Bringing patients' own medications into an emergency department by ambulance: effect on prescribing accuracy when these patients are admitted to hospital

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ABSTRACT

Objective: To determine whether the availability of patients' own medications (POM) in emergency departments (EDs) results in decreased prescribing errors of patients' usual medications on admission.

Design, participants and setting: Observational study of patients presenting by ambulance to the ED of Austin Hospital, a Melbourne metropolitan teaching hospital, between 13 and 31 March 2006. Patients were enrolled if they were brought to the ED by ambulance, aged 18 years or older, taking four or more regular medications, admitted to hospital, and not referred to a pharmacist before the admission medication chart was written. ED pharmacists determined patients' regular medications and details of medications brought in by ambulance. Admission medication charts were assessed and discrepancies were recorded as prescribing errors if a change was made after a pharmacist discussed the discrepancy with the prescriber.

Main outcome measures: Percentage of medications correctly prescribed when POM were brought in to the ED compared with when they were not; the nature and frequency of prescribing errors on admission.

Results: 100 patients were enrolled; they were taking 4–17 regular medications (mean, 8.0; SD, 3.7). Among the 428 POM that were brought to the ED, 56 errors occurred (13.1%); and among the 372 regular medications taken by patients for whom POM were not brought in, 95 errors occurred (25.5%) (difference in percentages, 12.4%; 95% CI, 6.7%–18.0%; $P < 0.001$). The most prevalent prescribing errors were omissions (40.4%), and most errors (72.8%) were classified as of "moderate" clinical significance.

Conclusions: When POM were brought to the ED by paramedics, significantly fewer errors occurred on admission medication charts. An intervention program to encourage paramedics to bring POM to the ED is indicated.

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An accurate medication history potentially reduces the risk of adverse drug events such as interactions or inadvertent ceasing of essential medications.[1-7] Obtaining such a history in an emergency department (ED) can be challenging, and patients' own medications (POM), if available, may give the earliest indication of the drug regimen taken before presentation. The label on each medication container provides information such as the name, strength and the frequency with which it is to be taken. POM may be particularly valuable when there are communication barriers, and after hours, when community records are unavailable.

In this study, we aimed to determine whether regular medications taken routinely before admission are more accurately prescribed on the hospital medication chart when POM are brought to the ED with the patient. If having these medications available in the ED is associated with improved prescribing, an intervention should be initiated to encourage patients and paramedics to bring POM to hospital.

METHODS

This observational study was conducted in the ED at Austin Hospital (Austin Health), a metropolitan mixed department serving adults and children, with about 51 000 presentations and an admission rate of 31% in 2006 (Michael Yeoh, Director of Quality and Audit, Austin Health, personal communication). Austin Health and Monash University ethics committees approved the study. As data were collected for routine care, patient consent was not required.

Patients were recruited to the study if they: were brought to the ED by ambulance between 13 and 31 March 2006 (inclusive); were aged 18 years or older; were taking four or more regular medications before presentation; and were admitted to the emergency medical unit or an inpatient ward. Patients presenting from institutionalised care or who had been referred to a pharmacist before the admission medication chart was written were excluded. Potentially eligible patients were identified prospectively between 08:00 and 20:00 by an ED pharmacist using the electronic ED admission database. Prospective identification meant that patients were identified on arrival by ambulance, and tracked throughout their ED stay to ensure that it was clear whether medications were brought in by ambulance. Patients whose medications were brought in later were excluded.

