Electronic information and clinical decision support for prescribing: state of play in Australian general practice

Jane Robertson^{a,*}, Annette J Moxey^b, David A Newby^a, Malcolm B Gillies^c, Margaret Williamson^d and Sallie-Anne Pearson^e

^aDepartment of Clinical Pharmacology, The University of Newcastle, Clinical Sciences Building, Calvary Mater Newcastle Hospital, Waratah, NSW 2298, ^bResearch Centre for Gender, Health & Ageing, The University of Newcastle, David Maddison Building, Newcastle, NSW 2300, ^cMedicines Information Team, ^dResearch and Development, National Prescribing Service, PO Box 1147, Strawberry Hills, NSW 2012 and ^eIntegrated Cancer Research, Level 4, Lowy Cancer Research Centre, University of NSW, Sydney, NSW 2052, Australia.

*Correspondence to Jane Robertson, Clinical Pharmacology, The University of Newcastle, Clinical Sciences Building, Calvary Mater Newcastle Hospital, Waratah, NSW 2298, Australia; E-mail: jane.robertson@newcastle.edu.au *Received 1 February 2010; Revised 5 May 2010; Accepted 10 May 2010.*

Background. Investments in eHealth worldwide have been mirrored in Australia, with >90% of general practices computerized. Recent eHealth incentives promote the use of up to date electronic information sources relevant to general practice with flexibility in mode of access.

Objective. To determine GPs' access to and use of electronic information sources and computerized clinical decision support systems (CDSSs) for prescribing.

Methods. Semi-structured interviews were conducted with 18 experienced GPs and nine GP trainees in New South Wales, Australia in 2008. A thematic analysis of interview transcripts was undertaken.

Results. Information needs varied with clinical experience, and people resources (specialists, GP peers and supervisors for trainees) were often preferred over written formats. Experienced GPs used a small number of electronic resources and accessed them infrequently. Familiarity from training and early clinical practice and easy access were dominant influences on resource use. Practice time constraints meant relevant information needed to be readily accessible during consultations, requiring integration or direct access from prescribing software. Quality of electronic resource content was assumed and cost a barrier for some GPs.

Conclusions. The current Australian practice incentives do not prescribe which information resources GPs should use. Without integration into practice computing systems, uptake and routine use seem unlikely. CDSS developments must recognize the time pressures of practice, preference for integration and cost concerns. Minimum standards are required to ensure that high-quality information resources are integrated and regularly updated. Without standards, the anticipated benefits of computerization on patient safety and health outcomes will be uncertain.

Keywords. Australia, clinical decision support, electronic information, general practice.

Background

Australia, like many other countries, is investing heavily in eHealth initiatives, including clinical information and decision support systems, individual electronic health records and Internet access at the point of care. This investment is made with the expectation that it will improve quality of care and ultimately patient health.¹ Clinical decision support systems (CDSSs) range from simple computerized reference works to sophisticated systems integrating knowledge and patient clinical data to generate patient-specific advice.¹ However, simply providing information in electronic formats does not guarantee uptake in routine clinical care.² Systematic reviews assessing the impact of CDSSs demonstrate modest changes in practice in line with the intent of

© The Authors 2010. Published by Oxford University Press.

This is an Open Access article distributed under the terms of the Creative Commons Attribution Non-Commercial License (http:// creativecommons.org/licenses/by-nc/2.5), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

CDSSs and mixed findings in relation to patient outcomes.³⁻⁶ There is some evidence that CDSS is more effective when advice is provided automatically (system initiated), within the clinical workflow and at the time of decision making.^{3,4,6} Our recent systematic review suggests that CDSS for prescribing may have greater impact in institutional (hospital inpatient) compared with ambulatory care settings and for 'fine-tuning therapy' (e.g. dose modifications and avoiding drug interactions) rather than influencing initial drug choices.⁶

