ORIGINAL ARTICLE

Patient safety features of clinical computer systems: questionnaire survey of GP views

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Aim: To investigate general practitioners' (GPs') stated knowledge, use and training needs related to the patient safety features of computerised clinical systems in England.
Design: Questionnaire survey.
Subjects and setting: GPs from six English primary care trusts.
Outcome measures: GPs' views on the importance of specified patient safety features on their computer system; their knowledge of the presence of specified safety features; previous training and perceived future training needs.
Results: Three hundred and eighty one GPs (64.0%) completed and returned the questionnaire. Although patient safety features were considered to be an important part of their computer system by the vast majority of GPs, many were unsure as to whether the system they were currently using possessed some of the specified features. Some respondents erroneously believed that their computers would warn them about potential contraindications or if an abnormal dose frequency had been prescribed. Only a minority had received formal training on the use of their system's patient safety features.
Conclusions: Patient safety was an issue high on the agenda of this GP sample. The importance of raising GPs' awareness of both the potential use and deficiencies of the patient safety features on their systems and ensuring that appropriate training is available should not be underestimated.

With patient safety and high quality care being priority health policy issues at an international level,[1 2] interest has grown in the potential of exploiting information technology (IT) developments to improve safety.[3] In primary (ambulatory) care, general practice computer systems could potentially have a major impact in reducing the risk of iatrogenic harm. Indeed, Bates *et al*[4] recently put forward a proposal for electronic medical records in United States (US) primary care, identifying that substantial benefits including improved quality, safety and efficiency are potentially realisable through their routine use. However, currently, only about 5% of US primary care providers use electronic medical records. In contrast, more than 90% of United Kingdom (UK) general practices regularly use computers to assist directly in delivering patient care. With the UK government's commitment to further developing the use of IT in the delivery of health care,[5] the use of computers is likely to increase further.

Promoting safer prescribing in the UK National Health Service (NHS) is a national priority.[6 7] Indeed, a recent prospective study[8] of the cause of admission of nearly 19 000 patients in two English hospitals showed that 6.5% were due to adverse drug reactions. Furthermore, 72% of these were classified as potentially avoidable. Safer prescribing in primary care has the potential to eliminate some of these avoidable hospital admissions. In principle, computer facilitated prescribing should help general practitioners (GPs) to practise safely by providing accurate information on patients and medicines at the point of decision making and effective decision support including intelligent hazard alerts for cautions, contraindications, and drug interactions. They should also be able to help in improving patient safety by assisting with generating timely and appropriate monitoring alerts, highlighting errors, and reporting on patients at risk[9 10]—for example, identifying patients on thyroxine whose thyroid function tests are overdue. However, there is evidence that errors in medicines management are continuing to result in potentially avoidable harm to patients,[11] despite widespread use of computer systems.

While UK GP computer systems have to fulfil certain quality standards in order for most GPs to be reimbursed for the purchase and maintenance costs, a specific focus on patient safety is lacking. Indeed, GPs themselves have reported difficulties with drug dosing for children, the elderly, and patients with renal impairment[12] and some have admitted to frequently overriding drug interaction hazard warnings without properly checking them.[13]

Many GPs are positive about the use of computers, believing that they have the potential to improve patient care.[14] However, in 1999 Delaney *et al*[15] surmised that a possible reason why computer decision support systems had not yet lived up to their potential was the failure of the needs of practitioners to be adequately examined. While the design of GP computer systems is an important factor, their potential to improve patient safety in primary care can only be fully realised if GPs are aware and make use of the functions available. It is therefore vital that any suggestions for improving the safety of GP computer systems take account of the user perspective. The survey reported in this paper is part of a larger programme of work on realising the potential of GP computer systems for improving patient safety commissioned by the National Patient Safety Agency.[16] Our objective was to ascertain the views of GPs on the patient safety features of their practice computer systems and their perceived needs for further training in effectively using these systems.

METHODS

Sampling frame

Our sampling frame comprised all GPs (n = 609) from six primary care trusts (PCTs) in two areas of England (four in the Midlands and two in the North-West). An English PCT combines primary and community care in a single organisation in a defined geographical area, typically covering a population base of about 100 000.

Box 1 Information obtained by the questionnaire

- GPs' views on the importance of a range of patient safety features on clinical systems.
- GPs' knowledge of the presence of a range of patient safety features on their current clinical system.
- GPs' previous training and their perceived future training needs.
- Demographic background.

