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Are Patients Reliable When Self-Reporting Medication Use? Validation of Structured Drug Interviews and Home Visits by Drug Analysis and Prescription Data in Acutely Hospitalized Patients

Bente Glintborg, MD, Peter René Hillestrøm, PhD, MSc, Lenette Holm Olsen, MSc, Kim Peder Dalhoff, DMSc, and Henrik Enghusen Poulsen, DMSc

The medication history among hospitalized patients often relies on patients' self-reports due to insufficient communication between health care professionals. The aim of the present study was to estimate the reliability of patients' self-reported medication use. Five hundred patients admitted to an acute medical department at a Danish university hospital were interviewed on the day of admission about their recent medication use. Blood samples drawn immediately after admission were screened for contents of 5 drugs (digoxin, bendroflumethiazide, amlodipine, simvastatin, glimepiride), and the results were compared to the patients' self-reported medication history. Information on prescribed drugs dispensed from any Danish pharmacy was collected from nationwide real-time pharmacy records. The authors performed home visits in a subgroup of 115 patients 4 weeks after their discharge. Stored drugs were inspected, and patients were interviewed about their drug use. Additional blood samples were drawn for drug analysis. The median age of included patients was 72 years, and 298 patients (60%) were women. Patients

reported use of 3 (median) prescription-only medications (range, 0-14) during the structured interview. The congruence between self-report and drug analysis was high for all 5 drugs measured (all kappa >0.8). However, 9 patients (2%) reported use of drugs that were not detected in their blood samples. In 29 patients (6%), the blood samples contained drugs not reported during the structured interview, but 14 of these drugs were registered in either hospital files or pharmacy records. Overall, the sensitivity of information from hospital files, structured interviews, and pharmacy records in identifying drug users was 87% to 93%, with no significant differences between methods. In conclusion, patients' self-reports are reliable when estimating recent use of cardiovascular and antidiabetic drugs.

Keywords: medication lists; pharmacy records; home visits; secondary medication interviews

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An updated and accurate medication list is an important part of the evaluation of hospitalized patients.^{1,2} The medication list is often based on patient self-reports, partly due to lacking or conflicting medication lists provided by treating health care professionals.³⁻⁵ However, various factors may complicate the interview process: language barriers, time pressure, or the patient's condition (acute illness, confusion).^{1,6} The benefits of performing secondary structured drug interviews are well established: a thorough and systematic interview performed after

admission provides a more comprehensive list compared to the hospital files. This has led some authors to suggest implementation of routine structured medication interviews to potentially reduce medication errors and adverse drug events.^{1,3,7}

Even secondary interviews may not be perfect due to possible underreporting of noncompliance and patients' recall bias.^{8,9} Home visits may be a more accurate method because the inspection of stored medication vials facilitates the patient's memory.¹⁰⁻¹² However, there is no gold standard that accurately identifies a patient's current medication use.¹³

Little has been done to validate medication lists based on structured interviews and home visits among hospitalized patients.¹⁴ This is in contrast to medication compliance research where self-reports are often confirmed or reevaluated through pharmacy records, tablet counts, or drug analysis in biological fluids.¹⁵⁻²⁰

The aim of the present study was to estimate the reliability of self-reported medication use among acutely hospitalized medical patients. We focused on 5 drugs traditionally used in diabetes or cardiovascular diseases. The medication history provided by the patient during a structured drug interview upon hospitalization and during a home visit after discharge was compared to drug analysis in blood samples. Additional information was collected from hospital files and pharmacy records. If detailed questioning itself provides reliable knowledge about the patients' medication use, this is reassuring for both daily clinical work and for research. Alternatively, if self-reported use is not a reliable data source, improved questioning techniques or new strategies would have to be developed to improve our knowledge of patients' medication use.