A range of strategies have been employed in different jurisdictions to increase uptake of electronic information sources and CDSSs in general practice (family practice). Australian government incentives have delivered high levels of computerization,⁷ with >90% of GPs having computers in their consulting rooms.⁸ Most use these for practice administration and writing prescriptions, only 33% capture all patient information electronically and 20% of GPs report accessing computerized information during consultations.⁸ It is unclear whether this low level of use of electronic information and CDSS reflects low demand, limited usefulness of CDSS content, poor integration with computer systems or perceived interference with clinical workflows and patient–clinician interactions.^{9,10}

Recently, the Australian government introduced an eHealth Incentive program¹¹ to encourage access to up to date electronic references relevant to general practice. The programme guidelines are illustrative not prescriptive in that they do not mandate which resources should be used nor how and where the information should be accessed (computer hard drive, CD-ROM or direct link to the Internet). However, it is unclear whether the resources proposed match the information needs of GPs.

We conducted this interview study of Australian GPs to explore their opinions and experiences of using clinical information and CDSSs for prescribing, to examine their information preferences (resources and formats), to identify their unmet needs and elicit their views on how CDSSs could better meet their information requirements.

Methods

Setting

As in the UK, Australian GPs are the gatekeepers to secondary specialist care and responsible for much of the management of chronic disease. However, Australian patients are not registered with a single practice and remuneration is based on a fee-for-service model that may contribute to time pressures on consultations.

Approach

We purposively sampled experienced GPs working in urban, regional and rural settings and those training for careers in general practice (GP registrars, hereafter referred to as 'Trainees') for this in-depth interview study.

Participants and recruitment

Experienced GPs. We identified potential participants via the National Prescribing Service (NPS, http:// www.nps.org.au), а national body providing professional development for GPs and other health professionals. NPS facilitators from three geographically based Divisions of General Practice distributed information sheets and consent forms to GPs during practice visits. Facilitators are funded in part by the NPS but employed by the local Divisions of General Practice to support local quality use of medicines initiatives. The Divisions covered a total of 777 GPs, 302 practices and a patient population of \sim 759 000 in a mix of urban, regional and rural practice locations in New South Wales (NSW, the largest Australian state).

GP registrars (Trainees). Study information packs were distributed by a researcher to registrars (GP vocational trainees) attending a workshop conducted by one of the regional GP training providers (urban–rural and rural areas along the Central Coast of NSW), as well as to those requesting a study pack in response to an email sent by the training organization to network members.

Participants were interviewed at their practice and received an AU\$150 gift voucher as compensation for their time.

Interviews

Semi-structured face-to-face interviews of 30–60 minutes were conducted between February and October 2008. Interviews were tape recorded and transcribed verbatim; all identifying information was removed to preserve participant anonymity.

The research team developed provisional questions, which were pilot tested with four GPs (see Box 1). Participants were asked to describe specific examples of their prescribing decisions and CDSS use, particularly relating to initiating new treatments or changing therapy, monitoring ongoing treatment or stopping therapy. Data collection and coding were conducted concurrently. We employed an iterative approach, using dialogue from earlier interviews to inform later questioning and to refine the interview schedule. The interview schedule was adapted for use with the trainees, to more closely reflect their level of experience and exposure to general practice. We stopped recruitment when the interviews did not generate new themes (reached redundancy).¹² Participants completed a short survey at the end of each interview eliciting demographic data and self-reported levels of confidence and skills in using computer systems.

•	What information or clinical decision support resources do you
	consult most often when making prescribing decisions? Pre-
	scribing decisions could relate to drug selection, dosage regi-
	men, adverse effects, interactions and contraindications.

Box 1 Summary of themes for interviews

- type of information or guidance you were seeking,
- o clinical circumstances where information is required,
- electronic or paper-based specific guidelines or information sources,
- o features of preferred resources,
- o frequency of use of resources,
- when is the information needed (point of care and away from patients),
- o access to preferred resources.
- Thinking about initiating a medicine, continuing a patient on therapy and stopping therapy, are there particular aspects of the prescribing process where information needs are greater?
- Are there particular clinical conditions where information needs are greater?
- Focussing specifically on electronic resources
 - advantages and disadvantages of electronic over paperbased resources,
 - o valued features of electronic decision support systems,
 - features of alerts and reminders (content, presentation and perceived usefulness),
 - support and training needs.
- In addition, for registrars ('Trainees')
 - changes in needs for information and clinical decision support over time,
 - contrast information needs in intern (hospital) practice and general practice training,
 - o what are your preferred resources and why,
 - o when is the information needed and used,
 - access to preferred information resources (people, paper and electronic).

