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ABSTRACT

Background Incomplete medication lists increase the risk of medication errors and adverse drug effects. In Denmark, dispensing data and pharmacy records are available directly online to treating physicians. We aimed (1) to describe if use of pharmacy records improved the medication history among patients consulting their general practitioner and (2) to characterise inconsistencies between the medication history reported by the patient and the general practitioner's recordings.

Methods Patients attending a general practitioner clinic were interviewed about their current medication use. Subsequently, the patients were contacted by phone and asked to verify the medication list previously obtained. Half of the patients were randomly selected for further questioning guided by their dispensing data: during the telephone interview, these patients were asked to clarify whether drugs registered in their pharmacy records were still in use. Pharmacy records show all drugs acquired on prescription from any national pharmacy in the preceding 2 years. The medication list was corrected accordingly. In all patients, the medication lists obtained on the in-clinic and telephone interviews were compared to the general practitioner's registrations.

Results The 150 patients included in the study had a median age of 56 years (range 18—93 years), and 90 (60%) were women. Patients reported use of 849 drugs (median 5, range 0—16) at the in-clinic interview. Another 41 drugs (median 0, range 0—4) were added during the telephone interview. In the subgroup of 75 patients interviewed guided by pharmacy records, additionally 53 drugs (10%) were added to the 474 drugs already mentioned. The 27 patients adding more drugs guided by pharmacy records were significantly older and used more drugs (both $p<0.05$) than the 48 patients not adding drugs. When the medication lists were compared with the general practitioner's lists, specifically use of over-the-counter products and prescription-only medications from Anatomical Therapeutic Chemical Classification System group J, A, D, N and R were not registered by the general practitioner.

Discussion Dispensing data provide further improvement to a medication history based on thorough in-clinic and telephone interviews. Use of pharmacy records as a supplement when recording a medication history seems beneficial, especially among older patients treated with polypharmacy.

The list of a patient's currently used medications constitutes an important foundation for diagnostics and treatment.[1] Polypharmacy is increasingly common because of therapeutic advances and the treatment of a wider range of risk factors.[2 3]

Multiple healthcare professionals are often involved in treating the same patient.[4] Insufficient communication at hand-off leads to the well-known problems of incorrect and mutually conflicting medication histories.[5–10] Consequently, the patient's self-reported medication use is often the primary source of medication information. Furthermore, only the patient can account for self-medication, use of over-the-counter (OTC) medications or adherence problems.[11]

The patient is, however, not always a reliable source of medication information. Polypharmacy combined with difficult drug names and generic substitution where one drug is changed to another with the same active substance but a different brand name causes difficulties in correctly stating the list of used drugs and possible recall bias.[12–15] Thus, various recall enhancement strategies may be used—for example, prompting with proprietary names, showing pictures of tablets, or naming indications and symptoms.[16–18]

In Denmark in 2004, national prescription data became available directly online to treating doctors. The database allows extraction of pharmacy records at the individual patient level. The data are real-time and are updated whenever a prescription is redeemed.[19]

The aim of the present study was to describe the use of pharmacy records as a recall enhancement strategy among patients consulting their general practitioner. The patients were questioned about their medication use based on registrations in their pharmacy records to describe whether this strategy provided additional information compared to comprehensive in-clinic and telephone interviews. The medication lists were subsequently compared to the general practitioner's registrations to clarify and characterise any inconsistencies.

METHODS

The study was performed in a general practitioner clinic located in a city area near Copenhagen. The general practitioner had 1511 regular patients attending the clinic; 803 (53%) were women. The general practitioner had knowledge on the online prescription records but had never accessed the records nor used them in the clinical work.

Patients scheduled for a visit in the clinic were included consecutively during April and May 2007. Only Danish-speaking adults (18+ years) were included in the study. Demented, terminally ill or first-time visitors were excluded. The Committees on Biomedical Research Ethics of the Capital Region of Denmark approved the study.