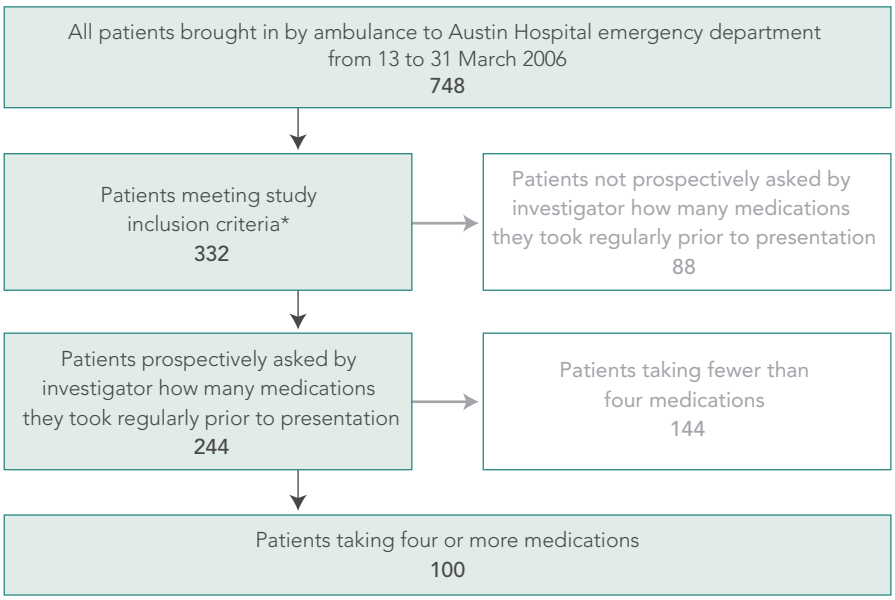
Each patient was seen by one of two ED pharmacists, who interviewed the patients and contacted their families or carers, pharmacies, doctors and community nursing services to compile his or her medication history. This was regarded as the "gold standard" list of medications taken before admission.

After the eventual admitting unit had reviewed the initial medication chart (containing orders prescribed earlier by the ED or medical units or both), an ED pharmacist assessed any differences between the medication history and the medications prescribed in hospital after admission to a hospital ward. Discrepancies (potential errors) identified were discussed with the admitting unit to determine the prescriber's intention. Deliberate changes to pre-admission medication regimens were not considered to be errors. To minimise bias associated with intentionally vigilant prescribing, medical staff were not made aware of the study.

One ED pharmacist collated and de-identified admission medication charts, medication histories and details of POM brought in. An independent pharmacist, not involved in the patient's clinical care, completed a standardised data collection form. The ED pharmacist who was involved in the patient's care checked these forms and any errors were corrected after discussion.

Medications were considered "brought in" if the patient's regular medications were

1 Details of the recruitment of the 100 patients in the study



* Admitted to hospital; aged ⩾ 18 years; taking four or more regular medications before presentation; not admitted from institutionalised care facilities; not referred to a pharmacist prior to the medication chart being written. ◆

brought in by ambulance, including labelled packs, medications in dose administration aids with a backing card outlining the regimen, and loose strips of identifiable tablets. Medications taken *pro re nata* (PRN), meaning "as needed", were not assessed. If a list was brought in, without the actual medications, the medications were considered "not brought in".

One ED pharmacist and the independent pharmacist worked separately to categorise and assign significance to the prescribing errors; then, together, they discussed inconsistencies to achieve consensus. Prescribing errors were classified as:

- wrong drug (another medication was intended);
- indication not treated (omission);
- unnecessary treatment (commission — charting a medication the patient was not taking or no longer taking);
- wrong dosage;
- wrong frequency;
- wrong formulation; and
- wrong route of administration.[8]

Each error was assessed as being of minimal, moderate or high significance. Errors of minimal significance were defined as those from which the patient was *unlikely* to suffer significant adverse events (eg, omission of vitamins, calcium supplements, aperients); errors of moderate significance were those from which the patient was *likely* to experience a medical adverse event (eg, omission of regular analgesia, eye drops for glaucoma, regular inhaled medications, and antiplatelet therapy); and errors of high significance were those involving medications of low therapeutic index or associated with potentially severe adverse events (eg, omission or other error in prescribing warfarin, insulin, strong regular analgesics, and β-blockers).

The main outcome measure was the percentage of medications taken before presentation that were correctly prescribed on admission when POM were brought in with patients arriving by ambulance to the ED compared with when they were not. We estimated that prescribing error rates were about 10% when POM were brought in with patients, and 20% when they were not. To detect this difference, at least 219 regular medications were required in each group (level of significance, $P < 0.05$; power, 0.8). The χ^2 test (with Yates correction) was used to compare proportions. EpiCalc 2000 (version 1.02; Brixton Health, Llanidloes, UK) was used for data analysis.

