Refereed papers

Identifying and establishing consensus on the most important safety features of GP computer systems: e-Delphi study

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ABSTRACT

Our objective was to identify and establish consensus on the most important safety features of GP computer systems, with a particular emphasis on medicines management. We used a two-round electronic Delphi survey, completed by a 21-member multidisciplinary expert panel, all from the UK. The main outcome measure was percentage agreement of the panel members on the importance of the presence of a number of different safety features (presented as clinical statements) on GP computer systems. We found 90% or greater agreement on the importance of 32 (58%) statements. These statements, indicating issues considered to be of considerable importance (rated as important or very important), related to:

computerised alerts; the need to avoid spurious alerts; making it difficult to override critical alerts; having audit trails of such overrides; support for safe repeat prescribing; effective computer–user interface; importance of call and recall management; and the need to be able to run safety reports. The high level of agreement among the expert panel members indicates clear themes and priorities that need to be addressed in any further improvement of safety features in primary care computing systems.

Keywords: Delphi survey, general practice, informatics, patient safety

Introduction

There is an increasing body of evidence that errors in primary care result in harm to patients, particularly in relation to medicines management.[1] Most prescribing in the United Kingdom (UK) is undertaken by general practitioners (GPs), and it is here that attention needs to be focused in order to reduce the disease burden associated with errors in medicines management. Computer systems, which are now routinely used in UK primary care, have considerable potential for preventing medication errors and improving patient quality of care.[2–6] In addition, the UK Government has recently launched several strategic initiatives to ensure further integration and harmonisation of computerisation throughout all areas of health care.[1,7]

The critical issue in using technology to maximise prescribing safety is that computer systems should be set up so that prescribers are alerted if they try to take an action that is likely to be hazardous. However, this is not made explicit in the Requirements for Accreditation – the National Health Service (NHS) Information Authority regulated core requirements – to which all GP systems should be capable of performing.[8] Indeed, we are aware that some systems are deficient in terms of the alerts that they issue.[9,10] Therefore, identifying particular situations where patient safety might be compromised, and developing a conceptual framework within which to analyse these situations, is likely to prove beneficial.

Our aim in this study was to identify and reach consensus on the key clinical scenarios involving patient safety for which GPs might benefit from information technology (IT) support, particularly in relation to medicines management. The study was a part of a larger project funded by the National Patient Safety Agency to explore the potential of computer systems for improving patient safety in primary care.

Methods

In order to reach consensus on the most important issues among experts, we used an electronic Delphi technique. The Delphi approach has been widely used in healthcare research as an approach to establishing consensus.[11,12] One recent example is its use in the development of health service indicators.[13] Figure 1 shows the steps involved in the two-round Delphi procedure used in this study.

Initially we compiled a database of 30 experts drawn from those in academic, clinical, administrative and business settings, whose work has been directly relevant to the application of computers in medicine. From this group we purposefully selected an expert panel of 22 members. Our selection criteria aimed to ensure an adequate breadth of expertise and perspectives on general practice computing and patient safety as well as availability of the selected people within the time-frame of the study.

Through searching the literature and drawing on clinical experience, two members of the research team (AA and BS) identified an initial list of medicines management errors/safety considerations where a possible role for IT-based solutions has been considered. These issues were then formalised into clinical statements and shared among the full study team for comments and refinement. Based on this feedback, we selected statements agreed by the entire multi-disciplinary team as being potentially important and incorporated these into a questionnaire for circulation to the Delphi panel members.

The questionnaire was circulated by email to the Delphi panel members in two rounds. Respondents were asked to score the importance of each statement on a 5-point Likert scale ranging from very important to irrelevant. The scores from the first round were circulated to the Delphi panel along with the questionnaire for the second round. The panellists were asked to score the questions in the second Delphi round having considered all the scores, and any comments, from the first round. Consensus was defined as having been achieved if 90% or more of the panel members rated that statement as 'important' or 'very important' after the second round.

Based on advice from the local research ethics committee, we did not need ethical approval for this study. The two-round Delphi process was conducted during the first quarter of 2003.