Analysis

At the completion of all interviews, we conducted a comprehensive descriptive thematic analysis by coding the dialogue in each interview transcript and determining themes relating to the codes. Three researchers generated independent coding schemes and the final coding scheme was derived by consensus. Final codes were applied through blinded dual coding of all transcripts to ensure the reliability and validity of qualitative data analysis. The transcripts were then imported into NVivo 7 (QSR International, http://www.qsrinternational.com) and the codes assigned by the two reviewers applied to organize data for further analysis. Two team members

 TABLE 1
 Demographic characteristics of participants

	Experienced GPs $(N = 18), n (\%)$	GP registrars 'Trainees' $(N = 9)$, n (%)
Sex		
Male	9 (50)	3 (33)
Female	9 (50)	6 (67)
Years in practice		
<10 years	2 (11)	n/a
10 – 20 years	5 (28)	
>20 years	11 (61)	
Use of computing system		
Prescribing	17 (94)	9 (100)
Electronic medical records	17 (94)	9 (100)
Confidence in using computers ^a		
Median (range)	4 (1.5–5)	4 (4–5)
Skills in using computers ^a		
Median (range)	4 (1.5–5)	4 (3–5)

^aSelf-reported confidence and skills in computer use, scored on 5 point Likert scale where 1 = not at all/limited and 5 = very confident/ advanced skills.

independently interpreted the thematic analysis and compared the responses of clinician groups (rural versus urban and experienced versus trainees). Differences in interpretation were resolved through discussion. Direct quotations from interview transcripts highlight particular aspects of these themes and are identified by interview number.

Results

Participants

Thirty-four study information packs were distributed to experienced GPs, 23 indicated their willingness to participate and 18 were interviewed for the study (six from each of the participating Divisions of General Practice). Twenty information packs were distributed to trainees, 17 agreed to participate and nine were interviewed.

The majority of experienced GPs (11/18, 61%) had been in practice for >20 years. All trainees and all but one of the experienced GPs reported using computers for prescribing and patient medical records. For the most part, systems alerted GPs to drug interactions and allergies with some incorporating electronic materials (e.g. MIMS, see Table 2). While the median selfreported levels of confidence and skills in computer use were the same in the two groups, the range was wider for the experienced GPs (1.5–5) than for trainees (3–5) (Table 1).

Our content analyses highlighted differences in responses between experienced and trainee GPs (but not urban and rural GPs) so we only contrast experienced and trainee GPs in the results.

Information needs and preferences

Not surprisingly, doctors' clinical experience was the dominant influence on practice and determined the need to consult additional information sources to support prescribing decisions. Doctors preferred to consult colleagues in specific clinical circumstances. Complex presentations, infrequently seen conditions, patients with multiple comorbidities or those failing one or more treatment regimens caused GPs to seek advice from others. Sometimes this meant corridor conversations with peers in their own practice. Experienced GPs repeatedly referred to specialist colleagues; trainees reported mentors and supervisors as their source of clinical expertize. Telephone hotlines and email services were alternative means of accessing specialist advice.

I consult my colleagues ... I follow advice and example from specialist colleagues ... I sometimes ring them up about prescribing things, particularly in patients they've had dealings with before. If there are patients who are having problems on particular medications or something is not working, I would certainly then ring them up or seek the advice of the local specialists. [Rural_GP6]

... the information I get from the specialist may not be just a recommendation on the drug, it may be a recommendation for some further tests because that situation is unusual. [Urban_GP1]

... I'm in GP training I think it's still easier for us to learn now because you know you have a supervisor who keeps on telling us or we go to the workshop. [Trainee_4]

Within this framework, printed and electronic information sources play an important but specific role in clinical practice. A key observation was the relatively infrequent use of information sources by some of the experienced GPs. These doctors have a limited repertoire of drugs and a personal formulary, which satisfies most of their prescribing—a number reported carrying the information needed for routine practice 'in my head'. They relied on resources to validate prescribing choices and confirm doses and contraindications, accessing information mostly during consultations.