Included patients were interviewed for this study immediately after their consultation with the general practitioner. During this in-clinic interview, the patient was asked to mention names and

regimens of all drugs used during the preceding month including prescription-only medications (POM), OTC drugs, herbals and dietary supplements. Open-ended questions were followed by specific questions regarding any use of vitamins, minerals, hormones, locally administered drugs (eye, ear and nose drops, inhalation therapy, dermatologicals), tranquillisers, analgesics, antacids and laxatives. The patient was asked to go through the medications stored in their home and to consider if they had any further information. A telephone consultation was scheduled within the next few days.

During the telephone interview, the patients were presented with the list they had stated previously. They were encouraged to make alterations or add new drugs. To limit resource demands, only half of the patients were selected for further questioning guided by their pharmacy records; selection occurred at random according to a computer-generated list. Individual pharmacy records are available from http://www.medicinprofilen.dk through a secure electronic log-on. Physicians are permitted access if they are responsible for the patient's treatment or if the patient consents. The pharmacy record contains information about all drugs acquired on prescription from any Danish pharmacy in the preceding 2 years. For individual dispensing data, the following are registered: date of handling, handling pharmacy, prescribing doctor, drug name, strength, formulation, package size, prescribed regimen and indication. The patients were asked to verify or deny if the drugs registered in the pharmacy records were still in use and whether the records caused them to make alterations in the medication list already stated.

The same interviewer, a senior medical student, performed all interviews. All questions were asked in a non-judgemental manner to make the patient as comfortable as possible.

The general practitioner had a medication list of individual patients stored electronically. The lists were updated automatically when new drugs were prescribed by the general practitioner. Information from other sources (eg, discharge letters) had to be updated manually. The general practitioner's medication lists were not obtained until all interviews were completed. The interview data were compared with the general practitioner's lists and discrepancies noted.

STATISTICS

Results are reported using descriptive statistics. Independent groups of data are compared by χ^2 tests (categorical data) or t tests (continuous data). The registration of used drugs in the general practitioner records was analysed by multiple logistic regression analysis to identify drug or patient characteristics predictive of registration. A generalised estimating equation model was used because of possible clustering of data at patient level. All variables (drug prescription status, number of used drugs, drug type according to Anatomical Therapeutic Chemical Classification System (ATC group), sex, patient age) were included simultaneously to adjust for confounding. Level of significance was set to $p<0.05$. All statistics were calculated with SAS V.9.0.

RESULTS

A total of 172 patients were eligible for inclusion during the study period, in which 22 patients declined to participate. Non-participants were significantly younger than the 150 patients included in the study (47 vs 56 years, $p<0.05$), whereas there were no sex differences ($p> 0.05$). Included patients had a median age of 56 years (range 18–93 years) and 90 (60%) were women. The in-clinic interview and pharmacy records were available in all included patients, although two patients could not be contacted by phone and provided incomplete data.

During the in-clinic interviews, patients reported use of 849 drugs (median of five different drugs per patient, range 0–16), in which 717 (84%) were mentioned spontaneously and 132 (16%) were mentioned after specific questioning. Another 16 drugs were reported as being used during the interview but were removed from the medication history during the subsequent telephone interview. During the telephone interview, a total of 41 drugs (27 patients) were additionally added to the medication history. Table 1 shows how OTC drugs, POM and herbals were reported upon the in-clinic and telephone interviews. The use of POM was significantly more likely to be reported spontaneously during the in-clinic interview compared to OTC drugs and herbals that often were mentioned after specific questioning or during the telephone interview ($p<0.05$).

Among the total number of 890 used drugs, 73 drugs (8%) were administered topically (eg, inhaled or applied on skin). These drugs were less frequently reported spontaneously during the in-clinic interview compared with drugs administered orally (31/73 (42%) vs 686/817 (84%), $p<0.05$). Similarly, the 274 (31%) drugs used on demand were less often reported spontaneously compared with drugs used daily (203/274, 74% vs 509/609, 83%, $p<0.05$).

