BJCP British Journal of Clinical Pharmacology

DOI:10.1111/j.1365-2125.2007.03017.x

The use of nationwide on-line prescription records improves the drug history in hospitalized patients

Bente Glintborg, Henrik E. Poulsen & Kim P. Dalhoff[1]

Department of Clinical Pharmacology, Rigshospitalet and [1]Clinical Pharmacologic Unit, Bispebjerg Hospital, Copenhagen, Denmark

Correspondence
Bente Glintborg, Department of Clinical Pharmacology, Rigshospitalet, Blegdamsvej 9, DK-2100 Copenhagen, Denmark.
Tel: + 45 3545 7642
Fax: + 45 3545 2745
E-mail: glintborg@dadlnet.dk

Keywords
home visits, medication lists, pharmacy records, secondary medication interviews

Received
26 February 2007

Accepted
22 June 2007

Published *OnlineEarly*
31 August 2007

WHAT IS ALREADY KNOWN ABOUT THIS SUBJECT

- Structured medication interviews improve the medication history upon hospitalization
- Pharmacy records are valid lists of the prescribed medications available to individual patients
- In Denmark, treating doctors now have access to their patients' pharmacy records through a real-time online electronic database

WHAT THIS STUDY ADDS

- Omission errors are frequent among hospitalized patients despite structured drug interviews and home visits
- Pharmacy records may be used to minimize patients' recall bias and improve the medication lists

BACKGROUND

Structured medication interviews improve the medication history in hospitalized patients. In Denmark, a nationwide electronic version of individual pharmacy records (PR) has recently been introduced. Use of these records could improve the medication lists in hospitalized patients.

METHODS

We prospectively included 500 patients admitted to an acute medical department. In individual patients, the PR was compared with (i) the medication list written in the patient chart and (ii) drug information provided by the patient during a structured drug interview upon admission and during a home visit after discharge.

RESULTS

Median patient age was 72 years. Upon admission, patients reported using 1958 prescription-only medications (POM) (median four drugs per patient, range 0–14), of which 114 (6%) were not registered in PR. In PR, 1153 POM (median one per patient, range 0–11) were registered during the month preceding admission. The patients did not report 309 (27%) of these upon admission. Home visits were performed in a subgroup of 115 patients. During home visits, 18% of POM registered in PR during the preceding month were not reported. Drug type was predictive of reporting irrespective of patient sex or age. Cardiovascular drugs were reported most and dermatologicals were reported less frequently. Underreporting might be due to recall bias, non-adherence or discontinuation of drugs.

CONCLUSIONS

Omission errors are frequent despite structured medication interviews. Pharmacy records or medication lists from all treating doctors must be included in medication reviews in order to reduce recall bias.

Introduction

Information is often lost at transitions in healthcare [1]. Information loss regarding prescribed medications causes medication errors [2, 3]. Targeted medication interviews upon hospitalization improve the medication lists [4–9]. Current campaigns on patient safety address the prevention of medication errors by use of systematic medication reviews (medication reconciliation) [10, 11].

Pharmacy records (PR) show all prescribed drugs available to the individual patient [12–14]. In Denmark, real-time electronic PR have become accessible to treating physicians [15]. The possible advantage of supplementing medication interviews with additional information from PR is unclear [13, 16–18].

The aim was to evaluate whether data from PR added knowledge to a medication list based on a structured medication interview among acute medical patients. Analyses of incongruent registrations were stratified according to patient and drug characteristics in order to detect when PR seemed especially useful.

Methods

Study sample

The study was conducted from February to September 2005 in an acute medical emergency ward at a university hospital in Copenhagen. The ward accepted patients with infectious, gastrointestinal, pulmonary, endocrine and cardiac medical diseases. A medication history was routinely written in the hospital file of all patients. Patients were eligible for the study if admitted on weekdays between 08.00 and 15.00 h. Patients unable to communicate sufficiently were excluded. All patients gave written informed consent. The Regional Ethics Committee and the Danish Registry Board approved the study.