... mostly you've got your armament in your head and so it's very rare that I go to any other source. [Regional_GP6]

... a computer in general practice is fantastic, it's a fantastic tool but that's all it is, it's still a tool. It doesn't make up for clinical knowledge, acumen, skill, all those sort of things. [Regional_GP7]

Consistent with their experience, trainees had greater information needs and were less confident

about their prescribing choices, dosing details, durations of therapy, pack sizes and the like. Trainees believed that their information needs would diminish as they gained experience and developed their own personal formulary. Trainees reported regular resource use out of hours to expand their clinical knowledge; they see this as part of their ongoing clinical training.

... I reckon I use these tools nearly every patient ... because I'm seeing a lot of new patients as well, every time I see a patient I look at their medication list. If there's some drug I don't know I always look it up ... [Trainee_1]

... this is the stuff I use all the time ... I feel really uncomfortable not having my AMH with me ... which might be just because I'm earlier in the job anyway, but still ... [Trainee_8]

Not only did trainees assemble a suite of resources, both electronic (including PDA versions) and paper but also they were often carried with them, not expecting to find their favoured resources available in the practices they worked in.

... if the computers were set up better or ... the programs had therapeutic guidelines and AMH already built in it would be a lot easier ... I always have to bring this big bag in with me full of books ... it's really annoying ... [Trainee_1]

Electronic information and CDSS

Regardless of how often resources were consulted, there was consistency between the two groups in the characteristics of valued electronic information sources. Three resources dominated the discussions— MIMS, the Australian Therapeutic Guidelines and the Australian Medicines Handbook (AMH) (Table 2).

It's just superb ... it's a lifesaver ... everyone, everyone uses antibiotic guidelines. [Regional_GP1]

Familiarity was often the result of first encountering the resource, usually in the printed version, early in clinical practice and in undergraduate and early postgraduate training. In the case of experienced GPs, this was most often MIMS, while trainees had been taught using the AMH. Trainees had also been introduced to the American resource Up to Date (http://www. uptodate.com) during vocational training, and the latter was now highly valued by them.

... [MIMS] ... I'm not saying that is the best layout, but that's the layout I've gotten used to since medical school days. I know where it is, I know there's going to be a section on interactions. I know there's going to be a section on the

Table 2	Features of	key electronic	information	resources used

Title	Funding and corporate governance	Content	Reported use	Valued features	Perceived limitations
MIMS	Electronic resources funded via subscription fees (as part of prescribing system), commercial	Compendium of regulator approved product information compiled by MIMS	After drug selection for: side effects, drug interactions, contraindications, doses, price, practicalities of prescribing, i.e. trade and generic names, pack sizes and subsidization status	Integrated in prescribing software so easy access, familiar layout, concise, quick, relevant, information on over-the-counter (OTC), non-prescription items	Not for guiding therapy choices, problems for some finding relevant sections—some scrolling through text required
Australian Medicines Handbook (AMH)	Subscription fees, not-for-profit	Drug monographs and comparative drug information	Choice of drug therapy and confirmation of prescribing details after drug selection	Australian, independent of pharmaceutical industry, reputable, clear practice points, concise, relevant, can scan around topic and drug options	Layout unfamiliar to some, not integrated, need to go outside prescribing software, too much information for some, no OTC products
Therapeutic Guidelines	Subscription fees, not-for-profit	Australian clinical practice guidelines for 14 clinical areas (includes antibiotics, psychotropic, neurology, palliative care and cardiovascular)	What to prescribe (drug and duration) for specific clinical conditions, particularly useful for less commonly seen clinical conditions	Australian, independent, reputable, confidence in resource, familiar, clear, simple, easy to use, concise, directive, represents 'best practice'	Not integrated, need to go outside prescribing software, cost

chemistry and biochemistry, so I know sort of roughly where they are down the screen. [Regional_GP2]

