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The epidemiology of medication errors: how many, how serious?

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1. Errors will always occur in any system, but it is essential to identify causes and attempt to minimize risks.
2. Although it is difficult to quantify precisely the extent of medication errors, they are clearly frequent and often avoidable, representing a major threat to patient safety.
3. Many of the consequences of these errors can be prevented by the intervention of pharmacists.
4. Some errors are due to the conditions under which prescribers work; where possible these should be improved (for example, low staffing levels).
5. Computerized prescribing can help but can also generate its own inherent errors.
6. Improved training of prescribers at the undergraduate and postgraduate levels is vital, a fact that is now being belatedly recognized.

The scale of the problem

Medicine, in the broadest definition of the word, is a dangerous undertaking. It can and does prolong and improve the lives of patients, but can also cause them great harm. Since 2001 the UK has had a National Patients Safety Agency (NPSA; http://www.npsa.nhs.uk), which examines all types of adverse events that affect patients. In the year up to June 2008, >800 000 incidents were reported in England, the overwhelming majority in secondary care. Of these, about 71 000, i.e. just under 9%, were related to medications. The fact that there were so few reports of incidents from primary care (<2000) must suggest that the problem is underestimated, since most prescribing takes place there rather than in hospitals. The statistics are not classified by the type of error, so we cannot establish what proportions are due to prescribing faults or prescription errors, as opposed to the other elements of the medication process in which errors can occur, namely dispensing and administration. These are alarming figures, but it is worth bearing in mind that 1.5 million prescriptions are written every day in general practice in the UK and 0.5 million in hospitals. Nevertheless, 1–2% of patients in UK and US hospitals are thought to be harmed by medication errors, mostly arising from prescribing rather than the later phases of the process [1–3].

A very wide range of methods have been used to collect data on medication errors, each with advantages, disadvantages, and imprecisions [4]. This is reviewed in depth by Ferner in this issue [5]. However, even relatively circumscribed studies can provide valuable data, despite not always being strictly comparable.

Studies on prescribing errors

In a prospective study in a London teaching hospital in 2002, every fifth medication order written for non-obstetric inpatients was examined over a 4-week period [6]. It was estimated that the total number of orders written over this period was about 36 000. The pharmacists carrying out the study identified prescribing errors in about 1.5% of orders and about 0.4% were considered potentially serious. Although most of the errors, about 60%, involved prescription writing, well over 50% of the serious errors involved prescribing decisions. Most errors occurred during the inpatient stay, but nearly one-third occurred at the time of admission. Specific examples included: a patient given five times the intended dose of diazepam; one for whom 10 times the correct dose of captopril was prescribed (but not given); and one with a plasma concentration of phenytoin below the target range in whom the dose was reduced rather than increased.

A retrospective study from the University of Washington involved a far smaller sample (1411 orders) over a period of 5 months in an internal medicine clinic [7]. An estimated

28% of the prescriptions contained at least one error, but only one-fifth of these were classified as clinical, including unrecognized drug–drug interactions, allergies not taken into account, and therapeutic duplication. In only one instance was the patient harmed (electrolyte disturbance in an elderly woman inappropriately given metolazone).

In a recent larger survey from two hospitals in the Netherlands, medication errors were analysed from the perspective of preventability [8]. In this case the results were much more disturbing. Some 60% of over 7200 medication orders contained at least one prescribing fault or transcription error, and there were 103 preventable adverse events (1.4% of the total number of orders); 92 of these patients experienced what the authors described as 'temporary harm'. For example, inappropriate dosing in a *Helicobacter* eradication regimen may have contributed to a recurrent and bleeding peptic ulcer, while in the most serious case overdose of low-molecular-weight heparin caused a fatal stroke. Other errors involved problems already noted, such as failure to note contraindications and allergies, failure to recognize drug–drug interactions, or the wrong choice of monotherapy.

The problems of pooling data from different studies have been well illustrated in a recent paper from Aberdeen, in which the authors attempted to estimate the scale of prescribing errors committed by junior doctors [9]. In a systematic review of 24 studies, estimates of error rates were 2–514 per 100 items prescribed and 4.2–84% of prescription charts. As the authors remarked, this makes useful conclusions difficult, except to reinforce the view that there are methodological problems as well as those associated with prescribing.