The 75 patients randomly selected for telephone interviews guided by their pharmacy records had similar sex distribution, age, and self-reported medication use (all $p>0.05$) as the remaining 75 patients. The patients interviewed guided by their dispensing data added another 53 drugs (10%) (median 0, range 0–5) to the 474 drugs already mentioned as being used, whereas no drugs were removed from the list. As shown in table 2, drugs from ATC group D were the drug type most frequently added. In general, topically administered drugs and drugs used on demand were more frequently added to the medication history at this step compared with orally administered drugs and drugs used daily (both $p<0.05$). The 27 patients adding more drugs were considerably older (63 vs 54 years, $p<0.05$) and used more drugs (10 vs 5 drugs, $p<0.05$) than the 48 patients not adding drugs.

The overall registrations in pharmacy records were compared to the 75 patients' self-reported medication use. As shown in figure 1, 97% of the drugs registered in pharmacy records within the preceding month and 89% of the drugs registered within 2 months were still in use. However, 12 patients (16%, 9%–26%) reported use of drugs registered in pharmacy records more than 1 year previously.

Among all 150 patients included in the study, the final medication history presented after the in-clinic and the telephone interview consisted of 943 drugs (median six different

Table 1 Number of drugs reported during in-clinic and telephone interviews according to drug class

Drug class	In-clinic interview		Telephone interview n (%)	Total (100 %)
	Spontaneous n (%)	Specific questioning n (%)		
Prescription-only medication	395 (87)	38 (8)	22 (5)	455
Over-the-counter drugs	215 (78)	50 (18)	10 (4)	275
Herbals	97 (70)	34 (25)	7 (5)	138
Unclassified	10 (45)	10 (45)	2 (9)	22
Total	717 (81)	132 (15)	41 (5)	890

Summed for n=150 patients.

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Table 2 Drugs added to the medication history after interviews guided by prescription data (PR), by ATC group

ATC group	Mentioned during in-clinic or telephone interview	Added after PR interview (% of total, 95% CI)	Total (100%)
A. Alimentary system	56	8 (13, 6 to 23)	64
B. Blood	28	4 (13, 4 to 29)	32
C. Cardiovascular	81	3 (4, 1 to 10)	84
D. Dermatologicals	10	11 (52, 30 to 74)	21
G. Genitourinary	14	0 (0, 0-23)	14
H. Hormonal	7	1 (13)	8
J. Antiinfectives	8	5 (38, 0 to 51)	13
L. Antineoplastic	1	1 (50, 1 to 99)	2
M. Musculoskeletal	32	2 (6, 1 to 20)	34
N. Nervous system	112	9 (7, 3 to 13)	121
P. Antiparasitics	2	2 (50, 7 to 93)	4
R. Respiratory	34	5 (13, 4 to 27)	39
S. Sensory	10	1 (9, 0 to 41)	11
V. Various	1	1 (50, 1 to 99)	2
Unclassified	13	0 (0, 0 to 24)	13
Total	409	53 (10, 7 to 13)	462

PR, pharmacy records.
Summed for n=75 patients.

drugs per patient, range 0–19). Of these, 498 (53%) were POM, 283 (30%) were OTC, 138 (15%) were herbals and 24 were unidentified. This final medication list was compared with the medication list registered by the general practitioner. None of the herbals were registered by the general practitioner. As shown in table 3, 91% of the used cardiovascular drugs were registered by the general practitioner, whereas—for example, only 53% of drugs from ATC group N (eg, tranquillisers, analgesics) were registered. POM were more frequently registered than OTC drugs (77% vs 33%, $p<0.05$).

According to logistic regression analysis (table 4), ATC group was predictive of whether a used drug was registered in the general practitioner records ($p<0.05$). Drugs from ATC group J, A, D, N and R were less frequently recorded compared with drugs from ATC group C (all $p<0.05$). Irrespective of ATC group, the odds of a POM being registered was 5.8 times higher than that of an OTC drug. The more drugs used the better the registration of individual drugs ($p<0.05$), whereas sex and age were not significant.