GPs mentioned the pressures of a 10- to 15-minute consultation and that their information needs were immediate at the point of care. They wanted clinically relevant information presented concisely, that was easily searchable, seamlessly integrated in the workflow and preferably embedded in their usual clinical software (the need to logon or go outside the main programme was seen as a burden and time waster). This time pressure was reflected in repeated statements about 'minimum effort' or 'limited clicking and scrolling'. The convenience of integration was such a desirable feature that it overrode other concerns about presentation or quality of the resource. In some cases, the lack of integration meant clinicians preferred paper formats of the resource, which allowed for rapid scanning of tables of contents and treatment options. Succinct summaries with clear practice points were preferred but with the facility for accessing more detailed information on the topic. Participants tended to assume the quality of the resources included in commercial software.

... if I can see something that saves me time and effort, I will use it. If it's there, I'll use it. [Rural_GP6]

... I think that non-integrated things will only ever get used if they are so vastly superior to what's out

there that they form an integral part and you can't live without them ... apart from that, unless something is seamlessly integrated and useful, it will not get used. [Regional_GP5]

... I've got the paper versions ... even if I was to get the electronic one it's not integrated with my software, so I still have to get out of the software to get into the other software. So I may as well use the ones that I've got here ... I've got them there. They're free. They work just as well. [Regional_GP4]

... I find I can scan a page much more easily than I can scan a computer screen and particularly with the Australian Medicines Handbook, I think there's a lot more information in the book than is available on the screen. [Rural_GP6]

... I guess it [MIMS] is just easy to follow ... easy to find what you want and ... I'm working on the assumption that it's a good quality database and I've never heard anyone say "no it's not" ... so I take it as gospel. [Rural_GP1]

When the information required was not available in the integrated resources, other electronic or paper sources were consulted. These often related to specific clinical conditions and patient populations, for example, depression (guides for switching between antidepressant medications), drugs in pregnancy and lactation and for paediatric dosing. One Australian resource, Murtagh's 'General Practice',¹³ was referred to by some as the 'bible for GPs'. Many of the participants reported use of the Google search engine, sometimes in apologetic terms; its ease of use offset by concerns about the quality of the information being accessed.

Neither experienced nor trainee groups identified information needs for specific clinical conditions or medicines to guide content development for future CDSSs. Rather, needs were highly dependent upon level of clinical experience, familiarity with existing resources and the patient populations being treated by them. Furthermore, participants did not identify particular points in the prescribing decision-making process (initiating, monitoring or stopping therapy) where CDSSs was seen to be more useful. Participants seemed to value on-demand information or passive decision support, in sources easily accessed that provide timely information to specific questions in formats they find helpful. Sometimes new resources were tried only a few times before being assessed as not useful.

... I just never found it useful, it never tells me what I want to know and I've never found it a particularly useful source of information. I'm not sure why. I've used it a few times and then gave up and thought it's just not delivering information in the way I needed to know. [Regional_GP6]

... the Australian Medicines Handbook, I did look at in paper copy some years ago. I haven't really looked at it in the last three years—but at that stage I kind of also went, "Oh, I don't really like the layout of this." Whether it was just nonfamiliarity and unwillingness to change. [Regional_ GP2]

Access and acceptability of CDSS

Cost was a consideration voiced more often by experienced GPs. Several practices had outdated resources, or insufficient licenses to serve all GPs, and this was attributed to cost. Particularly for Therapeutic Guidelines, this sometimes translated to a preference for paper formats because it had been provided for free (typically by pharmaceutical companies).

Trainees generally regarded information resources as essential for their work, but they too commented on the costs of having to buy and update resources themselves; most were accustomed to free access in the hospital system where they undertook early postgraduate training.

