD, Franklin M, *et al*. Cost-effectiveness of a pharmacist-led information technology intervention for reducing rates of clinically important errors in medicines management in general practices (PINCER). *Pharmacoeconomics* 2014; DOI: 10.1007/s40273-014-0148-8.