research

A computerised prescribing decision support system to improve patient adherence with prescribing

A randomised controlled trial

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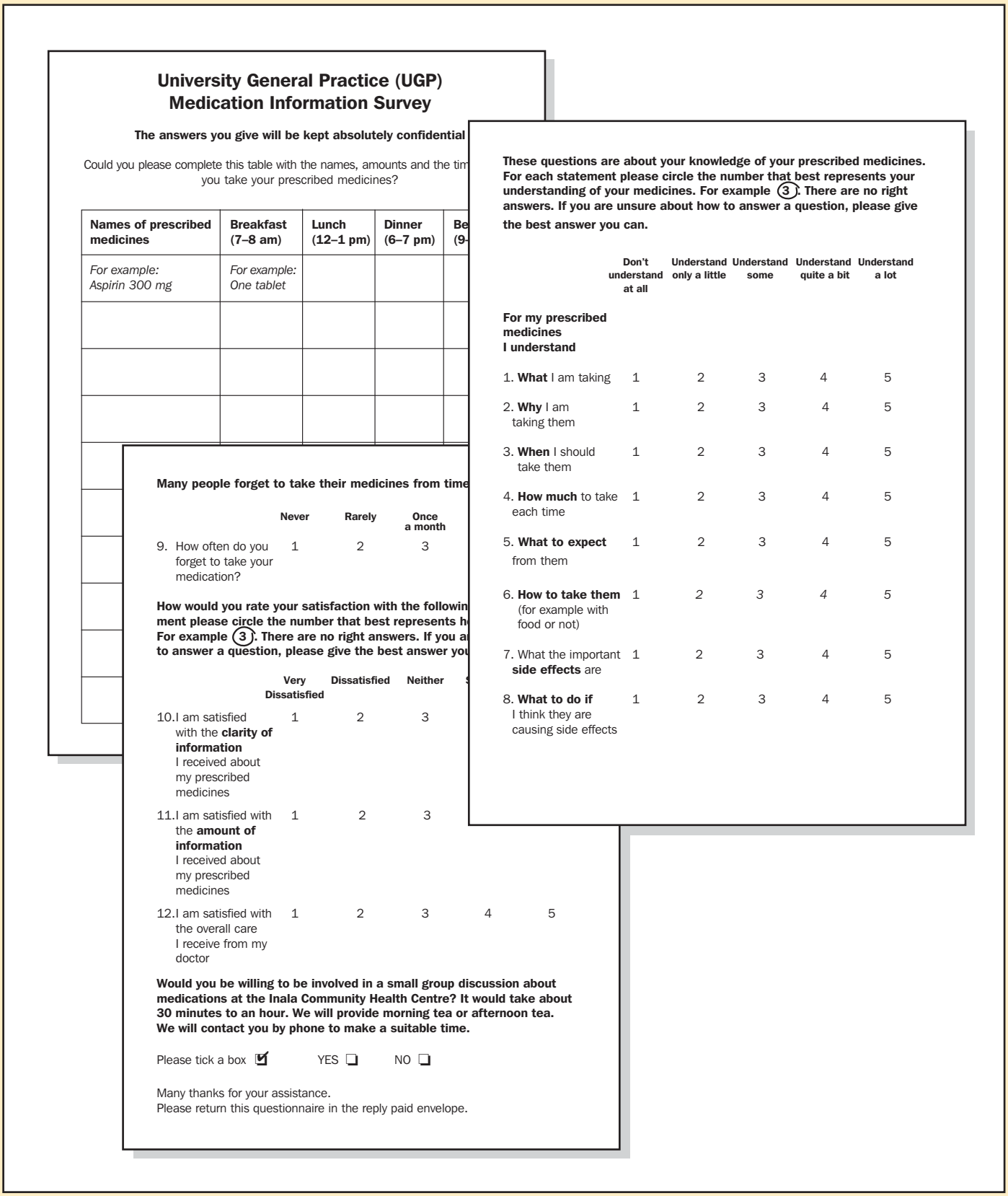
BACKGROUND Medication adherence is often suboptimal and this leads to poorer health outcomes.
METHODS *Participants:* 179 adult patients taking three or more, long term medications in one academic general practice in Brisbane, Queensland.
Design: Unblinded, factorial, randomised controlled trial of computer generated consumer product information, computer generated medication timetable, both, or usual care.
Main outcome measures: We derived adherence to medication by measuring the relative prescription rate for six groups of medications extracted by the Health Insurance Commission. We also measured patients' knowledge of, and satisfaction with, medications, and general practitioners' attitudes to the decision support system.
RESULTS There was no effect on medication adherence. Although GPs were supportive of the system, neither patients' self reported knowledge of medications, nor satisfaction with care, was increased by the intervention.
CONCLUSION Simply providing patients with medication timetables and computer generated consumer product information does not improve drug adherence in primary care.