MATERIALS AND METHODS

Study Design

The study was conducted from February to September 2005 in an acute medical emergency ward at Bispebjerg University Hospital, Copenhagen. This study was approved by the committees on biomedical research ethics of the capital region of Denmark. The ward accepted patients with infectious, gastrointestinal, pulmonary, endocrine, and cardiac medical diseases. Drug use prior to hospitalization is routinely collected from all patients immediately after admission and recorded in the hospital files. Specialists in internal medicine evaluate the patients, after which they are transferred to other departments or discharged to their home within 24 hours.

Patients were eligible for the study if they were admitted on weekdays between 8:00 and 15:00. Patients unable to cooperate or communicate sufficiently were excluded. A predetermined number of 500 patients were included consecutively in the study after they had given written and verbal informed consent. Information on drug use was obtained by (1) drug history in hospital files, (2) structured drug interview by external physician on the day of admission and after discharge in the patient's own home, and (3) pharmacy records.

Patients were interviewed in the afternoon of the day of their admission. During a structured interview, the patients were asked in detail about their drug use in the week preceding the admission and any recent alterations in drug regimen. If a district nurse dispensed the medicine in the patient's home, the nurse's list was included at the interview. Hospital files were retrieved. In all patients, blood samples were drawn within 1 hour after admission for later drug analysis.

In the planning phase of the study, we decided to specifically focus on the use of digoxin, bendroflumethiazide, amlodipine, simvastatin, and glimepiride. We chose these 5 drugs due to their widespread use.²¹ Furthermore, we expected the patients to handle the drugs homogeneously as these drugs frequently are dosed once daily and are used for longer time periods as part of a chronic treatment with no immediate symptoms following noncompliance. Also, analytical and pharmacokinetic characteristics were considered when choosing the right candidates: the drugs should be practically measurable in our laboratory, and the drugs should have a long elimination time, making them measurable 12 to 24 hours after intake.^{14,22} Among the 500 included patients, 171 reported daily use of digoxin, bendroflumethiazide, amlodipine, simvastatin, and/or glimepiride upon admission. This subgroup of patients was visited in their homes 4 weeks after discharge. During the visit, the patient accounted for current and recent medication use based on the medication inventory, and blood samples were drawn for later drug analysis.

Drug Analysis

Digoxin analyses were performed in blood samples drawn in patients reporting use of digoxin, bendroflumethiazide, amlodipine, simvastatin, or glimepiride upon admission (171 patients provided 170 samples at admission, and 115 patients provided 111 samples during home visits, yielding 281 samples for digoxin analysis). The contents of bendroflumethiazide, amlodipine, simvastatin, and glimepiride

were measured in available blood samples from all included patients (500 patients provided 485 samples at admission plus 111 samples from home visits, giving 596 samples for drug analysis).

Analyses for digoxin contents were performed with a fully automatic, standardized, quantitative, immunoassay procedure (Elecsys, Roche, Basel, Switzerland) at the Department of Clinical Biochemistry, Rigshospitalet. Detection limit was 0.2 nM.

An ultra-performance liquid chromatography (UPLC) method (Waters, Milford, Massachusetts) was used for the amlodipine, simvastatin, glimepiride, and bendroflumethiazide analyses at the Department of Clinical Pharmacology, Rigshospitalet. The following standards and internal standards were used: amlodipine and UK 52.829 (Pfizer, New York), simvastatin and lovastatin (Merck Sharp & Dohme, Whitehouse Station, New Jersey), glimepiride and glibenclamide (Aventis Pharma Deutschland GmbH, Frankfurt, Germany), bendroflumethiazide (LEO Pharma, Ballerup, Denmark), and cyclopentiazide (Novartis, Basel, Switzerland). For the amlodipine, simvastatin, glimepiride, and bendroflumethiazide assays, solid-phase extraction (Bond Elut-Certify cartridge, 130 mg/6 mL, Varian, Darmstadt, Germany) was used for pretreatment of plasma samples. Chromatographic separation of the analytes from matrix constituents was performed on a UPLC system (Waters) with a Zorbax XDB-C18 column (50 × 2.1 mm 1.8 μm, Agilent, Palo Alto, California). Solvents were 1 mM ammoniumacetate buffer and acetonitrile. Mass spectrometric detection of the eluted analytes was performed on an API 3000 triple quadrupole mass spectrometer (Applied Biosystems, Toronto, Canada) with turboionspray source. Detection was performed semiquantitatively using the multiple-reaction mode with the following mass-to-charge (m/z) transitions: m/z 409→238 for amlodipine, m/z 420→289 for bendroflumethiazide, m/z 491→352 for glimepiride, m/z 419→199 for simvastatin, and their respective internal standards: m/z 443→272 for UK 52.829, m/z 378→205 for cyclopentiazide, m/z 494→369 for glibenclamide, and m/z 405→199 for lovastatin. Positive-negative cutoff levels for blood samples containing a drug were based on limits of quantification, which were 0.50 μg/L, 0.25 μg/L, 0.25 μg/L, and 0.10 μg/L for amlodipine, bendroflumethiazide, glimepiride, and simvastatin, respectively.