... (would you like to have those therapeutic guidelines on your computer?)_ I would love to, but I don't want to spend \$300 for it. [Regional_GP4]

... fortunately some of the guidelines are given to me by the drug company so I don't have to buy them. [Urban_GP3]

... because it was just easier to carry around on this [the PDA] and I then also bought the AMH for PDA as well at the same time but I haven't updated those just because the ongoing cost. [Trainee_1]

... oh, I wish the government would take it on. The fact that it is done privately and you have to pay through the nose for it for what is valuable and I think essential drug information, I think is wrong. [Rural_GP3]

Alerts of potential drug-drug and drug-disease interactions, allergy warnings and contraindications for medicine use were the most common form of CDSS encountered by participants; these are a feature of the most popular electronic prescribing systems in Australia. While GPs valued the safety net these automatic reminders provide, most complained of the lack of clinical relevance of many of the warnings, their repetition and intrusion into the flow of the consultation. Participants reported the danger of alert fatigue and the risk of clicking through and missing important information or switching off alerts. A number of GPs were unaware of the range of alerts present in their chosen CDSS or did not recognize the importance of accurate clinical data to activate them.

... so I think the danger there is you get used to clicking off because the stuff that is coming up isn't actually relevant and sometimes you can miss things that do come up that's relevant [Regional_GP3]

... I think it's that fine balance between just enough to be supported and not so much that you really get annoyed with it. And then ... you stop looking ... you can't have fatigue of just seeing these things endlessly come up [Regional_GP6]

... so I accept that I'm going to have to deal with lots of nuisance ones in order to be reminded about the really key ones [Rural_GP3]

Most trainees had only ever prescribed using a computer and were at ease with computer systems and electronic means of decision support. Experienced GPs were more likely to express a desire for training with new systems. Trainees worried that consulting information sources, particularly paper-based resources, in front of patients might convey inexperience and a lack of competence; in this regard, computer resources were seen as more acceptable and able to be more discretely accessed during a consultation. Experienced GPs tended to be comfortable accessing information, computer or paper-based, suggesting that patients were happy to have information sourced and verified during the consultation.

... well I'm happy to read the books when the patient is not in the room ... opening a book and flipping through it firstly takes a long time and also it might make the patient lose confidence in the doctor ... but using the computer, patients are used to you scrolling around the computer all the time so they don't mind because you are checking up to date information on the internet ... when you are on the computer it's up to date. [Trainee_8]

Discussion

Our study demonstrates that electronic information and CDSSs currently play a small but important role in supporting prescribing by Australian GPs. More often, doctors rely on their own 'knowledge in practice',¹⁴ a mix of theoretical and experiential knowledge gained from their training and trusted people resources supplemented with personal clinical experience and paper versions of information resources. The lesser knowledge in practice of trainees explains in part their greater information needs, which were expected to diminish over time. Participants in this study mostly used passive information sources and did not identify specific needs for CDSSs. This may also reflect a lack of exposure to these resources and a clear understanding of the potential benefits of these systems.

Our findings are based on the views and selfreported practices of GPs drawn from urban, regional and rural areas in the state of NSW. However, the views expressed by our participants are consistent with other published literature in that we found doctors seek to address relatively few questions during consultations,¹⁵ they use a limited number of resources¹⁴ and accessibility of information appears to matter more than quality.¹⁶ Our participants' views on time pressures in consultations, the importance of integrating clinically relevant resources with timely clinical messages into software and clinical workflows and frustrations with alerts mirror those reported in studies conducted in other countries and practice settings.^{9,10,17,18} Thus, we believe that the views of our study participants are likely to be generalizable to other Australian GPs as well as family practitioners working in other jurisdictions.

Opportunities to impress GPs are limited. Participants spoke of trying a resource a few times, and if its performance or format disappointed, it was unlikely to be used again. GPs need to see the value of CDSS, that is, it provides some efficiency in process, improves patient care or saves them time—as illustrated by the widespread uptake of electronic prescribing. While the initial impetus for the widespread uptake of electronic prescribing in Australia was government-funded incentives provided under the Practice Incentive Program,¹⁹ continued use of these systems reflects the value they offer in practice. There is also the risk that CDSSs could inadvertently add to practitioner workload if GPs are required to evaluate the relevance and appropriateness of computer suggestions presented to them during consultations.²⁰

Our findings suggest that proposals in the Australian eHealth Incentive¹¹ go only partway towards addressing the information needs of GPs. The financial incentives will address some of the concerns about cost. However, software integration is not a feature demanded in this incentive. GPs are disinclined to go outside their primary software program; accessing CDs and websites were seen as time consuming and a barrier to use. Incentives cannot ensure available resources are used.