Patients were included in the study on the afternoon of the day of their admission by an external physician. Patients were asked about their drug use in the week preceding admission and any recent alterations in drug regimen. Medication lists from referring doctor or district nurses were included if available. Only prescription-only medications (POM) data are reported, defined as medications available only on prescription as opposed to over-the-counter products. POM are categorized according to the Anatomical Therapeutic Chemical (ATC) system [19].

Home visits are demanding on resources and it was decided to visit only the subgroup of patients reporting use of digoxin, bendroflumethiazide, amlodipine, simvastatin and/or glimepiride. Home visits were made 4 weeks after the patient's discharge. During the visit, the patient accounted for current and recent medication use based on stored drugs.

Information on all drugs acquired on prescription from a Danish pharmacy during the preceding 2 years was collected from http://www.sundhed.dk. This website represents real-time data as the handling of prescription is directly reported on-line to the central database. Information is accessible to all physicians with an electronic certificate if they are responsible for the patient's treatment or if the patient consents [15]. We calculated the time interval between registration in PR and patient interview for individual drugs as the number of days between the two dates. Generic drugs (same ATC code) were included only once per patient and the time interval was given according to the registration date in PR closest to the interview. In individual patients, the dispensing frequency in the preceding 6 months was registered for each drug.

Statistical analysis

The use of drugs is reported using descriptive statistics. Independent groups of data were compared by χ^2 or *t*-tests. The reporting of prescribed drugs was analysed by multiple logistic regression analysis in order to identify drug or patient characteristics predictive of reporting. Age was included as a continuous variable, but dispensing frequency was transformed to a categorical variable due to lack of linearity in the model control. A generalized estimating equation (GEE) model was used due to possible clustering of data at patient level. Statistics were calculated using SAS™ 9.1 (SAS Inc., Cary, NC, USA).

Results

Of 710 patients screened, 500 were included in the study. Reasons for exclusion were inability to give informed consent (confusion, aphasia, etc., $n = 118$), referral to other departments ($n = 82$) and not wishing to participate ($n = 10$). Included patients had a median age of 72 years (range 17–97 years), 298 patients were female (60%). Age and sex distribution was similar among included and excluded patients ($P > 0.05$). Among seven included patients, data from PR were not available (two foreigners without PR, five Danish patients not permitting access).

At admission, patients reported use of 1818 POM (median three drugs per patient, range 0–14) during the structured drug interview, of which 352 (median 0 per patient, range 0–8) were not mentioned in the hospital file. A total of 1958 POM were reported in the hospital file and/or at drug interview, of which 114 (6%) were not registered in PR. Unregistered POM included drugs from all ATC categories, and the registration frequency was >85% in all ATC groups. Half of the used drugs were bought 0–33 days before admission, but 27 patients reported using drugs bought >1 year previously.

A total of 2192 POM (median four per patient, range 0–20) were registered in PR 0–90 days before admission. Of the 400 drugs registered in PR the week preceding admission, 19% were not reported by the patient at time of admission (Table 1).

Table 1

Drugs registered in pharmacy records compared with the use reported by patients upon admission

Time interval, days*	Registration in pharmacy records, *n* (100%)	Registered in hospital file *n*	%	Registered upon drug interview *n*	%	Registered in hospital file and/or drug interview *n*	%	Not registered *n*	%
0–7	400	262	66	305	76	326	82	74	19
8–30	753	421	56	496	66	518	69	235	31
31–60	611	370	61	391	64	420	69	191	31
61–90	428	196	46	209	49	222	52	206	48
Total 0–90	2192	1249	60	1401	64	1486	68	706	32

The registration is shown in different time intervals with registration in PR set to 100%. The number of drugs, n, is summed for all 500 patients included. *Number of days between the drug being registered in PR and hospital admission.