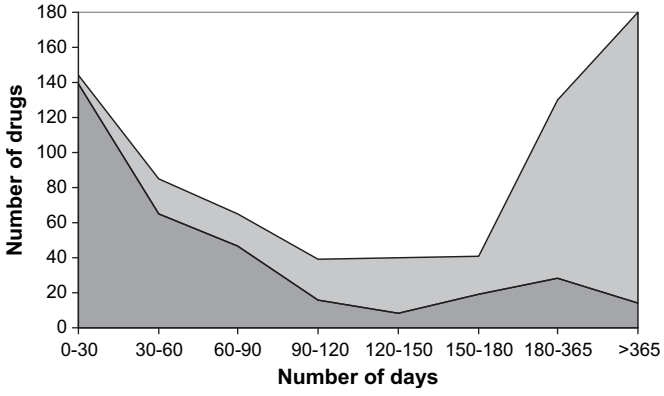

Figure 1 Drugs registered in pharmacy records (PR) compared to the patients' self-reported medication history. The *x*-axis shows number of days between the date of the registration in PR and the telephone interview. Light grey, drug registered in PR and not used; dark grey, drug registered in PR and used according to patient interview. Summed for n=75 patients.

Table 3 Patients' final self-reported medication history compared to the medication lists registered by the GP

ATC group	Final medication history	Registered in GP medication list (%, 95% CI)	Per cent registered (95% CI)
A. Alimentary tract	115	44	38 (29 to 48)
B. Blood	57	36	63 (49 to 76)
C. Cardiovascular	160	146	91 (86 to 95)
D. Dermatologicals	35	21	60 (42 to 76)
G. Genitourinary	24	19	79 (58 to 93)
H. Hormonal	10	7	70 (35 to 93)
J. Antiinfectives	20	9	45 (23 to 68)
L. Antineoplastic	4	1	25 (0 to 81)
M. Musculoskeletal	62	34	55 (42 to 68)
N. Nervous system	209	110	53 (46 to 60)
P. Quinine	4	4	100 (40 to 100)
R. Respiratory	59	37	63 (49 to 75)
S. Sensory	18	8	44 (21 to 69)
Others	4	3	75 (19 to 99)
Total	781	479	61

GP, general practitioner.
Summed for n=150 patients.

A total of 74 drugs were not reported by the patients but were registered as currently used in the general practitioner's medication lists. These drugs were distributed between ATC groups without any specific pattern.

DISCUSSION

Our study demonstrates that interview technique is a potentially important factor for attaining accurate medication histories. Whereas the patients often mention daily used prescription drugs spontaneously, OTC drugs and drugs used on demand are not reported until specific questioning or additional telephone interviews are conducted. Even after extensive questioning, another 10% is added to the medication list guided by the pharmacy data. The general practitioner's medication lists are insufficient regarding OTC products and non-cardiovascular POM.

A correct and updated medication list constitutes an important foundation for further treatment whenever a patient is in contact with the healthcare system. However, the construction of such a list is a formidable task and several obstacles have to be overcome.[20 21] The frequent involvement of several physicians in the treatment of the same patient combined with absent or insufficient communication at hand-offs lead to the well-acknowledged problem of mutually conflicting medication lists. Poor chart documentation practice and lack of awareness of the importance of a medication history may be two of the underlying problems.[22–24]

The poor registration of OTC and herbals in medication histories is well known.[10 25–27] Patients and physicians often omit these drugs because they consider them unimportant.[28 29] This is however a misunderstanding because non-prescription drugs also may be involved in harmful drug–drug interactions or may cause adverse drug effects.[30–32] Similarly, patients are more likely to report use of drugs for conditions perceived as serious—for example, cardiovascular drugs.[20 33]

Several authors have called for electronic registration and common medication lists to improve the sharing of medication information across healthcare sectors.[4 10] The introduction of a Danish national prescription database, which allows extraction of data at the individual patient level and which is available directly online to the treating physician, may be a step in this direction. The database was introduced in 2004, but <10% of

Table 4 Identified risk factors for missing registration of used drugs in the GP records