Results

All 22 panel members invited to take part in the study agreed to participate. One panel member, however, failed to reply to the first Delphi round questionnaire and was therefore excluded from the second round. All 21 members who completed the first round went on to complete the second round. The professional backgrounds and key characteristics of the Delphi panel are given in Table 1.

We formulated 55 clinical statements, and these were incorporated into our questionnaires. Statements considered important by 90% or more of respondents after round 2 are given in Table 2; statements that were considered important by less than 90% of respondents are shown in Table 3.
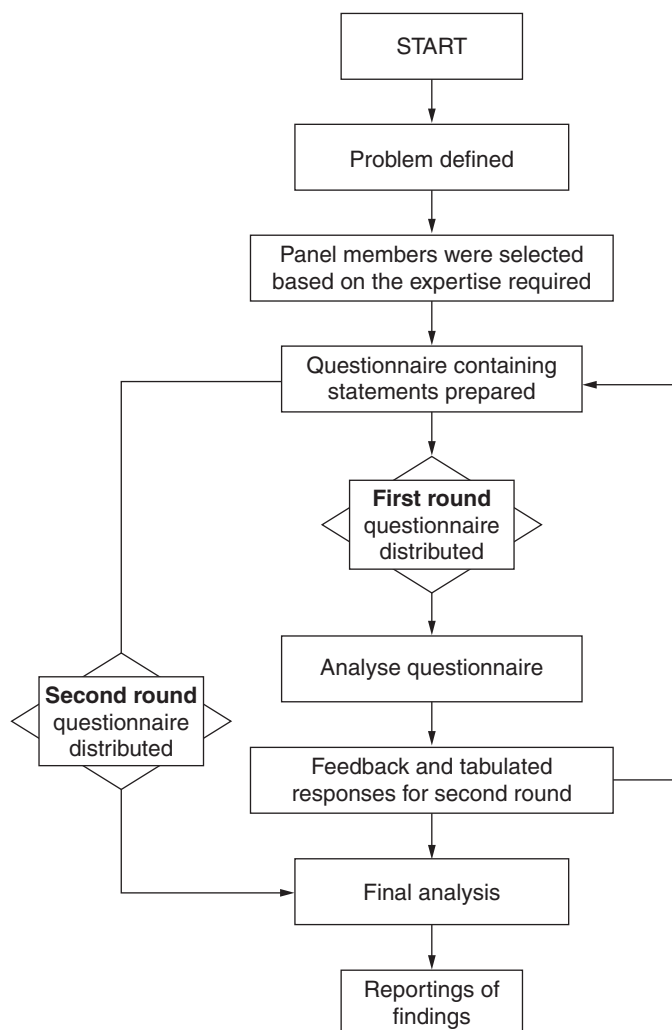
Figure 1 Flow diagram showing two round e-Delphi process

We found 90% or greater agreement for 32 statements, with an average agreement on the importance of these questions of 98%. For 42 statements, the agreement was 80% or more and for only five items were levels of agreement below 70%.

The key themes around which consensus was achieved were:

- the importance of computerised alerts
- the need to minimise spurious alerts
- making it difficult to override critically important alerts
- having audit trails of such overrides
- support for safe repeat prescribing
- effective computer–user interface
- importance of call and recall
- the need to be able to run safety reports.

In terms of the computer–user interface the following were considered important:

- making it difficult to override hazard alerts

- providing a clear display of alerts
- highlighting drugs with similar names
- having mechanisms to ensure that prescribers recorded the reasons why any particularly serious hazard alerts were overridden.

Repeat prescribing issues were also considered important:

- drug overuse
- drug underuse
- items being requested beyond the agreed review date
- whether or not the item had been authorised as a repeat prescription.

Other safety issues considered important included:

- the coding of clinical conditions (especially use of Read codes)
- monitoring of clinical results or appointments
- laboratory links
- alerts for extreme or clinically relevant results.