Questionnaire development

To inform the questionnaire development and ensure it covered issues relevant to practising GPs, five semi-structured interviews were conducted with GPs from the Midlands. These explored GPs' views about the most important issues regarding knowledge, usage, and training needs relating to the patient safety features of GP computer systems and perceived barriers to the use of computers to help improve patient safety. After development, the questionnaire was piloted in three general practices. The final version comprised four broad sections designed to elicit the information shown in box 1.

Survey and statistical methods

The first mailing was dispatched in March 2003, together with a personally signed covering letter and a reply-paid envelope. A further two postal reminders (including another copy of the questionnaire) were sent to non-responders.

Completed questionnaires were entered into a Microsoft Access database using a form with validation rules in order to minimise possible data entry errors. Data were exported to SPSS version 11.5 and analysed using descriptive statistics.

Local research ethics committee approval for the study was obtained in each locality (Nottingham, Stockport and South Manchester).

RESULTS

Response rate and demographic characteristics

Fourteen of the 609 questionnaires were returned uncompleted because the GP no longer worked at the practice; 390 completed questionnaires were returned giving a response rate of 65.5% (390/595). Of these, 381 were suitable for analysis giving an overall usable response rate of 64.0% (381/595). The usable response rate from individual PCTs ranged from 55.0% to 69.4%. The usable response rate for individual questions ranged from 85.6% to 100%.

Respondents had a mean age of 45 years (range 29–67). Female GPs were over-represented (42.1% *v* 37.0%) compared with national figures.[17] Respondents from a wide range of different sized practices were represented, the majority (212/362; 58.6%) working in practices with a list size between 4000 and 10 000 patients. Only 3.6% (13/362) of respondents worked in a practice with a list size of less than 2000. Almost all respondents described their role as that of a GP partner (344/364; 94.5%). Although GPs using computer systems from the six major UK system suppliers were represented, the majority (292/352; 83.0%) used systems from just two.

GPs' views on the importance of computer system patient safety features

GPs' views on the importance of a range of patient safety features on their clinical computer system are shown in table 1.

Table 1 GPs' views on the importance of specified patient safety features on their computer system

	% agreement			
How important do you think it is for a GP computer system to have …?	Very important	Important	Of minimal importance	Unimportant
Drug interaction alerts (n = 376)	80.6	18.1	1.3	0
Contraindication alerts, e.g. alerting you to a past medical history of peptic ulcer when trying to prescribe an NSAID to a patient (n = 381)	70.6	28.3	1.0	0
Allergy alerts, e.g. alerting you that a patient is allergic to a particular drug if you were to try to prescribe it (n = 379)	90.0	10.0	0	0
Alerts regarding frequency of dose, e.g. alerting you that methotrexate is normally prescribed weekly (n = 381)	53.5	42.5	3.9	0
Alerts regarding drugs with similar names, e.g. alerting you to a potential hazard if you were to select penicillamine rather than penicillin (n = 379)	44.6	44.3	10.8	0.3
Features that make it extremely difficult to override an alert for a potentially fatal prescribing error (n = 378)	61.4	31.5	6.6	0.5
Alerts to warn you that a patient has gone beyond their review date when it comes to trying to issue a repeat prescription (n = 379)	11.1	68.9	18.2	1.8
Alerts to warn you that a patient may be underusing their medication when it comes to trying to issue a repeat prescription (n = 354)	4.5	64.1	29.4	2.0
Alerts to warn you that a patient may be overusing their medication when it comes to trying to issue a repeat prescription (n = 355)	19.4	71.0	9.0	0.6
Prompts that require you to record a reason if you have overridden an alert (n = 353)	13.3	49.9	28.9	7.9
Computerised audit trails that allow a practice to see if alerts have been overridden (n = 347)	17.9	51.3	25.9	4.9
Systems for recalling patients who need blood test monitoring, e.g. urea and electrolyte (U&E) levels for patients on diuretics (n = 354)	27.1	64.7	8.2	0
Systems for recording intended referrals so that patients can be identified if a referral hasn't been made within a certain period of time (n = 354)	26.6	54.5	17.5	1.4
Computer searches that allow you to run reports on patients who may have received potentially hazardous drug combinations (n = 351)	24.2	60.4	13.1	2.3
Computer searches that allow you to run reports on patients who may be at risk from their medications, e.g. patients with asthma who might be receiving β-blockers (n = 353)	26.9	58.4	13.0	1.7
In laboratory linked practices, having alerts to inform GPs of seriously abnormal results (n = 353)	56.1	41.9	2.0	0

In all tables the denominator for each question varies as not all respondents answered every question.

