

# Insufficient Medication Documentation at Hospital Admission of Cardiac Patients: A Challenge for Medication Reconciliation

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**Background:** Medication errors may occur when hospital doctors are not adequately informed about a patient's prescribed drugs.

**Methods:** The drug lists of 103 patients who were electively admitted for coronary angiography were assessed. Discrepancies between lists noted in admission letters, patient's personal medication lists, and medication histories were analyzed.

**Results:** Patients took a mean of  $5 \pm 3$  drugs. Nine percent of all drugs taken were only mentioned when a systematic medication history was obtained but were not stated in admission letters or on medication lists. Only 88% of admission letters reported the patient's medication. Twenty-one percent of generics were incorrectly documented as originals in the admission letter. Less than 50% of patients taking  $\geq 4$  drugs had a written instruction on how to take their medication. A total of 86 drugs actually taken by the patients were not identical to those listed in the referral letter or the medication list, leaving uncertainties as to how outpatient medication should be continued. Medication was modified in 25% of all patients at hospital discharge.

**Conclusions:** Instructions for patients taking multiple drugs and information in admission letters need to be improved. These results underline the importance of medication reconciliation at hospital admission.

**Key Words:** hospital admission, medication errors, medication reconciliation, polypharmacy, written instruction

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## INTRODUCTION

Most patients with chronic diseases such as coronary artery disease (CAD) are prescribed multiple drugs to treat risk factors. Furthermore, elderly patients are often prescribed

medication for other ailments. Thus, meticulous documentation of the medication is essential both for the treating physician and the patient, particularly when patients are referred to another doctor or to a hospital. Obviously, it is sometimes necessary to change a patient's established medication during a hospital stay, if there are medical reasons for doing so. However, the hospital doctor needs to have a detailed list of his patients' current medication to avoid medication errors; to prevent unintentional, unnecessary, and potentially dangerous changes in medication; and to avoid interactions, as well as to assess the appropriateness of treatment. In some patients, obtaining current medication is easy and secure (eg, admission of patients from nursing homes with adequate written documentation); in other cases, it can be difficult (eg, emergency admission of patients in unstable conditions, elderly patients with impaired cognitive function, and patients with inadequately documented polypharmacy who do not know their drug history). Thus, the putative current medication often has to be assembled by using a combination of admission letters, written instructions (if existing), and patient history. However, in clinical practice, these sources of information are often incomplete and sometimes contradictory, making a medication survey difficult. The process of verifying medication use, identifying variances, and rectifying medication errors at interfaces of care is called "medication reconciliation"<sup>1</sup>; by this process, doctors obtain the most accurate list of their patient's medications, which is crucial for patient safety.<sup>2</sup>

Previous studies showed that 27% of all prescribing errors occurring in hospitals can be attributed to incomplete medication histories.<sup>3</sup> According to a systematic review of 22 studies including 3755 patients, up to 54% of patients have a history of at least 1 medication error on hospital admission.<sup>4</sup> In one of the studies reviewed,<sup>4</sup> 1 or more drugs were not recorded in 61% of all hospital medical records.<sup>5</sup> These studies underline the importance of a detailed and complete medication documentation for each patient on hospital admission. Many studies have assessed the problems of continuing medication at the interface between hospitals and primary care at hospital discharge.<sup>6</sup> In recent years, however, the process of "medication reconciliation" at hospital admission has gained more attention.<sup>7–9</sup> Medication reconciliation remains a challenge, especially in situations where the quality of medication documentation is poor. Therefore, we compared the drug lists in admission letters with patients' personal lists and patients'

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memorized drug lists in cardiac patients who were electively admitted to the Cardiology Department of the University Hospital Zurich for elective coronary angiography.

## METHODS

### Study Design

This prospective study was conducted at the University Hospital in Zurich from April to May 2007. Patients electively admitted to the cardiology department for elective coronary angiography because of suspected or known CAD were eligible for inclusion in the study. Patients were excluded if they were directly admitted from another hospital without spending at least 1 day at home before admission to the university hospital. The study was approved by the local research ethics committee (Kantonale Ethikkommission, SPUK Innere Medizin) and was performed independently without external sponsoring by private persons or companies. The study had no influence on drug prescription. Written consent was obtained from all study participants.

### Assessment of Medication

Current medication (medication history) was assessed by 3 doctors (P.F., R.W.S., and L.C.H.) as part of the routine patient examination following a strict protocol. Besides the medication reported by the patient, patients were specifically asked about other medications using a standardized checklist that contained several groups of frequently used but not stated drugs: tranquilizers and sleeping pills; laxatives; analgesics; antidepressants and neuroleptics; herbal supplements; eye-drops; minerals such as magnesium, calcium, or potassium; insulin; hormones; aphrodisiacs; and gastrointestinal drugs such as proton pump inhibitors. The medication stated in the admission letter as being the patient's current medication was documented. Furthermore, each patient was asked whether he/she had received a written instruction (medication list) by his/her doctor on how to take his/her drugs, or whether he/she had construed his/her own medication list. The drugs listed in these medication lists (if existing) were documented.