Table 1 Demographic and professional characteristics of Delphi expert panel

Panellist no.	Gender	Professional background	Professional role
1	M	GP	Academic/Clinical
2	M	GP	Clinical
3	F	Pharmacist	Academic
4	F	GP	Academic/Clinical
5	M	Pharmacist	GP computer system specialist
6	M	GP	Health policy
7	F	Pharmacist	Academic
8	F	Pharmacist	Clinical/Academic
9	M	GP	Clinical
10	F	GP	Policy/Clinical
11	M	GP	Policy
12	M	GP	GP computer system specialist/Clinical
13	M	GP	Clinical
14	M	GP	Academic/GP computer system specialist
15	M	GP	Clinical/Technical
16	F	Pharmacist	Academic/Clinical
17*	M	GP	GP computer system specialist/Clinical
18	F	Primary Care Manager	GP computer system specialist/Manager
19	M	GP	Academic/Clinical
20	M	GP	Policy/Clinical
21	M	GP	Academic/Clinical
22	F	Pharmacist	Clinical

* Did not reply to the first round and was therefore excluded from the second Delphi round

Discussion

Our multidisciplinary Delphi panel reached agreement on the importance of a range of safety features relating to GP computer systems. The results are likely to provide relevant information for policy makers and developers of GP computer systems, given that we used a well-established technique for consensus building, worked through a multidisciplinary expert panel, and achieved a high response rate from participants.

GP computer systems used in the UK already have many of the safety features identified in our modified Delphi study. For example, current Requirements for Accreditation of computer systems ensure that interaction alerts, allergy alerts and certain aspects of repeat prescribing are covered.[8] However, in a previous study we have shown deficiencies in GP computer systems in terms of contraindication alerts, the presence of spurious alerts, managing repeat prescribing and warning about similar drug names.[10] These are safety issues that were considered important by our Delphi panel.

In the UK we have fed our results back to the National Patient Safety Agency and the National Programme for Information Technology in the NHS.[14] It is hoped that our findings will help to inform the safety requirements for GP computer systems in coming years. Our

Table 2 Statements considered important by 90% or more of respondents (*n*=21)

Section 1: Prescribing safety issues

Scoring: 5 = very important; 4 = important; 3 = of equivocal importance; 2 = unimportant; 1 = irrelevant

No.	Statement: 'When selecting a drug the computer should alert the prescriber if . . .'	Median score	% agreement for scores 4 & 5
1	. . . the drug may be contraindicated because of the patient's age, e.g. use of aspirin in children	5	95%
3	. . . the drug is contraindicated because of pregnancy, e.g. cytotoxics such as methotrexate	5	95%
6	. . . the drug is contraindicated because of a previous allergy, e.g. penicillin	5	100%
7	. . . the drug is contraindicated because of a recorded diagnosis of renal impairment, e.g. oxytetracycline	5	100%
8	. . . the drug should be used with caution because of a recorded diagnosis of renal impairment, e.g. ACE inhibitors	4	95%
9	. . . the drug is contraindicated because of a diagnosis of DVT, e.g. combined with contraceptive pill	5	95%
11	. . . the drug is contraindicated because of elevated serum creatinine ($>150\,\mu$Mol/L), e.g. oxytetracycline	4	100%
15	. . . the drug is contraindicated because of a recorded diagnosis of heart failure, e.g. non-selective beta-blockers such as propranolol	5	95%
16	. . . the drug is contraindicated because of a recorded diagnosis of coronary heart disease, e.g. triptans such as sumatriptan	5	95%
17	. . . the drug is contraindicated (or should be used with caution) because of a recorded history of peptic ulcer, e.g. non-selective NSAIDs	5	100%
18	. . . the drug is contraindicated because of a recorded diagnosis of asthma, e.g. non-cardio-selective beta-blockers such as propranolol	5	100%
21	. . . there is a clinically significant potential interaction with another drug that the patient has recently been prescribed, e.g. sildenafil and nitrates	5	100%
26	. . . the frequency of dose may be inappropriate and dangerous, e.g. methotrexate prescribed daily	5	100%
27	. . . the necessary monitoring requirements have not been met, e.g. full blood count not recorded within the previous 12 weeks in a patient taking methotrexate	4	90%

Section 2: Repeat prescribing safety issues

35	When a patient requests a repeat prescription the computer should make it clear whether the item requested has been authorised as a repeat	5	100%
36	When practice staff try to print out a repeat prescription it should be clear whether the item requested has gone beyond its review date	5	100%
38	When practice staff try to print out a repeat prescription they should be alerted if patients appear to be either under-using or over-using their medicines	4	90%