Table 2 GPs' knowledge of the presence of a range of patient safety features on their current clinical computer system

As far as you know, does your computer have the following safety features ...?	% responses		
	Yes	No	Not sure
Contraindication alerts, e.g. warning you to a past medical history of peptic ulcer when trying to prescribe an NSAID to a patient (n = 352)	53.7	34.9	11.4
Allergy alerts, e.g. alerting you that a patient is allergic to a particular drug if you were to try to prescribe it (n = 354)	85.3	10.5	4.2
Alerts regarding frequency of dose, e.g. alerting you that methotrexate is normally prescribed weekly (n = 354)	27.7	49.7	22.6
Alerts regarding drugs with similar names, e.g. alerting you to a potential hazard if you were to select penicillamine rather than penicillin (n = 353)	18.1	62.6	19.3
Features that make it extremely difficult to override an alert for a potentially fatal prescribing error (n = 377)	13.0	57.3	29.7
Alerts to warn you that a patient has gone beyond their review date when issuing a repeat prescription (n = 377)	82.8	13.3	4.0
Alerts to warn you that a patient may be underusing their medication when it comes to trying to issue a repeat prescription (n = 375)	52.8	39.7	7.5
Alerts to warn you that a patient may be overusing their medication when it comes to trying to issue a repeat prescription (n = 377)	65.3	28.9	5.8
Prompts that require you to record a reason if you have overridden an alert (n = 376)	33.0	54.8	12.2
Systems for recalling patients who need blood test monitoring, e.g. U&Es for patients on diuretics (n = 372)	16.9	68.5	14.5
Systems for recording intended referrals so that patients can be identified if a referral hasn't been made within a certain period of time (n = 374)	11.8	69.5	18.7

It is notable that in all cases the majority of respondents considered the issues raised to be important or very important. In most instances more than 80% of respondents considered this to be the case. More than 95% of respondents considered the presence of alerts regarding drug interactions, contraindications, allergies, dose frequencies, and seriously abnormal laboratory test results to be important or very important.

GPs' knowledge of the presence of patient safety features on their current computer system

GPs' knowledge of the presence of a range of safety features on their current clinical computer system is shown in table 2.

It is notable that, for every safety feature enquired about, at least 15 respondents were unsure as to whether it was present on their own system. For some of our respondents using specific computer systems, it is possible to link part of the data from table 2 to previous work that used simulated test cases to evaluate the prescribing safety features of four computer systems.[18]

Table 3 shows the percentage of GPs using each system who believed, incorrectly, that their computer would alert them in the specified case. It is notable that, for every system tested, some of our respondents using that system misguidedly believed that it possessed contraindication alerts. Conversely, some respondents believed that their system did not possess an alert when in reality it did (table 4).

GPs' previous training and perceived future training needs

Only about one quarter (n = 94) of respondents had received formal training in the use of the safety features available on their current clinical computer system. Table 5 shows GPs' views on whether they considered that they needed any further training to make best use of a range of patient safety features (where applicable). Only six respondents identified that they had no training needs.

DISCUSSION

This study investigated GPs' stated knowledge, use, and training needs related to the patient safety features of computerised clinical systems in England. The key finding was that some respondents incorrectly believed that their computer system would warn them about potential contra-indications and if an abnormal dose frequency had been prescribed.

Careful attention was paid to the face and content validity of the questionnaire during development and we are, as a

Table 3 Alerts that GPs incorrectly believed their computer system would warn them about

Alert	Percentage believing they would be warned			
	System A (n = 12)	System B (n = 150)	System C (n = 17)	System D (n = 18)
Contraindication alerts, e.g. alerting them to a past medical history of peptic ulcer when trying to prescribe an NSAID to a patient	16.7	69.3	23.5	55.6
Alerts regarding frequency of dose, e.g. alerting them that methotrexate is normally prescribed weekly	0	√	5.9	5.6
Alerts regarding drugs with similar names, e.g. alerting them to a potential hazard if they were to select penicillamine rather than penicillin*	8.3	34.7	0	0
Alerts warning them that a patient may be overusing their medication when it comes to trying to issue a repeat prescription	√	96.0	35.3	27.8

√, alert specified is an integral part of this system.
*Note that, when the systems were evaluated, the 10 most frequently used drug pairs with similar names were tested. No system provided a warning in all cases.[18]

Table 4 Alerts that GPs incorrectly believed their computer system would *not* warn them about

Alert	Percentage believing they would *not* be warned			
	System A (n = 12)	System B (n = 150)	System C (n = 17)	System D (n = 18)
Alerts regarding frequency of dose, e.g. alerting them that methotrexate is normally prescribed weekly	×	24.0	×	×
Alerts warning them that a patient may be overusing their medication when it comes to trying to issue a repeat prescription	50.0	×	×	×

×, the alert specified is not present on this system.

consequence, confident about the internal validity of our instrument. The final response rate of 64% potentially limits the generalisability of the results, as does the fact that the sample was not representative of all English GPs. However, GPs were sampled in two different areas of England and our sample frame included male and female GPs of different ages and working in a range of practice structures.