Pharmacy Records

Information on all drugs prescribed to individual patients within the preceding 2 years was collected

from the nationwide electronic pharmacy records at www.sundhed.dk. These data are available to all physicians if they are either responsible for the patient's treatment or if the patient gives consent.²¹

Statistics

The use of drugs is reported using descriptive statistics. Independent groups of data were compared by chi-square tests (for categorical data) and t tests (for continuous data). Kappa statistics (κ) were used to test if agreement exceeded chance between structured interviews and drug analysis.²³ Statistics were calculated using SAS 9.1.

RESULTS

In total, 500 patients were included in the study. Reasons for exclusion are shown in Figure 1. The most common reasons for exclusion were referral to other departments or discharge shortly after admission (82 patients) or severe dementia (37 patients). Included and excluded patients were similar regarding age (mean age 68 vs 69 years, $P = .5$) and sex distribution (60% vs 54% women, $P = .2$). Included patients had a median age of 72 years (range, 17-97 years), and 298 patients were women (60%). Patients remained in the acute medical ward or in a stationary medical department in the hospital for a median of 3 days (range, 0-121 days). All included patients completed the interview on drug use, and all patients permitted access to their hospital files; in 7 patients, pharmacy data were not available (2 foreigners without pharmacy record, 5 Danish patients not permitting access). Blood samples were not available for analysis in 15 patients upon admission (too little or unsuitable material) and in 4 patients upon home visit (blood sampling not accepted or not possible).

During the structured interview performed upon admission, patients reported use of a total of 1818 prescription-only medications (POMs) daily or on demand in the preceding week (median 3 different generic drugs per patient; range, 0-14); 352 of these POMs (median 0 per patient; range, 0-8) were not registered in the medication history in the hospital file. In addition, 140 POMs were registered in the hospital file but not mentioned during the interview.

During the structured interview upon admission, 36 patients reported daily use of amlodipine, 87 patients used bendroflumethiazide, 45 patients used digoxin, 15 patients used glimepiride, and 34 used simvastatin. During the home visit, the numbers of