RESULTS

Of 748 patients brought in by ambulance to the Austin Hospital ED from 13 to 31 March 2006, 100 fulfilled our selection criteria and were recruited into the study (Box 1). No patients were referred to a pharmacist prior to the medication chart being written. Box 2 shows baseline characteristics of the 100 patients.

Prescribing accuracy increased when POM were brought in compared with when

2 Baseline characteristics of the 100 patients in the study

Characteristic	
Mean age in years (SD)	71.8 (14.7)
Number of men	63
Location of patient pick-up by ambulance	
Home	86
Other*	14
Australasian Triage Scale category[9]	
1 and 2 (resuscitation, emergency)	30
3 (urgent)	50
4 and 5 (semi-urgent, non-urgent)	20
Disposition from emergency department	
Emergency medical unit	18
Medical unit, specialist unit, or other hospital	82
Verbal communication in English	
No problems	66
Borderline barrier (language or medical reasons†)	15
Unable to communicate (language or medical reasons†)	19
Regular medications taken	
Mean number (SD)	8.0 (3.7)
Range	4–17

* Includes home of relative or friend, doctor's surgery, public place. † Such as confusion or respiratory distress. ◆

3 Nature and number of the 151 prescribing errors identified

Error category	Occurrence (%; 95% CI)	Examples
Wrong drug	6 (4.0%; 1.6%–8.8%)	Irbesartan (irbesartan with hydrochlorothiazide intended); omeprazole (esomeprazole intended)
Indication not treated (omission)	61 (40.4%; 33.0%–49.0%)	Aspirin, diazepam, eye drops for glaucoma, glyceryl trinitrate patch, insulin, simvastatin, warfarin
Unnecessary treatment (charting a medication the patient was not taking or no longer taking)	17 (11.3%; 6.9%–18.0%)	Amlodipine, darbepoetin alfa, diltiazem, hydrochlorothiazide, levetiracetam, pantoprazole
Wrong dosage	43 (28.5%; 22.0%–36.0%)	Methotrexate (15 mg weekly charted, 7.5 mg weekly intended); protaphane insulin (70 units charted, 60 units intended)
Wrong frequency	20 (13.2%; 8.5%–20.0%)	Diclofenac (nocte charted, bd intended); gemfibrozil (tds charted, bd intended); gliclazide modified-release tablets (mane charted, bd intended)
Wrong formulation	4 (2.6%; 0.9%–7.1%)	Carbamazepine (previously taking controlled-release formulation, immediate-release formulation prescribed)

bd = twice daily. tds = three times daily. mane = morning. nocte = at night. ◆

4 Occurrence and examples of prescribing errors of differing levels of significance

Significance of error	Occurrence (%; 95% CI)	Examples
Minimal	39 (25.8%; 19.0%–34.0%)	• Omission of alendronate 70 mg orally weekly. • Omeprazole charted when esomeprazole was intended. • Fluticasone/salmeterol inhaler 250/25 µg was charted as 250/50 µg. • Mixtard insulin (Novo Nordisk) charted as 12 units, patient was on 10 units. • Folic acid dose charted as 2.5 mg orally daily, patient was on a dose of 7.5 mg.
Moderate	110 (72.8%; 65.0%–80.0%)	• Oxycodone 5 mg orally tds was charted for a patient presenting with sciatica; the patient was taking 15 mg orally bd before admission. Naproxen slow-release 1000 mg orally daily was also omitted in the same patient. • Gliclazide 40 mg orally mane was charted; the patient was taking 30 mg of a modified-release formulation. • Omission of a lunchtime dose of aluminium hydroxide in a patient with renal disease. • Long-term therapy with prednisolone 5 mg orally bd charted as 5 mg orally mane.
High	2 (1.3%; 0–5.0%)	• Methotrexate was charted as 15 mg weekly when the dose before admission was 7.5 mg. One dose of 15 mg was given in hospital before the error was amended. If this dose had been continued after discharge, it could have harmed the patient. • Omission of warfarin used to manage the risk of stroke associated with atrial fibrillation.