Risk factor	OR (95% CI)
Prescription status	
Over-the-counter	5.8 (3.72 to 9.00)*
Prescription-only	1
Number of used drugs	0.93 (0.88 to 0.97)*
ATC group*	
Antiinfectives (ATC J)	12.5 (3.27 to 47.5)*
Sensory (ATC S)	7.51 (0.74 to 76.5)
Alimentary tract (ATC A)	6.68 (2.95 to 15.1)*
Dermatologicals (ATC D)	4.63 (1.59 to 13.5)*
Nervous system (ATC N)	4.13 (1.79 to 9.51)*
Hormones (ATC H)	3.46 (0.58 to 20.5)
Respiratory (ATC R)	3.15 (1.19 to 8.35)*
Musculoskeletal (ATC M)	2.43 (0.92 to 6.48)
Blood (ATC B)	2.05 (0.91 to 4.58)
Genitourinary (ATC G)	1.69 (0.40 to 7.05)
Cardiovascular (ATC C)	1
Sex	
Female	1.35 (0.84 to 2.16)
Male	1
Age, per 10 years	0.87 (0.73 to 1.02)

GP, general practitioner.
Results from the multiple logistic regression analysis are reported as ORs.
*$p<0.05$.

general practitioners access the data on a daily basis. Because of practical difficulties and technical limitations, only few hospital physicians have access to the database.[19]

Several authors have previously described how the patient's self-reported medication use often is inconsistent with individual pharmacy records; this indirectly points towards insufficient reporting and suggests a potential benefit of using pharmacy records.[20 34–38] Any use of pharmacy data demands methodological considerations about which records are to be considered relevant; large time windows ensures high sensitivity but often on expense of specificity.[38–40]

Some methodological difficulties might be resolved if patients were questioned directly based on their pharmacy record data. Pharmacy data are often included during comprehensive medication interviews to improve the medication history.[41–45] However, few authors explicitly state in which way the data from pharmacy records affect the process. In a single study, in-hospital patients were questioned about their medication use guided by their pharmacy records.[39] The authors found 26% of used drugs only by use of dispensing data, and among 518 drugs possibly used according to calculation of legend times, the patients admitted use of the 410 (79%). This is in agreement with our study, where the inclusion of pharmacy records added more drugs to the medication history despite previous extensive interviews.

The gold standard method on how to provide the most accurate medication information is widely discussed.[20 37] In this context, our data provide interesting information. Several authors assume that a comprehensive medication interview provides accurate information.[45 46] However, as shown in our study, another 5% of used drugs are added during a telephone interview and one in three patients add even more drugs when questions are guided by their pharmacy records. Thus, careful consideration is necessary when interview methods are chosen.

Some limitations have to be considered when interpreting our study results. The study was performed with a single general practitioner, and other general practitioners might potentially record their medication lists differently. Although few patients declined to participate in the study, non-participants were significantly younger; this may have biased our results. Furthermore, the exclusion of patients not able to give informed consent possibly excluded some of the patients having most difficulties reporting their medication use.

The process of medication reconciliation is recommended in several countries to prevent discrepancy-related medication errors.[47–49] The strategy implies a systematic approach whenever a medication history is obtained. The reconciliation process is labour extensive and time consuming, and despite promising results, little is known about how and when to reconcile with the maximum effect.[11 48 50] Pharmacy records seem a promising supplement of medication information for use in the daily clinical practice if they are easily available. It is noticeable that the patients seem to use most of the drugs purchased within the preceding months. Thus, pharmacy records might be a valuable tool among patients unable to cooperate during medication history taking—for example, because of dementia or unconsciousness. Perhaps an interview method based on pharmacy records combined with specific questioning regarding the use of OTC drugs, herbals and dietary supplements might be an efficient and less time-consuming method for medication reconciliation.

CONCLUSION

Incomplete medication lists among patients treated in primary care are an ongoing problem. It is time consuming and provides difficulty in obtaining a correct and complete list of the currently used drugs, but use of pharmacy records seems a promising way to enhance patients' recall.

Competing interests None.

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