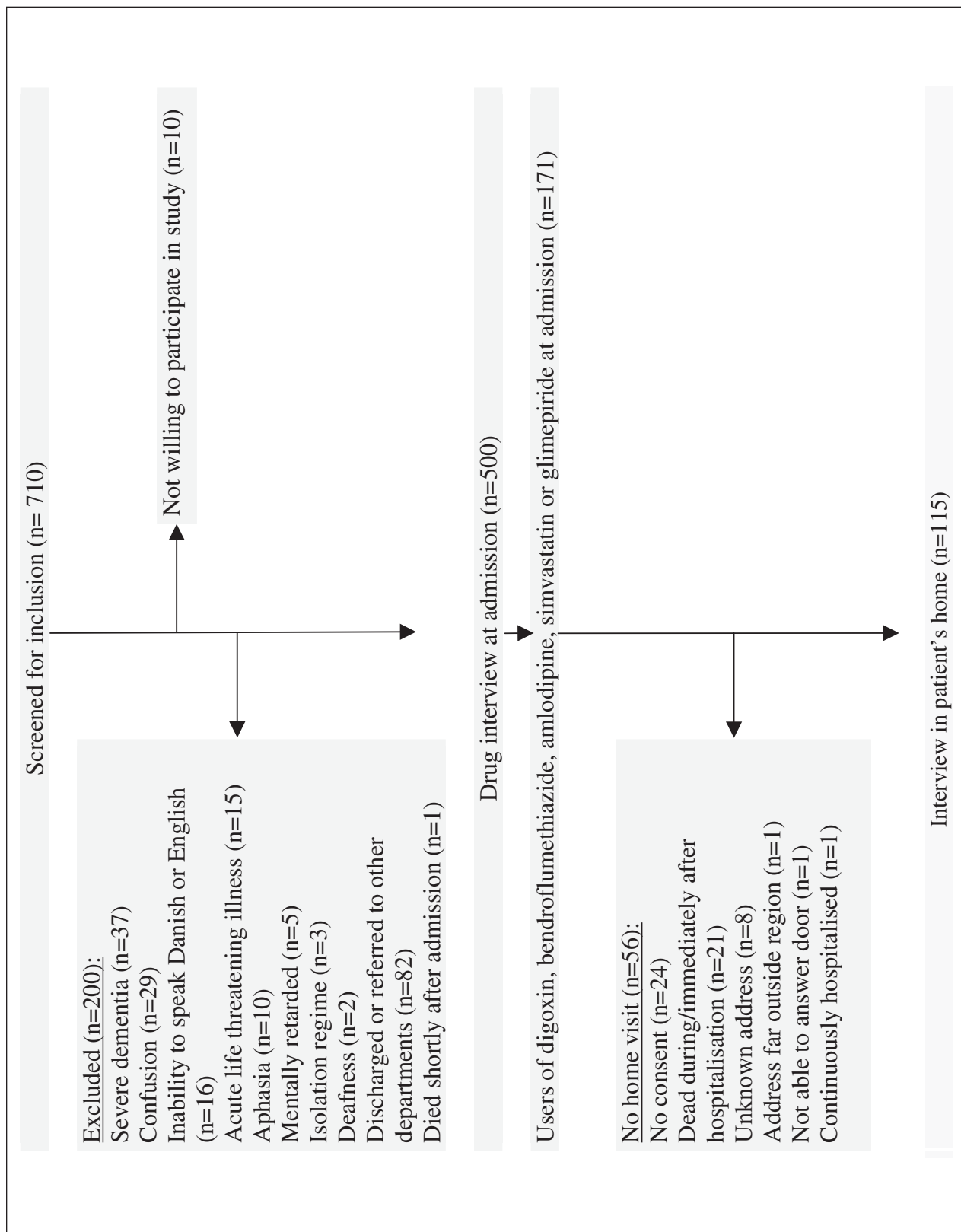


Figure 1. Study design. Inclusion and exclusion of patients.

Table I Agreement Between the Patients' Self-Reported Drug Use During the Structured Interview Versus Drug Analysis in Blood Samples

		Self-Reported Use Upon Admission						
		Used in the Preceding 0-24 h		Used in the Preceding 24-48 h		No Use		
		Plasma Detection		Plasma Detection		Plasma Detection		
Drug	Number of Samples Analyzed	Yes	No	Yes	No	Yes	No	Kappa (95% CI)
Amlodipine	485	32	0	2	1	5	445	0.92 (0.85-0.99)
Bendroflumethiazide	485	77	3	4	3	10	388	0.91 (0.86-0.96)
Digoxin	170	43	1	0	0	1	125	0.97 (0.93-1.00)
Glimepiride	485	13	0	1	1	2	468	0.93 (0.83-1.00)
Simvastatin	485	28	1	2	2	6	446	0.88 (0.79-0.96)