Table 2

Identified risk factors for reporting prescribed drugs upon admission†

	Model 1 OR (95% CI)	Model 2 OR (95% CI)
Number of reimbursements‡**		
One reimbursement		0.22 (0.13, 0.35)**
Two to four reimbursements		0.62 (0.4, 0.98)*
≥5 reimbursements		1
ATC group**		
Dermatologicals (ATC D)	0.04 (0.02, 0.12)**	0.05 (0.01, 0.16)**
Anti-infectives (ATC J)	0.11 (0.06, 0.17)**	0.15 (0.08, 0.26)**
Musculoskeletal (ATC M)	0.17 (0.09, 0.36)**	0.18 (0.09, 0.35)**
Sensory (ATC S)	0.23 (0.08, 0.66)*	0.23 (0.08, 0.64)**
Respiratory (ATC R)	0.35 (0.19, 0.62)**	0.30 (0.17, 0.53)**
Alimentary tract (ATC A)	0.38 (0.20, 0.72)**	0.35 (0.18, 0.66)**
Genitourinary (ATC G)	0.49 (0.18, 1.29)	0.37 (0.14, 0.96)*
Nervous (ATC N)	0.47 (0.27, 0.82)*	0.40 (0.32, 0.69)**
Hormones (ATC H)	0.46 (0.08, 2.60)	0.48 (0.08, 2.70)
Blood (ATC B)	0.51 (0.21, 1.24)	0.48 (0.20, 1.14)
Cardiovascular (ATC C)	1	1
Sex	NS	NS
Age	NS	NS

Results from the multiple logistic regression analysis reported as odds ratios (OR). Model 1 only includes Anatomical Therapeutic Chemical (ATC) group as explanatory variable. Model 2 includes ATC group and the number of reimbursements as explanatory variables. Calculations are corrected for patient's sex and age, although these variables were without statistical significance. †Prescribed drugs were identified as drugs registered in pharmacy records 0–30 days before admission. ‡Number of reimbursements during the 6 months preceding admission. *$P < 0.05$; **$P < 0.005$.

ATC category was predictive of whether a drug prescribed in the preceding month was reported upon admission ($P < 0.005$); cardiovascular drugs were reported most frequently. The odds of reporting drugs from ATC groups N, A, R, S, M, J, D were significantly lower (Table 2). Drugs dispensed several times in the preceding 6 months were more likely to be reported, but inclusion of this variable only slightly affected the odds ratios coupled to effect of ATC group (Table 2).

In the subgroup of patients reporting use of digoxin, bendroflumethiazide, amlodipine, simvastatin and/or glimepiride (171 patients), 115 home visits were made. The reasons for lacking a home visit were: death ($n = 21$), no consent ($n = 24$) and other ($n = 11$). The patients visited had a median age of 77 years (range 22–96 years) and 76 patients were women (66%). Of the 663 POM (median six drugs per patient, range 1–14) reported used the preceding week, 20 POM (3%) were not registered in PR. Among 340 POM (98 patients) registered in PR 0–30 days before the visit, 62 POM (18%) were not reported during the interview. Cardiovascular drugs were reported more frequently than drugs from ATC groups A, D, G, J, N and R ($P < 0.05$). Of 111 POM (median 0 per patient, range 0–9) registered in PR the week preceding the home visit, 12 (11%) were not mentioned.

Discussion

Medication reconciliation is gradually being implemented in several countries, including the USA, UK and Denmark in order to reduce medication errors upon hospitalization [10, 11, 20, 21]. Upon reconciliation, available medication lists are compared with patient's self-reported use. Patient's recall bias, involvement of multiple prescribers or missing medication lists from primary care may complicate the process [22, 23].

We evaluated if PR provided additional information compared with a structured medication interview. Even when including knowledge from hospital files, 19% of POM bought from a pharmacy the preceding week were unreported. During a home visit, 11% of POM were unreported. This incongruence might be due to discontinuation of therapy or recall bias. The latter is more likely, as the patients were asked to clarify all drugs used in the preceding week, including drugs currently discontinued. Therefore, 100% congruence would be expected. In a previous study, patients widely agreed using drugs registered in their PR, but forgot to mention them [14].