In the absence of agreed Australian national standards, software vendors determine the content of the decision support incorporated into their systems. At present, these do not routinely include the AMH or Therapeutic Guidelines, favoured resources of participants in this study. Furthermore, our study demonstrated that GPs tend to assume electronic resources are good quality; recent evidence suggests that this confidence may be misplaced.²¹ In the absence of agreed standards, professional bodies and other relevant independent organizations may have a role in evaluating the quality of CDSS.

The Australian situation can be contrasted with that in the UK, where there is greater emphasis on standards and accreditation.²² Clinical Knowledge Summaries produced on behalf of the National Health Service are a mandatory component of accredited computing systems used during GP consultations. The web-based resources are developed by a multidisciplinary team and reviewed by professional organizations and patient groups, providing concise summaries on common clinical conditions in addition to detailed up to date clinical and background information, non-drug advice, patient information leaflets and recommendations for referral. Recognizing the differing needs and preferences of end-users these are also available through hand-held devices (e.g. PDAs, SmartPhones). UK computing systems also enable derivation of clinical indicators for the UK Quality and Outcomes Framework.²³ Significantly, the national strategy recognizes the importance of training to enable good data recording and storage practices that encourage data quality and respect patient confidentiality.

Conclusions

Simply making resources available electronically does not ensure their use in routine clinical practice. New CDSSs need to take account of the time pressures of practice, the requirement for access to integrated information systems that fit GPs' clinical needs and their patterns of practice. Standards and benchmarks are required to ensure that high-quality resources are universally available; these need to be inexpensive and updated regularly. Incentives and a national strategy may also be necessary. Progress elsewhere can provide a framework for Australian developments. Without attention to these fundamental issues, the uptake of CDSSs in Australia will be slow and the anticipated improvements in patient safety and health outcomes uncertain.

Acknowledgements

A Study Guidance Group consisting of representatives of all three organizations oversaw the conduct of all aspects of the research, commenting on study design and data interpretation. The authors alone are responsible for the final analysis, interpretation of the data and the writing of this paper. The final manuscript was not subject to approval by any of the research partners.

Competing interests: MBG and MW are employees of the NPS, which is an independent non-profit organization funded by the Australian Government Department of Health and Ageing to promote Quality Use of Medicines. JR is a member of the Prescribing Intervention Working Group, Pharmacy Review Group and Communications Review Group of the NPS and as an external consultant receives sitting fees for participation in these NPS activities. The authors have no other conflicts of interest to declare.

Authors' contribution: All authors were involved in study design and development of the provisional interview questions; AJM and S-AP pilot tested the interview schedule; AJM conducted the interviews; AJM, JR and S-AP generated the coding scheme; AJM and JR coded the transcripts; JR and S-AP interpreted the thematic analysis; JR, S-AP and MBG drafted the manuscript; all authors contributed to revisions of the manuscript. All authors read and approved the final manuscript.

Declaration

Funding: Research partnership between the Universities of Newcastle and New South Wales and the NPS (GO 186735). Ethical approval: University of Newcastle and University of NSW Research Ethics Committees and the CEOs of participating Divisions of General Practice and Training Networks.

Conflict of interest: none.