		Self-Reported Use During Home Visit						
		Used in the Preceding 0-24 h		Used in the Preceding 24-48 h		No Use		
		Plasma Detection		Plasma Detection		Plasma Detection		
Drug	Number of Samples Analyzed	Yes	No	Yes	No	Yes	No	Kappa (95% CI)
Amlodipine	111	23	1	1	0	0	86	0.97 (0.92-1.00)
Bendroflumethiazide	111	39	3	0	1	3	65	0.88 (0.79-0.97)
Digoxin	111	25	1	0	0	2	83	0.93 (0.84-1.00)
Glimepiride	111	8	0	1	0	0	102	1.00
Simvastatin	111	26	2	0	0	1	82	0.93 (0.85-1.00)

Only the shaded columns are included in the kappa calculation. Cases with disagreements are marked in bold and outlined in Tables III and IV. CI, confidence interval.

users were as follows: amlodipine, 25 patients; bendroflumethiazide, 45 patients; digoxin, 29 patients; glimepiride, 9 patients; and simvastatin, 29 patients. The results of drug analysis compared with the reported use are shown in Table I. Despite habitual daily use, several patients had temporarily discontinued drug use in the 24 hours preceding the interview—especially in connection to hospitalization due to acute illness. These cases were excluded from the comparison, as it was difficult to interpret the results of the drug analysis. The agreement between self-reported drug use in the preceding 0 to 24 hours and drug analysis was excellent for all drugs, with all the lower bounds of the 95% confidence interval (CI) for κ exceeding 0.79.

Table II shows the sensitivity of different methods in detecting drug-containing blood samples upon admission and hence in detecting medication use.

The sensitivity of hospital files, self-reports, and pharmacy records was more than 80%, with pharmacy records tending to be more sensitive (not significant, $P > .1$).

In 42 cases (36 patients, 7% of included patients), the self-reported drug use was incongruent with drug analysis. These 36 patients had similar age (median 73 years; range, 47-93) and sex distribution (66% women) as patients with congruent data (both $P > .1$). In total, 9 patients (2%) reported use of drugs not detectable in their blood samples, and in 29 patients (6%), the blood samples contained drugs not reported during the structured interview (2 patients are counted in both categories). Inconsistencies occurred upon admissions as well as during home visits. Individual cases are shown in Tables III and IV. Some patients not reporting use of drugs detected in their blood sample had chronic diagnoses that

Table II The Sensitivity of Hospital Files, Structured Interviews, and Pharmacy Records in Identifying Drug Users Upon Admission

Drug	Blood Samples Containing Drug, n (%)	Registered in Hospital File, n (%)	Reported During Structured Interview, n (%)	Registered in PR, n (%)
Amlodipine	39 (100)	31 (79)	34 (87)	36 ^a (92)
Bendroflumethiazide	91 (100)	79 (87)	81 (89)	82 (90)
Digoxin	44 (100)	41 (93)	43 (98)	43 (98)
Glimepiride	16 (100)	14 (88)	14 (88)	14 (88)
Simvastatin	36 (100)	32 (89)	30 (83)	35 (97)
Overall (% , 95% CI)	226 (100)	197 (87, 83-91)	202 (89, 86-92)	210 (93, 90-96)

Drug users are defined as patients having the drug detectable in their blood sample (set to 100%). PR, pharmacy records; CI, confidence interval.

a. One patient did not permit access to PR.