The time window for studying registrations in PR has been discussed [24, 25]. Short time periods increase the

positive predictive value of PR and more of the registered drugs are actually used. In contrast, large time windows must be applied to identify all currently used drugs. In our study, patients used drugs bought >1 year before study inclusion.

Chronic therapy dispensed several times in the preceding 6 months was more likely to be reported, perhaps due to less recall bias or because they were more likely still to be in use upon the interview. However, underreporting was especially linked to drug type irrespective of patient sex and age. Previous studies have similarly found better reporting of cardiovascular drugs as opposed to, for example, respiratory drugs, antibiotics or topically applied drugs [25–28].

The study was performed among patients acutely admitted to a medical department and we would expect similar results in similar settings. However, our data probably represent a best-case scenario, as some of the patient categories expected to have the most problems in self-reporting were excluded, e.g. patients admitted evenings and nights, and patients with dementia or confusion.

We find PR objective, valid and complete when measuring the POM available to individual patients. The records include all drugs whether prescribed from primary or secondary care, and they are not subject to recall bias. Due to Danish refund policies and a monopolized pharmacy system, very few POM are bought outside pharmacies [15, 28].

It was beyond the scope of the study to evaluate the clinical impact of insufficient medication history, but insufficient medication lists are known to hamper patient safety due to overprescribing, misinterpretation of drug-related symptoms and medication errors [16, 29, 30].

Use of PR in daily clinical practice is, at best, a future scenario in most countries, as the records are available only in local pharmacies. In Denmark, few physicians use the electronic records in their daily work [15]. However, our data illustrate that omission errors occur despite secondary interviews. Lists of prescribed drugs from all treating doctors must be provided whenever possible.

Competing interests: None declared.

We thank the nurses and secretaries at Bispebjerg hospital for their help during the data collection.

REFERENCES

1 Bell CM, Bajcar J, Bierman AS, Li P, Mamdani MM, Urbach DR. Potentially unintended discontinuation of long-term medication use after elective surgical procedures. Arch Intern Med 2006; 166: 2525–31.

2 Nickerson A, MacKinnon NJ, Roberts N, Saulnier L. Drug-therapy problems, inconsistencies and omissions identified during a medication reconciliation and seamless care service. Healthc Q 2005; 8 Spec No: 65–72.

3 Barnsteiner JH. Medication reconciliation: transfer of medication information across settings – keeping it free from error. Am J Nurs 2005; 105: 31–6.

4 Andersen SE, Pedersen AB, Bach KF. Medication history on internal medicine wards: assessment of extra information collected from second drug interviews and GP lists. Pharmacoepidemiol Drug Saf 2003; 12: 491–8.

5 Feely M, Singleton S, McGibney D. The inadequacies of information on current drug therapy in out-patients' records. J R Coll Physicians Lond 1984; 18: 222–4.

6 Cattell R, Wooller S, O'Mahoney S. Obtaining the correct drug history. Postgrad Med J 1997; 73: 255.

7 Manley HJ, Drayer DK, McClaran M, Bender W, Muther RS. Drug record discrepancies in an outpatient electronic medical record: frequency, type, and potential impact on patient care at a hemodialysis center. Pharmacotherapy 2003; 23: 231–9.

8 Bond CA, Raehl CL, Franke T. Clinical pharmacy services and hospital mortality rates. Pharmacotherapy 1999; 19: 556–64.

9 A Spoonful of Sugar. Medicines Management in NHS Hospitals. London: Audit Commission 2001. Available at http://www.audit-commission.gov.uk (last accessed: 1 July 2007).

10 Institute for Healthcare Improvement. http://www.ihi.org/IHI/Programs/StrategicInitiatives/SaferPatientsInitiative.htm (last accessed: 1 July 2007).

11 Operation Life Denmark. Available at http://www.operationlife.dk, http://www.trygpatient.dk (last accessed: 1 July 2007).

