

### What is already known on this topic

Prescription errors often occur because the prescriber does not have immediate access to relevant information relating to the drug or the patient

Computerised systems containing rules to prevent incorrect or inappropriate prescribing increase the appropriateness of drug treatment and reduce errors

Such systems have not been widely implemented because of difficulty providing decision support at patients' bedside

### What this study adds

A rules based system for prescribing and recording the administration of drugs that can be accessed from the patient's bedside through wireless terminals was introduced

Over 11 months the system stopped 58 unsafe prescriptions and gave over 700 high level warnings

The system was considered an improvement by most doctors and nurses

have been eliminated, and patients' prescriptions are always available. Prescriptions are checked against patient data as well as information on drug interactions and maximum recommended doses, which increases the likelihood that prescribing will be safe. The prescriptions abandoned as a result of warning messages constitute an important contribution to safety and patient care. We have also found that the system facilitates the introduction of treatment protocols into clinical care and makes audit of drug prescribing easy (data not shown).

Because the system has been designed to support clinical decision making rather than to control it, it has been well received by doctors, nurses, and pharmacists. It was seen as improving the effectiveness and safety of patient care. Most of the prescription warnings generated by the system are low level interaction warnings, which are usually overridden. However, the purpose of these warnings is to give information on potential interactions, which would otherwise have to be sought in a drug formulary. The warnings of drug interactions and contraindications reinforce users' knowledge of drugs.

We have not yet examined the effect of the introduction of the system on patient outcomes, but this is an important area for future study. Although the system is generic in concept and potentially applicable to any specialty, it is currently only in use in the renal unit, and its effectiveness in other settings remains to be examined.

We thank the staff of the Queen Elizabeth Hospital renal unit and pharmacy and the programming and development teams at Wolfson Computer Laboratory for their contributions to the design and implementation of the system.

Contributors: PGN designed the questionnaire, analysed all the data, and drafted the paper. DA, NTR, and MP initiated the introduction of the system and participated in the interpret-

ation of the data and writing the paper. PGN will act as guarantor.

Funding: None.

Competing interests: Since its development the system has been acquired by McKesson HBOC. Wolfson Computer Laboratory has a contract with McKesson HBOC to develop the system further and both the laboratory and the renal unit receive royalties from sales of the system. NTR and MP have been reimbursed by McKesson HBOC for attending several conferences.

- 1 Leape LL, Brennan TA, Laird N, Lawthers AG, Localio AR, Barnes BA, et al. The nature of adverse events in hospitalized patients: results of the Harvard medical practice study II. *N Engl J Med* 1991;324:377-84.
  - 2 Bates DW, Cullen DJ, Laird N, Petersen LA, Small SD, Servi D, et al. Incidence of adverse drug events and potential adverse drug events: implications for prevention. *JAMA* 1995;274:29-34.
  - 3 Ferner RE. Errors in prescribing and giving drugs. *Journal of the Medical Defence Union* 1992;8:60-3.
  - 4 Leape LL, Bates DW, Cullen DJ, Cooper J, Demoneco HJ, Gallivan T, et al. Systems analysis of adverse drug events. *JAMA* 1995;274:35-43.
  - 5 Lesar TS, Briceland LL, Delcours K, Parmalee JC, Masta-Gornic V, Pohl H. Medication prescribing errors in a teaching hospital. *JAMA* 1990;263:2329-34.
  - 6 Lesar TS, Briceland L, Stein DS. Factors related to errors in medication prescribing. *JAMA* 1997;277:312-7.
  - 7 Bates DW, Boyle DL, Vander Vliet M, Schneider J, Leape L. Relationship between medication errors and adverse drug events. *J Gen Intern Med* 1995;10:199-205.
  - 8 Wyatt J, Walton R. Computer based prescribing: improves decision making and reduces costs. *BMJ* 1995;311:1181-2.
  - 9 Schiff GD, Rucker TD. Computerized prescribing: building the electronic infrastructure for better medication usage. *JAMA* 1998;279:1024-9.
  - 10 Johnston ME, Langton KB, Haynes RB, Mathieu A. Effects of computer-based clinical decision support systems on clinician performance and patient outcome: a critical appraisal of research. *Ann Intern Med* 1994;120:135-42.
  - 11 Evans RS, Classen DC, Pestotnik SL, Lundsgaarde HP, Burke JP. Improving empiric antibiotic selection using computer decision support. *Arch Intern Med* 1994;154:878-84.
  - 12 Pestotnik SL, Classen DC, Evans RS, Burke JP. Implementing antibiotic practice guidelines through computer-assisted decision-support: clinical and financial outcomes. *Ann Intern Med* 1996;124:884-90.
  - 13 Evans RS, Pestotnik SL, Classen DC, Clemmer TP, Weaver LK, Orme JF, et al. A computer-assisted management program for antibiotics and other anti-infective agents. *N Engl J Med* 1998;338:232-8.
  - 14 Shojania KG, Yokoe D, Platt R, Fiskio J, Ma'luf N, Bates DW. Reducing vancomycin use utilizing a computer guideline: results of a randomized controlled trial. *J Am Med Inform Assoc* 1998;5:554-62.
  - 15 Bates DW, Leape LL, Cullen DJ, Laird N, Petersen LA, Teich JM, et al. Effect of computerized physician order entry and a team intervention on prevention of serious medication errors. *JAMA* 1998;280:1311-6.
  - 16 Raschke RA, Gollihare B, Wunderlich TA, Guidry JR, Leibowitz AL, Peirce JC, et al. A computer alert system to prevent injury from adverse drug events: development and evaluation in a community teaching hospital. *JAMA* 1998;280:1317-20.
  - 17 Purves IN. PRODIGY: implementing clinical guidance using computers. *Br J Gen Pract* 1998;48:1552-3.
  - 18 Cockcroft DW, Gault MH. Prediction of creatinine clearance from serum creatinine. *Nephron* 1976;16:31-41.
- (Accepted 14 February 2000)

### Corrections and clarifications

#### Reviews

In Simon Chapman's review of the book *Curbing the Epidemic: Governments and the Economics of Tobacco Control* (15 January, p 192) we unfortunately misspelt the name of one of the book's editors—Prabhat Jha.

#### Not time to put cot death to bed

We inadvertently forgot to incorporate a couple of late changes to this article by Sylvia Limerick (11 September, pp 698-700). In the second paragraph on p 699, disease categories were from ICD-9 (not ICD-10), and in the second paragraph on p 700, the reference is 7 (not 2).

#### Recent advances in intensive care

In this article by Stephen Stott (5 February, pp 358-61) the figure showing the technique of percutaneous tracheostomy (p 360) was adapted from a diagram provided by Cook Critical Care.