References

- ¹ Australian Health Information Council. *Electronic Decision Support Systems Report 2008*. http://www.health.gov.au/internet/main/publishing.nsf/Content/AHIC+EDSS+Report (accessed on 14 July 2009).
- ² Bates DW, Kuperman GJ, Wang S *et al.* Ten commandments for effective clinical decision support: making the practice of evidence-based medicine a reality. *J Am Med Inform Assoc* 2003; **10**: 523–30.
- ³ Garg AX, Adhikari NK, McDonald H et al. Effects of computerised clinical decision support systems on practitioner performance and patient outcomes. JAMA 2006; 293: 1223–38.
- ⁴ Kawamoto K, Houlihan CA, Balas EA, Lobach DF. Improving clinical practice using clinical decision support systems: a systematic review of trials to identify features critical to success. *BMJ* 2005; **330:** 765. Epub 2005 March 14.
- ⁵ Mollon B, Chong J, Holbrook A *et al.* Features predicting the success of computerized decision support for prescribing: a systematic review of randomized controlled trials. *BMC Med Inform Decid Mak* 2009; **9:** 11.
- ⁶ Pearson S-A, Moxey A, Robertson J et al. Do computerised clinical decision support systems for prescribing change practice? A systematic review of the literature (1990-2007). BMC Health Serv Res 2009; 9: 154.
- ⁷ Protti D, Bowden T. Australian GPs and Their Computers— Electronic Prescriptions Provide the Biggest Benefit. http:// www.cma.ca/multimedia/CMA/Content_Images/Inside_cma /HIT/10country/Australia.pdf (accessed on 5 January 2009).
- ⁸ McInnes DK, Saltman DC, Kidd MR. General practitioners' use of computers for prescribing and electronic health records: results from a national survey. *Med J Aust* 2006; **185:** 88–91.
- ⁹ Short D, Frischer M, Bashford J. Barriers to the adoption of computerised decision support systems in general practice consultations: a qualitative study of GPs' perspectives. *Int J Med Inform* 2004; **73**: 357–62.
- ¹⁰ Ahearn MD, Kerr SJ. General practitioners' perceptions of the pharmaceutical decision-support tools in their prescribing software. *Med J Aust* 2003; **179:** 34–7.
- ¹¹ Department of Health and Ageing. Practice Incentives Program eHealth Incentive Guidelines March 2009. http://www.medicareaustralia.gov.au/provider/incentives/pip/files/ehealth-guidelines. pdf (accessed on 21 June 2009).
- ¹² Strauss AL, Corbin J. Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory, 2nd edn. Thousand Oaks, CA: Sage Publications, 1998: p. 312.
- ¹³ Murtagh J. *General Practice*, 4th edn. Sydney: McGraw-Hill, 2007.
- ¹⁴ Gabbay J, le May A. Evidence based guidelines or collectively constructed "mindlines?" ethnographic study of knowledge management in primary care. *BMJ* 2004; **329:** 1010. doi:10.1136/ bmj.329.7473.1013.
- ¹⁵ Coumou HCH, Meijman FJ. How do primary care physicians seek answers to clinical questions? A literature review. *J Med Libr Assoc* 2006; **94:** 55–60.
- ¹⁶ González-González AI, Dawes M, Sánchez-Mateos J et al. Information needs and information-seeking behavior of primary care physicians. Ann Fam Med 2007; 5: 345–52.
- ¹⁷ van der Sijs H, Aarts J, Vulto A, Berg M. Overriding of drug safety alerts in computerized physician order entry. *J Am Med Inform Assoc* 2006; **13:** 138–47.
- ¹⁸ Taylor LK, Tamblyn R. Reasons for physician non-adherence to electronic drug alerts. *Stud Health Technol Inform* 2004; **107:** 1101–5.

- Quinlan F. Electronic prescribing in general practice: one small step. Aust Presc 2000; 23: 50–1.
 Rousseau N, McColl E, Newton J, Grimshaw J, Eccles M. Practice
- ²⁰ Rousseau N, McColl E, Newton J, Grimshaw J, Eccles M. Practice based, longitudinal, qualitative interview study of computerised evidence based guidelines in primary care. *BMJ* 2003; **326:** 314. doi:10.1136/bmj.326.7384.314.
- ²¹ Sweiden M, Reeve JF, Brien JE et al. Quality of drug interaction alerts in prescribing and dispensing software. *Med J Aust* 2009; **190**: 251–4.
- ²² Royal College of General Practitioners. Information Management and Technology in General Practice. RCGP Information Sheet No.7 February 2005. http://www.rcgp.org.uk /pdf/ISS_INFO_07_Feb05.pdf (accessed on 3 December 2009).
- ²³ Department of Health. Quality and Outcomes Framework (QOF). London: NHS. http://www.dh.gov.uk/en/Healthcare/Primarycare/Primarycarecontracting/QOF/index.htm (accessed on 2 February 2010).