Table III Cases With Disagreement Between Patient's Self-Reported Drug Use and Drug Analysis, Drugs Reported as Used During the Preceding 24 Hours But Not Detectable in Blood Samples

Time	Case Number	Sex/Age, y	Drug	Reported Use		Registration in Pharmacy Record, Days ^a
				Daily Dose	Latest Dose	
Admission	1	Male/47	Digoxin	62.5 µg	Same day	79
	2	Female/89	Bendroflumethiazide	5 mg	Previous day	110
	3	Female/73	Bendroflumethiazide	2.5 mg	Same day	24
	4	Male/54	Simvastatin	40 mg	Same day	129
	5	Male/73	Bendroflumethiazide	5 mg	Previous day	24
Home visit	6	Male/86	Bendroflumethiazide	5 mg	Previous day	24
			Simvastatin	20 mg	Previous day	84
	7	Female/64	Digoxin	187.5 µg	Same day	21
			Bendroflumethiazide	2.5 mg	Previous day	118
8	Female/91	Simvastatin	80 mg	Previous day	55	
		Bendroflumethiazide	2.5 mg	Same day	79	
9	Female/90	Amlodipine	5 mg	Same day	61	

a. Number of days between date of interview and date of the drug being purchased from pharmacy according to pharmacy record.

made treatment probable (eg, morbus cordis incompen-satus or hypertension among patients using bendroflumethiazide, as well as morbus cordis arterioskleroticus or hypercholesterolemia in patients using simvastatin), but this was not always the case (Table IV).

Bendroflumethiazide was the drug most frequently having incongruent registrations. Three patients reported use of the drug within 24 hours before admission, but the drug was not detected in their blood samples. All 3 patients had purchased the drug from a pharmacy in the preceding 1 to 3 months. In another 10 patients, bendroflumethiazide was detected in their blood sample despite no reports of use and no current registrations in hospital files. According to the nationwide pharmacy records, 8 of these patients had not purchased the

drug from a pharmacy in the preceding 2 years. During home visits, the interview was in disagreement with results of bendroflumethiazide analysis in 6 patients.

DISCUSSION

A correct and updated medication list is essential for the evaluation and further treatment of hospitalized medical patients to prevent medication errors and adverse drug effects. In general, structured drug interviews provide better information than the medication lists routinely written in hospital files.^{3,6} Some authors declare structured interviews the gold standard when it comes to estimating medication use,¹ especially when the interviews are performed in the patient's home,¹⁰ but few have tested the reliability of these methods.¹⁴

Table IV Cases With Disagreement Between Patient's Self-Reported Drug Use and Drug Analysis, Drugs Detected in Blood Samples Although Not Reported as Being Used

Time	Case Number	Sex/Age, y	Drug	Registration		All Chronic Diagnoses Registered in Hospital File	
				Pharmacy Records, Days ^a	Hospital Files ^b		
Admission	10	Male/70	Bendroflumethiazide	No	Yes (previous)	Cardiac insufficiency	
	11	Female/61	Bendroflumethiazide	25	No	Osteoporosis	
	12	Male/79	Bendroflumethiazide	No	No	—	
	13	Male/76	Bendroflumethiazide	60	No	Diabetes, depression	
	14	Female/82	Bendroflumethiazide	No	No	Epilepsy, lung cancer	
	15	Male/55	Bendroflumethiazide	No	No	Alcohol addiction, constipation	
	16	Female/61	Bendroflumethiazide	No	No	COLD	
	17	Female/47	Bendroflumethiazide	No	No	—	
	18	Female/93	Bendroflumethiazide	No	No	Chronic pancreatitis	
	19	Female/58	Bendroflumethiazide	No	No	—	
	20	Male/83	Simvastatin	68	Yes (current)	Coronary sclerosis	
	21	Female/75	Simvastatin	59	Yes (current)	Coronary sclerosis, hypercholesterolemia	
	22	Female/79	Simvastatin	25	No	Coronary sclerosis	
	23	Male/60	Simvastatin	No	No	Diabetes	
	7	Female/64	Simvastatin	21	No	Hypercholesterolemia	
	24	Female/84	Simvastatin	10	No	—	
	25	Female/50	Glimepiride	No	No	Cushing's disease	
	26	Male/83	Glimepiride	No	No	Atrial fibrillation	
	27	Male/69	Amlodipine	No	No	Apoplexia cerebri sequelae	
	28	Female/72	Amlodipine	19	No	Diabetes, COLD	
	29	Female/83	Amlodipine	49	No	Hypertension	
	30	Female/84	Amlodipine	27	No	Osteoporosis	
	31	Female/72	Amlodipine	62	No	Lung cancer	
	32	Female/56	Digoxin	No	No	COLD	
	Home visit			Digoxin	No	No	
		33	Female/81	Digoxin	No	No	COLD, Hypertension
		34	Female/65	Bendroflumethiazide	19	Yes (previous)	Hypertension
		35	Female/68	Bendroflumethiazide	No	No	Hypertension
		9	Female/90	Bendroflumethiazide	57	Yes (previous)	Hypertension
	36	Female/88	Simvastatin	No	No	Hypertension, atrial fibrillation	