Table 2 continued

Section 3: General safety issues

Decision support

39	When selecting a drug, the computer system should be capable of providing the clinician with information on the safety of this drug	5	90%
40	Hazard alerts need to provide clinicians with sufficient detail to enable them to make informed decisions	5	95%
41	Hazard alerts need to be designed so that they do not provide clinicians with irrelevant or spurious information	5	100%

Interface

42	Hazard alert messages should be displayed clearly on the computer screen	5	100%
43	It should be difficult to override alerts if there is a risk of serious patient harm as a consequence, e.g. prescription of sildenafil with a nitrate	5	100%
44	If a clinician decides to override a clinically relevant hazard alert they should be prompted to record a reason for this	5	100%
45	When selecting a drug from a drop-down menu there should be mechanisms in place to make it difficult erroneously to issue a drug with a similar name if this could cause serious patient harm, e.g. penicillin and penicillamine	5	100%

Coding

47	When suppliers of clinical databases construct hazard alerts they should use only those codes that are associated with a genuine hazard (e.g. using codes for the interaction between verapamil [rather than all calcium channel blockers] and beta-blockers)	5	95%

Monitoring

48	It should be possible to set up the system so that patients can be automatically recalled for blood tests and other forms of monitoring	4	100%

Lab links

50	Users should be alerted to seriously abnormal results, e.g. hyperkalaemia	5	100%

Reporting and clinical audit

51	It should be possible to record intended referrals on the computer and then run reports to identify any patients who have not subsequently been referred	5	90%
52	It should be possible to run reports on patients who have received potentially hazardous drug–drug combinations	5	100%
53	It should be possible to run reports on patients at risk from their medication, e.g. patients on long-term high-dose oral corticosteroids who are not receiving prophylaxis for osteoporosis	5	100%
54	Computer systems should be designed so that it is possible to produce an audit trail of clinicians' actions in response to hazard alerts	5	100%
55	It should be possible to run reports to identify situations where a clinician has overridden a clinically important hazard alert	5	100%

Table 3 Statements considered important by less than 90% of respondents

Section 1: Prescribing safety issues

Scoring: 5 = very important; 4 = important; 3 = of equivocal importance; 2 = unimportant; 1 = irrelevant

No.	Statement: 'When selecting a drug the computer should alert the prescriber if . . .'	Median score	% agreement for scores 4 & 5
2	. . . the drug is not indicated because of the patient's gender, e.g. erroneous prescription of female hormones to men	4	70%
4	. . . the drug is contraindicated in pregnancy and the patient is a woman of childbearing age, e.g. cytotoxics such as methotrexate	4	75%
5	. . . the drug is contraindicated because a woman might be breastfeeding, e.g. cytotoxics such as methotrexate	4	75%
10	. . . it is an unlicensed indication, e.g. statin in heart failure	3	45%
12	. . . the drug should be used with caution because of elevated serum creatinine ($>150\,\mu$Mol/L), e.g. ACE inhibitors	4	85%
13	. . . the drug should be used with caution because of a recorded diagnosis of liver failure, e.g. opioid analgesics	4	80%
14	. . . the drug should be used with caution because of elevated serum transaminases, e.g. statins	4	85%
19	. . . the drug should be used with caution because of a recorded diagnosis of diabetes, e.g. systemic corticosteroids	4	85%
20	. . . the drug is contraindicated because of a recorded diagnosis of thyroid dysfunction, e.g. when considering starting a patient on amiodarone	4	75%
22	. . . there is a potential contraindication that might be implied from another drug that has been prescribed, e.g. attempted use of a non-cardio-selective beta-blocker in a patient taking bronchodilators (proxy for asthma/COPD)	5	65%
23	. . . variations in bioavailability mean that different formulations of a drug may not have the same clinical effects, e.g. attempted generic prescription of a lithium preparation	4	70%
24	. . . the quantity of medication supplied might be dangerous in overdose, e.g. greater than one month's supply of an older tricyclic antidepressant at full dose (150 mg per day)	3	10%
25	. . . the length of treatment course supplied might be dangerous without review, e.g. greater than three months' supply of methotrexate	4	65%