Unsurprisingly, a very high proportion of GPs considered patient safety features as an important part of their computer system. Despite this, many were unsure as to whether the system they were currently using possessed some of the specified features. As part of our larger programme of work, research was undertaken to evaluate computer system safety features of the four systems most commonly used in England using simulated test cases.[18] This has shown that the systems tested failed to warn in more than half the types of situation when a warning could be reasonably expected. The ''best'' system warned in only seven of 18 test cases. Of particular concern is the fact that some respondents to the present survey believed that their system would warn them in certain clinical situations when in reality it would not.

Our findings related to training supports those from other studies. Lack of training has been previously identified as a barrier to computer use by GPs, with existing training in computer use perceived to be poor.[14] Furthermore, despite the increasing use of computers in primary care, a sample of GPs in a recent qualitative study perceived their lack of skill and confidence in IT to be a significant barrier to the use of their practice decision support system.[19]

GPs' views on their own training needs—together with the fact that many recognised that they did not know whether specific safety features were present on their current system and others believed their system did not possess a specific alert when it did—reinforces the importance of training for GPs and the fact that this is a real need rather than simply a perceived one. Ideally, this should encompass part of an induction programme for new members of staff. Furthermore, consideration needs to be given to the time commitment involved and the different training requirements for single handed practices, group practices, and staff providing locum cover. Qualitative research may have a potentially valuable role to play in exploring GPs' views further.

At a global level, clinical computer systems used in UK primary care are considerably advanced. However, the problems identified in this paper will be important issues to address in the development of any clinical computer system worldwide. In order to improve clinical outcomes, the importance of raising GPs' awareness of both the potential use and deficiencies of the patient safety features on their systems should not be underestimated. Standardisation of systems in terms of the features offered may also go some way to improving patient safety.

From a UK policy perspective, the task now remains at a national level for key stakeholders to work together to ensure a consistent approach to alerts wherever possible, to put systems in place to make it less easy to override important alerts, and to provide suitable training. Repeated spurious alerts potentially expose patients to danger if GPs become complacent. A reduction in these, together with the expansion of laboratory links, is a major safety issue in the electronic era. In the UK there is a major opportunity to address some of these issues through the National Programme for Information Technology in the NHS.[20] As part of this initiative there are plans for an Integrated Care Records Service (ICRS)[21] whereby essential information on patients regarding their health and social care is recorded electronically and made available to authorised professionals. It will be very important for the ICRS to link in with existing computer systems so that clinicians are automatically alerted to potential safety issues such as drug contraindications.

Computers can never provide the complete answer and human vigilance will always have an important role to play. However, by using computers to their fullest potential and

Table 5 GPs' views on their need for further training

Do you think you need any further training to make best use of ...?	% responses		
	Yes	No	Not sure
Hazard alerts for drug interactions and/or contraindications (n = 368)	32.3	58.2	9.5
Recording drug allergies on the practice computer (so that an alert will be generated if there are future attempts at prescribing) (n = 369)	30.9	65.3	3.8
Alerts to encourage safe repeat prescribing, e.g. patients being beyond their review date, or patients apparently underusing or overusing their medication (n = 366)	27.3	64.5	8.2
How to use the practice computer to develop effective systems for recalling patients who need blood test monitoring (n = 372)	70.4	25.0	4.6
How to use the practice computer for recording intended referrals so that patients can be identified if a referral has not been made within a certain period of time (n = 361)	73.7	21.6	4.7
How to use the practice computer to do searches that allow you to run reports on patients who may have received potentially hazardous drug combinations and/or contraindicated drugs (n = 363)	62.3	28.9	8.8
In laboratory linked practices, ensuring that all results are dealt with safely (n = 326)	55.5	38.7	5.8

Key messages

- GPs consider safety features an important part of their clinical computer system.
- Some GPs incorrectly believed that their computers would warn them in certain clinical situations.
- A minority of GPs had received training on the use of their computer system's patient safety features.

training users appropriately, they are a powerful tool to help reduce prescribing hazards to patients and improve the safety and quality of patient care.

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