bd = twice daily. tds = three times daily. mane = morning. ◆

they were not. A total of 151 admission prescribing errors were identified. Among the 428 POM that were brought to the ED, 56 errors occurred (13.1%); among the 372 regular medications taken by patients for whom POM were not brought in, 95 errors occurred (25.5%). Therefore, 86.9% of medications taken before admission were correctly charted when medications were brought in, and 74.5% of medications were correctly charted when they were not (difference in percentages, 12.4%; 95% CI, 6.7%–18.0%; $P < 0.001$).

All, some, or none of patients' regular medications were brought in for 30%, 37% and 33% of patients, respectively. Paramedics were often able to bring in POM for patients in high-acuity triage categories, or those transported from a public place, relative or friend's home or doctor's clinic. The most prevalent error type was omission, occurring on 61 occasions (Box 3). Most prescribing errors were of moderate significance (Box 4). One medication (insulin) that was brought in was lost, requiring redispensing before discharge.

DISCUSSION

Bringing POM to the ED with patients arriving by ambulance was associated with almost half as many prescribing errors on admission medication charts compared with when POM were not brought in. This suggests that bringing POM to the ED may assist in improving prescribing accuracy.

Omissions were the most prevalent errors, and this is consistent with findings of previous studies.[10-13] Medications that were not in tablet form were commonly omitted, including injections (particularly of insulin) and eye drops for glaucoma, highlighting that questions about such medications are routinely required during history taking. Another common error was prescription of wrong dosages; these were commonly charted for inhalers and cardiovascular medications.

For about two-thirds of patients (67%), paramedics brought in all or some medications, and it is notable that even patients in high-acuity triage categories, or those transported from a public place, relative or friend's home or doctor's clinic, often arrived with their medications.

If paramedics are to bring POM to EDs routinely, some procedural issues need to be managed. The risk of losing POM in transit or in hospital must be minimised. To achieve this, medications must not be sent back home before discharge as having these

available at the time of hospital discharge can be of great assistance for many reasons, including educating patients about changes made in hospital and disposing of medications that the patient should no longer take. Many EDs currently use distinctive bags to store POM, and this may minimise the risk of medications being lost.[14]

One paramedic station in New South Wales has increased the number of patients arriving at their local ED with their own medications. Paramedics store a blood pressure sphygmomanometer in a large, clear, zip-locked bag, which is then placed inside the case of a portable resuscitator. As paramedics always carry both pieces of equipment, the plastic bag serves both as a reminder to bring patients' medications to hospital, and as a receptacle in which to transport them.[15]

Having POM available in hospital has a number of other advantages beyond improving prescribing accuracy. It provides an opportunity to assess appropriate medication storage and to check issue and expiry dates, which are important for medications such as glyceryl trinitrate tablets, eye drops, adrenaline (eg, EpiPen Auto-Injector; CSL, Melbourne, Vic) and insulin. Techniques or difficulties using inhaler and insulin devices can also be assessed. Cases of multiple brands of the same medication being taken concurrently can be detected and POM containers and their contents may provide clues about adherence to dosing regimens. Having POM available in EDs may also reduce delays in administering doses, especially after hours.

A comprehensive medication history is more likely when multiple sources of information are used,[16,17] in conjunction with active communication with the patient or carer involved in organising the medications. POM should be used as prompts for patients to articulate their usual routine of medication administration.

Our study has a number of limitations. A medication history taken by the ED pharmacist was considered accurate, forming the "gold standard" against which discrepancies on medication charts were compared. It is not possible to prove the accuracy of the medication histories, but care was taken to minimise error.

Most eligibility criteria could be determined from the electronic ED admissions database. The exception was whether patients took four or more regular medications before presentation. The fact that 88 patients who met all other eligibility criteria were not asked the number of regular medications they were taking may have introduced some selection bias, as it was not possible to determine whether these patients differed from those who were included in the study. Most of these patients presented after 20:00 and were discharged from the ED before 08:00, outside the hours when an ED pharmacist was available to prospectively identify potentially eligible patients. Finally, this was a single-site study involving two clinical pharmacists, which may limit external validity.