12 Monson RA, Bond CA. The accuracy of the medical record as an index of outpatient drug therapy. JAMA 1978; 240: 2182–4.

13 Van Hessen PA, Petri H, Urquhart J. Do prescribed drugs always follow the patients to hospital? Pharm Weekbl Sci 1990; 12: 66–70.

14 Lau HS, Florax C, Porsius AJ, De Boer A. The completeness of medication histories in hospital medical records of patients admitted to general internal medicine wards. Br J Clin Pharmacol 2000; 49: 597–603.

15 Danish Medicines Agency. http://www.laegemiddelstyrelsen.dk (last accessed: 1 July 2007).

16 Beers MH, Munekata M, Storrie M. The accuracy of medication histories in the hospital medical records of elderly persons. J Am Geriatr Soc 1990; 38: 1183–7.

17 Cornish PL, Knowles SR, Marchesano R, Tam V, Shadowitz S, Juurlink DN, Etchells EE. Unintended medication discrepancies at the time of hospital admission. Arch Intern Med 2005; 165: 424–9.

18 Chesney MA, Ickovics JR, Chambers DB, Gifford AL, Neidig J, Zwickl B, Wu AW. Self-reported adherence to antiretroviral medications among participants in HIV clinical trials: the AACTG adherence instruments. Patient Care Committee & Adherence Working Group of the Outcomes Committee of the Adult AIDS Clinical Trials Group (AACTG). AIDS Care 2000; 12: 255–66.

19 WHO Collaborating Centre for Drug Statistics Methology. Guidelines for ATC-Classification and DDD Assignment, 2nd edn. Oslo: WHO 1998.

20 Vira T, Colquhoun M, Etchells E. Reconcilable differences: correcting medication errors at hospital admission and discharge. Qual Saf Health Care 2006; 15: 122–6.

21 Whittington J, Cohen H. OSF healthcare's journey in patient safety. Qual Manag Health Care 2004; 13: 53–9.

22 Barat I, Andreasen F, Damsgaard EM. The consumption of drugs by 75-year-old individuals living in their own homes. Eur J Clin Pharmacol 2000; 56: 501–9.

23 Bikowski RM, Ripsin CM, Lorraine VL. Physician–patient congruence regarding medication regimens. J Am Geriatr Soc 2001; 49: 1353–7.

24 Lau HS, De Boer A, Beuning KS, Porsius A. Validation of pharmacy records in drug exposure assessment. J Clin Epidemiol 1997; 50: 619–25.

25 Johnson RE, Vollmer WM. Comparing sources of drug data about the elderly. J Am Geriatr Soc 1991; 39: 1079–84.

26 Sjahid SI, van der Linden PD, Stricker BH. Agreement between the pharmacy medication history and patient interview for cardiovascular drugs: the Rotterdam elderly study. Br J Clin Pharmacol 1998; 45: 591–5.

27 Heerdink ER, Leufkens HG, Koppedraaijer C, Bakker A. Information on drug use in the elderly: a comparison of pharmacy, general-practitioner and patient data. Pharm World Sci 1995; 17: 20–4.

28 Olesen C, Sondergaard C, Thrane N, Nielsen GL, de Jong-van den Berg Olsen J. Do pregnant women report use of dispensed medications? Epidemiology 2001; 12: 497–501.

29 Leape LL, Bates DW, Cullen DJ, Cooper J, Demonaco HJ, Gallivan T, Hallisey R, Ives J, Laird N, Laffel G, Nemeskal R, Petersen LA, Porter K, Servi D, Shea BF, Small SD, Sweitzer BJ, Thompson BT, Vander Vliet M. Systems analysis of adverse drug events. ADE Prevention Study Group. JAMA 1995; 274: 35–43.

30 Lisby M, Nielsen LP, Mainz J. Errors in the medication process: frequency, type, and potential clinical consequences. Int J Qual Health Care 2005; 17: 15–22.