Nonadherence to medications can lead to consequences ranging from incomplete control of disease (with low adherence) to toxicity (from over dosing).[1] It increases costs by minimising the effectiveness of proven health care interventions.[2] Medications are costly to government, community and patients, (the Pharmaceutical Benefits Scheme [PBS] prescription costs for the year ending 30 June 2001 was $3 820 600 000)[3]. Among elderly people discharged from hospital with congestive heart failure, 30% had an adherence rate of less than 80%.[4]

Information about medications can come from many sources, including the original prescriber, pharmacist, media, friends or relatives. Adherence is improved by providing directed information.[5] Theoretically, general practitioners should be optimal sources because they know their patients' circumstances, which should best position them to answer individual questions.[6] Linking written information delivery to computer generated prescriptions seems ideal to supplement information provided verbally. Furthermore, the provision of consumer product information (CPI) before purchasing a prescribed medication might allow patients to make decisions that are more informed.[7]

Clinical Decision Support Systems (DSSs) are computer systems designed to support the patient care related activities of medical practitioners.[8] They are useful in many areas of clinical care, including the provision of both provider and patient directed preventive reminders[8–10] and drug dosing.[11]

Hospital based studies have shown that the provision of patient information at discharge[12,13] enhances adherence. We set out to undertake a similar trial in general practice.



University General Practice (UGP) Medication Information Survey

The answers you give will be kept absolutely confidential

Could you please complete this table with the names, amounts and the tim
you take your prescribed medicines?

Names of prescribed medicines	Breakfast (7–8 am)	Lunch (12–1 pm)	Dinner (6–7 pm)	Be (9-
For example: Aspirin 300 mg	*For example: One tablet*			

Many people forget to take their medicines from time

	Never	Rarely	Once a month
9. How often do you forget to take your medication?	1	2	3

**How would you rate your satisfaction with the followin
ment please circle the number that best represents h
For example (3). There are no right answers. If you a
to answer a question, please give the best answer you**

	Very Dissatisfied	Dissatisfied	Neither		
10. I am satisfied with the **clarity of information** I received about my prescribed medicines	1	2	3		
11. I am satisfied with the **amount of information** I received about my prescribed medicines	1	2	3		
12. I am satisfied with the overall care I receive from my doctor	1	2	3	4	5

Would you be willing to be involved in a small group discussion about medications at the Inala Community Health Centre? It would take about 30 minutes to an hour. We will provide morning tea or afternoon tea. We will contact you by phone to make a suitable time.

Please tick a box ☑ YES ❑ NO ❑

Many thanks for your assistance.
Please return this questionnaire in the reply paid envelope.

These questions are about your knowledge of your prescribed medicines. For each statement please circle the number that best represents your understanding of your medicines. For example (3). There are no right answers. If you are unsure about how to answer a question, please give the best answer you can.

	Don't understand at all	Understand only a little	Understand some	Understand quite a bit	Understand a lot
For my prescribed medicines I understand					
1. **What** I am taking	1	2	3	4	5
2. **Why** I am taking them	1	2	3	4	5
3. **When** I should take them	1	2	3	4	5
4. **How much** to take each time	1	2	3	4	5
5. **What to expect** from them	1	2	3	4	5
6. **How to take them** (for example with food or not)	1	2	3	4	5
7. What the important **side effects** are	1	2	3	4	5
8. **What to do if** I think they are causing side effects	1	2	3	4	5

Figure 1. University General Practice medication information survey (sample)