Table 3 continued

Section 2: Repeat prescribing safety issues

28	When putting a drug onto a repeat prescription then the prescriber should be required to specify a review date (or a number of repeats)	5	84%
29	When putting a drug onto a repeat prescription then the prescriber should be required to specify the indication for the drug	4	79%
30	It should not be possible for unqualified staff to put drugs onto repeat prescription	5	86%
31	It should not be possible for unqualified staff to re-authorise a repeat prescription	5	81%
32	When setting review dates these should not go beyond a year OR when setting numbers of repeats the maximum number allowed should be 13	4	71%
33	In order to help monitor medication adherence the prescriber should be requested to state the expected length of time between prescription requests	3	33%
34	In order to help monitor medication adherence it should be easy for practice staff to review the frequency of previous issues of specified prescription items	4	81%
37	If a patient requests a repeat prescription beyond its review date the user should be prompted to request that the patient attends for a prescription review	4	86%

Section 3: General safety issues

Decision support (no agreement below 90%)

Interface (no agreement below 90%)

Coding

46	The user should be warned if they use a code that may not trigger an intended alert, e.g. the code 'history of asthma' may not trigger an alert if a non-cardio-selective beta-blocker is subsequently prescribed	4	71%

Monitoring (no agreement below 90%)

Lab links

49	It should not be possible to automatically file <u>all</u> normal lab results, e.g. a negative urine culture might require action if the patient had presented initially with haematuria	4	86%

Reporting and clinical audit (no agreement below 90%)

findings may also be relevant to other countries that are considering the safety features that need to be available on computer systems used in primary care.

REFERENCES

1 Smith J. *Building a Safer NHS for Patients: improving medication safety.* London: Department of Health, 2004.

2 Avery AJ. The use of computers to aid GP prescribing. *Prescriber* 1998;9(21):13.

3 Preece J. *The Use of Computers in General Practice* (4e). London: Churchill Livingstone, 2000.

4 Royal College of General Practitioners. *General Practice Computerisation*. Royal College of General Practitioners information sheet 2003; No.7, March. www.rcgp.org.uk/information/publications/information/PDFInfo/07_MARCH_03.pdf

5 Chen Y-F, Avery AJ, Neil KE, Johnson C, Dewey ME and Stockley IH. Incidence and possible causes of prescribing potentially hazardous/contraindicated drug combinations in general practice. *Drug Safety* 2005;28(1):67–80.

6 Nolan TW. System changes to improve patient safety. *British Medical Journal* 2000;320:771–3.

7 Department of Health. *Delivering 21st Century IT Support for the NHS: national strategic programme.* London: Department of Health, 2002.

8 NHS Information Authority. *General Medical Practice Computer Systems: requirements for accreditation RFA 99 v1.2.* www.nhsia.nhs.uk/sat/specification/pages/rfaspec.asp

9 Magnus D, Rodgers S and Avery AJ. GPs' views on computerised drug interaction alerts: questionnaire survey. *Journal of Clinical Pharmacy and Therapeutics* 2002; 27(5):377–82.

10 Fernando B, Savelyich BSP, Avery AJ *et al.* Prescribing safety features of general practice computer systems: evaluation using simulated test cases. *British Medical Journal* 2004;328:1171–2.

11 Adler M and Ziglio E. *Gazing into the Oracle: the Delphi method and its application to social policy and public health.* Bristol: Jessica Kingsley Publishers, 1996.

12 Linstone H and Turoff M. The *Delphi Method: techniques and applications.* Reading, MA: Addison-Wesley, 1975.

13 Cantrill JA, Sibbald B and Buetow S. Indicators of the appropriateness of long-term prescribing in general practice in the United Kingdom: consensus development, face and content validity, feasibility, and reliability. *Quality in Health Care* 1998;7(3):130–5.

14 Avery A, Savelyich BSP and Teasdale S. Improving the safety features of general practice computer systems. *Informatics in Primary Care* 2003;11:203–6.

CONFLICTS OF INTEREST

None.

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