In conclusion, the significant reduction in prescribing errors on the hospital admission medication charts of patients admitted through the ED when POM were brought in with the patient compared with when POM were not brought in suggests that bringing POM to hospital should become a part of paramedics' standard procedures, wherever possible. A promotional campaign to encourage paramedics to bring POM to hospital is indicated.

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COMPETING INTERESTS

None identified.

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REFERENCES

1 The Society of Hospital Pharmacists of Australia. Committee of Specialty Practice in Clinical Pharmacy. SHPA standards of practice for clinical pharmacy. *J Pharm Pract Res* 2005; 35: 122-146.
2 The Society of Hospital Pharmacists of Australia. Committee of Specialty Practice in Emergency Medicine. SHPA standards of practice in emergency medicine pharmacy practice. *J Pharm Pract Res* 2006; 36: 139-142.
3 Rodehaver C, Fearing D. Medication reconciliation in acute care: ensuring an accurate drug regimen on admission and discharge. *Jt Comm J Qual Patient Saf* 2005; 31: 406-413.
4 The Joint Commission. Sentinel event alert. Issue 35. Using medication reconciliation to prevent errors. 2006, 25 Jan. http://www.jointcommission.org/SentinelEvents/SentinelEventAlert/sea_35.htm (accessed Aug 2009).
5 Institute for Healthcare Improvement. Improvement stories. Accuracy at every step: the challenge of medication reconciliation. 2006; 20 Mar. http://www.ihi.org/IHI/Topics/PatientSafety/MedicationSystems/ImprovementStories/AccuracyatEveryStep.htm (accessed Aug 2009).
6 Rogers G, Alper E, Brunelle D, et al. Reconciling medications at admission: safe practice recommendations and implementation strategies. *Jt Comm J Qual Patient Saf* 2006; 32: 37-50.
7 Gleason KM, Groszek JM, Sullivan C, et al. Reconciliation of discrepancies in medication histories and admission orders of newly hospitalized patients. *Am J Health Syst Pharm* 2004; 61: 1689-1695.
8 Hepler CD, Strand LM. Opportunities and responsibilities in pharmaceutical care. *Am J Health Syst Pharm* 1990; 47: 533-543.
9 Australasian College for Emergency Medicine. Policy on the Australasian Triage Scale. Last reviewed 2006. http://www.acem.org.au/media/policies_and_guidelines/P06_Aust_Triage_Scale_-_Nov_2000.pdf (accessed Aug 2009).
10 Cornish PL, Knowles SR, Marchesano R, et al. Unintended medication discrepancies at the time of hospital admission. *Arch Intern Med* 2005; 165: 424-429.
11 Tam VC, Knowles SR, Cornish PL, et al. Frequency, type and clinical importance of medication history errors at admission to hospital: a systematic review. *CMAJ* 2005; 173: 510-515.
12 Nicholls M, Horler K, Campbell D, et al. Medicines. Peace in a POD (patients' own drug). *Health Serv J* 2001; 111: 35.
13 Drewett NM. Stop regular medicine errors. *Pharm in Pract* 1998; 8: 193-196.
14 Chan EW, Taylor SE, Marriott JL, Barger B. Exploration of attitudes and barriers to bringing patient's own medications to the emergency department: a survey of paramedics. *J Emerg Primary Health Care* 2008; 6 (4). Article 990313. http://www.jephc.com/uploads/990313EC1.pdf (accessed Aug 2009).
15 Australian Resource Centre for Healthcare Innovations. TABLETS — Tablets are bagged letting emergency treat safely. 2007. http://www.archi.net.au/e-library/awards/awards06/safety/tablets (accessed Aug 2009).
16 Carney SL. Medication accuracy and general practitioner referral letters. *Intern Med J* 2006; 36: 132-134.
17 Varkey P, Cunningham J, O'Meara J, et al. Multidisciplinary approach to inpatient medication reconciliation in an academic setting. *Am J Health Syst Pharm* 2007; 64: 850-854.

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