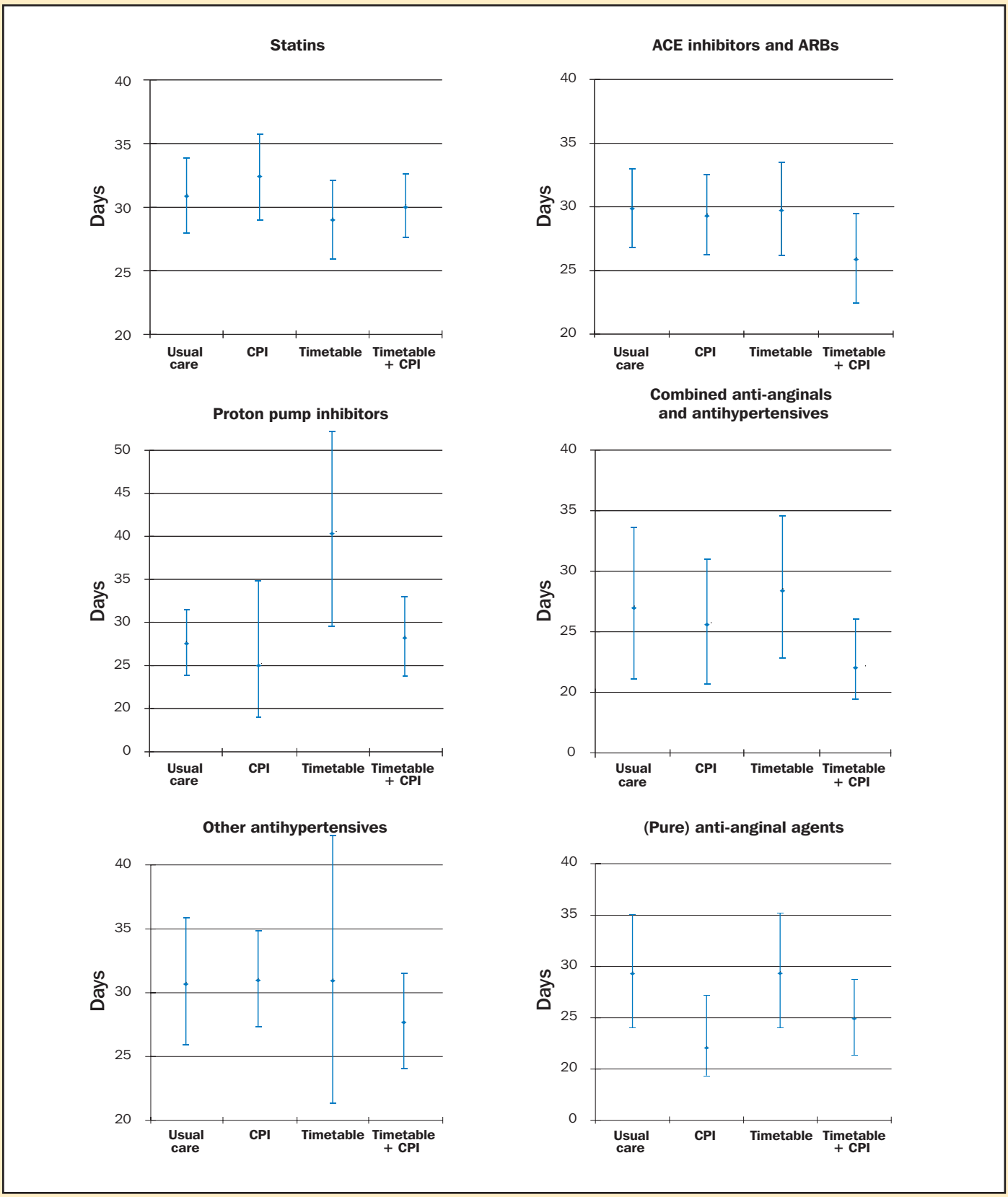


Figure 2. Days between dispensing for groups of medications (95% CI for mean)

Table 1. Long term medications for analysis

Class of medication	Generic names
Statins	Simvastatin, atorvastatin, pravastatin, fluvastatin
Angiotensin converting enzyme (1, 2) inhibitors	Perindopril, enalapril, lisinopril, ramipril, irbesartan, captopril, quinapril, fosinopril, trandolapril, losartan
Combined anti-anginal and antihypertensive agents	Atenolol, metoprolol, diltiazem, verapamil, nifedipine[†]
Other antihypertensive agents hydrochlorothiazide with amiloride	Amlodipine, felodipine, nifedipine[†], indapamide,
Anti-anginal agents	Isosorbide mononitrate, glyceryl trinitrate
Proton pump inhibitors	Omeprazole, pantoprazole, lansoprazole

[†] Nifedipine appears twice depending on its use as an antihypertensive or an anti-anginal agent, which could be derived from its formulation