COLD, chronic obstructive lung disease.

a. Number of days between date of interview and date of the drug being purchased from the pharmacy according to pharmacy records. *No* indicates no registration of the drug in the pharmacy records in the preceding 2 years.

b. Registrations of drug use in hospital files during current or previous hospitalizations. *No* indicates no registrations in available hospital files.

In the present study, the congruence between self-reported medication use and drug analysis was uniformly high, both upon admission and at the home visit. We mainly focused on 4 cardiovascular drugs and 1 antidiabetic drug; therefore, the high reliability of self-reported medication use may not necessarily be generalized to other drug types or other patient groups. The experience in the field is limited, and only a few previous studies have tried to validate the self-reported medication lists by use of drug analysis. Patients acutely admitted to a medical

department may be more attentive to their medication use and therefore better at self-reporting. A previous study also measuring blood levels of cardiovascular drugs, but in an ambulatory setting of US elderly, concluded self-reports as reasonably sensitive for ascertaining use of digoxin ($\kappa = 0.94$), thiazide ($\kappa = 0.62$), and propranolol ($\kappa = 0.43$). However, the congruence between self-report and drug analysis was low for aspirin ($\kappa = 0.16$) mainly due to nondetection of the reported drug.¹⁴ The authors augmented that pharmacokinetic differences

and shorter half-lives of thiazide and aspirin were more likely to explain the incongruence than poor reporting or nonadherence. In a study among volunteer American blood donors, 89% reported a drug intake that was consistent with an extended serum toxicology screen that included a wide range of prescription drugs and drugs of abuse.²⁴ We know from previous studies that have validated self-reports by prescription data or inspection of medication containers that patients report their medication use differently depending on drug type and prescription status. Cardiovascular drugs and drugs used to treat serious illnesses are more likely to be reported than dermatologicals and over-the-counter products.^{10,12,25,26} Thus, validation of self-reports may especially prove valuable for the latter drug categories.

Despite the high reliability of structured interviews, we found several cases where self-reports were incongruent with drug analysis. In 9 patients (2% of screened), drugs reported as used were not detected in the patients' blood samples. This could be explained by errors of commission (ie, the patient erroneously mentioned a drug not actually used). Alternatively, a used drug could be metabolized and present in too low concentrations to be detected—for example, cases 2, 5, 6, and 7, where the drugs were taken the previous day (Table III). Finally, the incongruence might represent undisclosed noncompliance. A total of 29 patients (6% of screened) did not report use of drugs detected in their blood sample. This might be due to an error of omission: the patient forgets to mention a drug actually used. This is especially plausible if the drug is registered in the pharmacy record. Drugs detected in the blood but not registered in pharmacy records must have been provided outside the pharmacy system (eg, from relatives or from treating doctors). The fact that some patients used drugs without having diseases matching the traditional drug indications might be due to a lack of documentation.²⁷ Furthermore, for diseases diagnosed and treated outside the hospital system, loss of information across health care sectors or poor communication might possibly explain the mismatch.^{5,28}