Nonhospital prescribing

As the NPSA report suggests, there are fewer data on prescribing faults in primary care than in hospitals. However, the pattern is similar. A survey of prescriptions submitted to 40 randomly selected community pharmacies in Denmark showed a prescribing correction rate of 23 per 1000 prescriptions, although less than half of these could strictly be described as clinical errors [10]. Another Danish group attempted a systematic review of 14 studies to assess the frequency and nature of preventable adverse events in ambulatory care, although in fact they rather confusingly also considered 15 studies based on hospital practice [11]. They estimated that the adverse event rate was 15 per 1000 person-months and the rate of preventable adverse events 5.6 per 1000 person-months, although the confidence intervals were very wide in both cases. However, they noted that the most frequent problems were prescribing an inappropriate drug or failure to monitor treatment adequately (for example, the international normalized ratio during anticoagulation or electrolyte balance during diuretic therapy).

Causes and cures

Human error theory has been used to analyse the sources of medication error in a confidential interview study of 44 doctors who had made serious or potentially serious prescribing errors [12]. As might be expected, the interviewees gave a wide range of explanations for the errors. Many focused on the problem of heavy workload, often with what was seen as inadequate staffing. Probably related to this was the high frequency of apparent slips in attention: for example, thinking about one drug and prescribing another. Lapses were also frequent, such as not stopping a drug after the course should have ended. Worrying, especially for those involved in undergraduate medical education, was the view among junior doctors that they had inadequate knowledge and training to prepare them to act as independent prescribers, a finding that has since been replicated in different studies [13, 14].

What can be done to remedy these problems? Some of the problems are organizational and to do with the way healthcare is managed, especially in hospitals, but other interventions can also be helpful. Annual audit of prescribing, with targeted interventions, appears to be effective, although certainly time-consuming and labour-intensive [15]. In many countries it is recognized that clinical pharmacists can make an invaluable contribution in preventing prescribing errors from actually harming patients [16]. Another increasingly widely adopted approach is the use of computerized prescribing systems, which can, amongst other important features, identify obviously incorrect dosages and warn about potential drug interactions: this is discussed elsewhere in this issue [17]. A recent systematic review of 25 papers showed a significant risk reduction for medication errors in 23, but the extent of reduction varied from 13 to 99% and the authors noted wide variations in methods and quality – a familiar story in this field of research [18]. However, electronic prescribing is not a total solution: although it significantly reduces the rate of errors and the necessity for pharmacist interventions, it can introduce new system-specific errors, such as prescribing the wrong dose if the system sets a default value for a particular drug [19]. Obviously, both prescribers and pharmacists need to be aware of these potential sources of error.

Finally, it is evident that everywhere we must make greater efforts to provide appropriate training for future prescribers, who in many countries include healthcare professionals other than doctors. Often, and this applies very much to the UK, knowledge of drugs and prescribing has had a minor role in the curriculum, other aspects of training being given greater emphasis, e.g. communication skills. But prescribing is not only immensely important for its beneficial effects; it is also potentially very dangerous. There are signs, for example in the UK General Medical Council's 2009 draft version of its template for undergraduate medical training, *Tomorrow's Doctors* [20], and the Royal College of Physicians' report on relations

between the UK's National Health Service and pharmaceutical companies [21, 22], that the need for more teaching in this area is being appreciated at last.

Conclusion

Errors will always occur in any system, but it is essential to identify causes and attempt to minimize risk. Although it is difficult to quantify precisely the extent of prescribing errors, they are clearly frequent and often avoidable, representing a major threat to patient safety. Many of the consequences of these errors are prevented by the intervention of pharmacists. Some errors are due to the conditions under which prescribers work; where possible, these should be improved (e.g. low staffing levels). Computerized prescribing can help, but can also generate its own inherent errors. Improved training of prescribers at the undergraduate and postgraduate levels is vital, a fact that is now being belatedly recognized.

Competing interests

None to declare.

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