Table 2. An example medication timetable

Medication	Strength	Breakfast 7–8 am	Lunch 12–1 pm	Dinner 6–7 pm	Bedtime 9–10 pm
Imdur durules (isosorbide mononitrate)		One with water			
Hydrocortisone	30 g	Apply twice a day or to the red area			Apply twice a day or to the red area
Diazepam	5 mg	One before meals	One before meals	One before meals	One at bedtime
Other medications:					
Panafcortelone: take as directed in a reducing dose					

Methods

We undertook an unblinded, two by two factorial, randomised controlled trial on adult (over 17 years) patients taking three or more long term medications from the University General Practice, Inala Community Health Centre, Brisbane, Queensland. The practice serves a population of predominantly low socioeconomic status with wide ethnic diversity. The study received approval from the University of Queensland Ethics Committee. Exclusion criteria were failure to provide informed consent, illiteracy, or visual impairment. A DSS was developed to interface with the prescribing system (Rx Medical Version 3.0). Patients were randomised by a computer algorithm within the DSS that also collected data and generated the interventions. The interventions were the relevant CPI as provided by the pharmaceutical companies, and/or a medication timetable[12] that linked taking of medications to meal times and bedtime. Both interventions were printed at the discretion of the treating GP. Patients were followed for a minimum of six months. Recruitment for the trial began in April 1997 and ceased in April 1999.

Relative prescription rates (observed/expected prescription interval) were calculated for six groups of medications (*Table 1*). Adherence was measured using data from the Health Insurance Commission (HIC). Values of more than 30 days suggested low adherence, and those less than 30 days suggested over adherence.

A (piloted) patient questionnaire was designed that assessed self reported knowledge of names of patients' medications and was compared with the practice database, self reported knowledge of medications (including side effects, indication and timing) and patient satisfaction with information they received about their medications and care at the practice (*Figure 1*). These were mailed with a replied paid envelope, and up to three telephone calls were made if there was no reply within two weeks. The six GPs who used the DSS completed a questionnaire about their satisfaction with the DSS. This was supplemented by interview data.

We calculated that 200 patients were needed to detect a 40% difference in adherence.[12] Analysis was by intention to treat, and used Chi-square, Kruskall-Wallis and ANOVA tests.

Results

One hundred and seventy-nine patients were recruited. There were no differences ($p<0.05$) in the four trial groups with respect to numbers of females, age or numbers of medications prescribed. Fifty-three percent of study patients were women, with an average age of 63 years (SD: 10.7). On entry, patients had an average of eight (SD: 4.1) medications, both long and short term.

Medication adherence

Two separate analyses of the PBS data from the HIC were performed. Initially the entire data set was analysed. This did not show any significant differences between any of the study groups (data not presented). We tested whether there was an effect from the interventions that occurred only during the first six months following an individual's entry into the study (*Figure 2*).

The results indicated the interventions did not influence patient adherence to the selected long term medications.

Patient survey results

Of the 172 questionnaires mailed to patients, 121 questionnaires were returned by mail or answered during phone follow up (70% response rate). There were seven deaths during this time. There were no statistically significant differences between the four study groups with respect to any of the attitudinal or self reported knowledge related items on the questionnaire.

GP attitudes to the DSS

The GPs were supportive of the DSS; they guessed that more appropriate medication information should improve adherence to prescribed medications. Their major criticism related to the CPI. Most felt the time taken to print 7–8 pages of relatively hard to read material was not worth their time.[14] They felt printing the medication timetable (*Table 2*) was more useful. Consequently, at interview most GPs said they usually printed the timetable but rarely printed the CPI. One unintended benefit was a trigger to review the current list of medications. However, they were unable to generate the interventions as frequently as they would have desired.

Discussion

We found computer generated medication information failed to influence the adherence of patients to long term medication or patients' knowledge about their medications and their satisfaction with the care. The GPs supported the concept, despite some reservations about CPI sheets.

The success of the earlier hospital study[12] was with medical patients on discharge who were more likely to have undergone changes to their medications, which may have made the usefulness of a timetable much greater.

Perhaps the proxy we used for measuring adherence – the somewhat crude estimate of the duration between prescribing and dispensing – may not have been valid. Although we did not achieve the numbers we estimated for adequate power, there were few trends to suggest a type-2 error.

Although computer generation of information seems an attractive option, it is not effective on its own at improving adherence in general practice. It may well be that it is the content and the patient centredness of the material that is important to success.

Implications of this study for general practice

- Patients need medication information.
- Simply providing more medication information did not improve adherence.
- Further work is needed to find ways to efficiently improve adherence to drugs in general practice.

Acknowledgments

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Conflict of interest: none.

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