Case 7 makes an illustrative example of discrepancies between blood samples and self-report. This 64-year-old woman has used atorvastatin since 2000, according to a note from her general practitioner brought upon hospitalization. However, simvastatin had been purchased from a pharmacy 21 days before admission, whereas there were no registrations of atorvastatin. Simvastatin was present in the blood sample drawn upon admission. The patient was treated with atorvastatin during hospitalization, and

the treatment was noted in the discharge letter. After discharge, no prescriptions for atorvastatin were collected from the pharmacy. During the home visit, the patient reported using simvastatin, but the drug was not measurable in the blood sample. This might be due to noncompliance, low plasma level of the drug, or use of atorvastatin. The latter is the most likely explanation, illustrating an analogous substitution of atorvastatin with simvastatin accompanied by insufficient communication between health care sectors. The clinical implications are likely to be minimal, but the case illustrates some of the difficulties when comparing self-reports and blood analysis. Similar problems exist in pharmacoepidemiological research, where prescription data are used to estimate medication use and long-term compliance. Here, discontinuations of chronic therapy may be interpreted as possible noncompliance, but switching to analogous drugs must be considered as an alternative.²⁹

Pharmacy records and structured interviews were slightly more sensitive in identifying medication use compared to hospital files; however, the differences were not statistically significant. This may be due to the circumstance that cardiovascular and antidiabetic drugs are among the drug types already registered most accurately in hospital files.^{6,30} This may also be the reason why we were unable to detect any superiority of structured interviews performed in the patients' homes as compared to in-hospital interviews.

The nationwide pharmacy records might have helped identify patients not reporting all their drug use. In Denmark, pharmacy records are available directly online to treating physicians at www.sundhed.dk.²¹ The possible benefit from general use of the records in daily clinical practice remains to be established. The records may prove especially useful in identifying use of traditionally underreported drugs (eg, dermatologicals, antibiotics) or when investigating drug use retrospectively over longer time periods. Several authors have suggested use of pharmacy records to reduce errors of omission upon hospitalizations.^{1,30} In 1 study, the pharmacy records improved the structured interview and added 25% to the number of used drugs.³⁰

Our overall finding that 93% of patients seemed to correctly state their recent medication use may be a best-case scenario. Patients with dementia, acute illness, or inability to give informed written consent for other reasons were excluded. These patients might especially have problems reporting their medication use correctly.⁶ All patients gave informed consent and were thus aware of the drug analysis; this may perhaps have encouraged accurate reporting of drug

use. Furthermore, the knowledge of a forthcoming home visit could make patients more conscientious and aware of their medication use.³¹ Thus, other results may be found outside a research setting.¹⁴

Medication prices and extent of reimbursement are known to affect medication use and long-term adherence. This must be kept in mind when our data from Denmark are to be related to the data from other countries.^{32,33} In Denmark, medications are automatically reimbursed, with a large reimbursement following a small sale and a large reimbursement following a large sale.²¹ Therefore, most citizens experience some self-payment when they acquire POMs. Functional health literacy and the ability to understand and act on health information is another factor influencing medication-taking behavior.³⁴ Literacy is markedly lower among the elderly even after adjustment for gender, race, education, and cognition.³⁵ Our study included mainly the elderly from an urban low-income area, and it seems reassuring that even this population group reported their current medication use with such high reliability. Although drug levels in biologic fluids are direct measures of drug intake, a single measurement gives no information about drug use over longer time periods.³¹ The patient's ability to describe drug use over longer periods must be anticipated to be lower than in the preceding 24 hours.¹⁶ Indeed, nonadherence and unreliable self-reporting of adherence problems challenge effective disease management.^{32,36} For example, in HIV treatment, where 100% adherence is paramount, therapeutic drug monitoring and repeated measurements of blood drug concentrations have been useful, mainly because drug levels correspond to treatment effects but also because low drug levels indicate poor medication adherence.³⁷⁻³⁹

In conclusion, structured questioning seems a highly reliable method when obtaining information about short-term use of cardiovascular and antidiabetic drugs. Self-reports are, however, incongruent with drug analysis in 7% of patients. This figure may be larger in other drug types or outside a research setting. Pharmacy records may help identify some of the patients giving incorrect information.

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