Data provided by these 3 sources of a patient's current medication were compared (number of drugs, name of the drugs [original registered trade marks, briefly "originals"; or generic brand names, briefly "generics"], and dosages and times of application). Combined drug products (eg, beta blocker and diuretic) were counted as 1 drug. A 100% correct documentation of drug intake was defined in the following way: brand name (eg, Beloc ZOK, Meto Zerok, and so on), dosage (eg, 50 mg), and frequency (eg, 1-0-0). The term "cardiovascular drug" was used for antihypertensive drugs, drugs for congestive heart failure, platelet inhibitors, and oral anticoagulants, as well as for lipid-lowering drugs. Modification of medication was defined as a change of drug (eg, from enalapril to lisinopril and change from lisinopril to a combination of lisinopril/hydrochlorothiazide), a change in dosage (eg, from lisinopril 10 mg 1-0-0 to 20 mg 1-0-0) or frequency (eg, from lisinopril 10 mg 1-0-0 to 10 mg ½-0-½), or if a drug was discontinued. The medication reported by the patient while taking his/her history was used as a reference for comparison with admission letters and medication lists.

## Statistics

Descriptive statistics were calculated using Microsoft Office Excel 2003. All data are shown as mean  $\pm$  SD.

## RESULTS

### Study Population

One hundred eleven patients who were admitted for elective coronary angiography were included in the study. Eight patients were excluded because they were directly transferred from other hospitals to the cardiology ward. One-half of the 103 patients analyzed were admitted by hospital doctors (internists and cardiologists), and one-half were admitted by general practitioners and outpatient cardiologists. Time between written coronary angiography request and hospital entry was less than 1 month in two-thirds of the patients (the date of request was unclear in 2 of 103 patients). Coronary angiography was indicated for the following reasons: suspected CAD in about one-half of patients, known CAD in about one-third of patients, and other reasons in about one-fifth of patients (follow-up examinations after heart transplantation, preoperative examinations, and coronary angiographies combined with intervention for valvular defects). The mean age of the patients examined was 63 years, with women being slightly older than men ( $66.5 \pm 13.6$  vs.  $62.2 \pm 11.7$  years). Age distribution and more detailed data about the study population (except indication of coronary angiography and medication) are shown in Table 1.

### Medication

The mean ( $\pm$ SD) number of drugs per patient was 5 ( $\pm 3$ ). Eighty percent of patients were taking some form of oral anticoagulation (aspirin, clopidogrel, and/or phenprocoumon), and a majority of the patients were being treated with antihypertensive or anticongestive medication. Two-thirds of patients had lipid-lowering therapy. More data on medication at hospital admission are provided in Table 2. Of interest, 59

**TABLE 1.** Characteristics of Study Population (n = 103)

Mean ( $\pm$ SD) age (yrs)	63 (12)
Age distribution (n)	
<40 years	2
40–59 years	39
60–79 years	58
$\geq 80$ years	4
% Women (n)	26 (25)
Admitting doctor (n)	
General practitioner	23
Outpatient cardiologist	34
University hospital Zurich	31
Other hospital of the region	15
Time between coronary angiography request and hospital admission (d)	
<8	14
8–14	10
15–28	43
>28	34

**TABLE 2. Medication at Hospital Admission**

Anticoagulation (n)	
Total	83
Aspirin	57
Clopidogrel	2
Phenprocoumon	8
Aspirin + clopidogrel	14
Aspirin + phenprocoumon	1
Aspirin + clopidogrel + phenprocoumon	1
Antihypertensive/anticongestive medication (n)	
Beta blocker	63
Calcium channel blocker	21
ACE inhibitor, angiotensin receptor blocker	58
Diuretics	34
Lipid-lowering therapy (n)	
Total	61
Diabetes therapy (n)	
Total	13
Oral antidiabetics (single, combination)	6 (3, 3)
Insulin	3
Insulin, metformin + another oral antidiabetic	4

drug preparations (9% of all drugs) were not reported in the admission letter or by the patient during the initial history taking but could be extracted by a systematic medication interview using the predefined checklist. These 59 drugs reported by 35 patients included 8 benzodiazepines, 15 magnesium or calcium supplements, 3 laxatives, 9 analgesics, 6 eyedrops, 4 herbal supplements, 6 proton pump inhibitors, 1 antidepressant, 1 muscle relaxant (baclofen), 1 hormone (estradiol ovula), 1 phosphodiesterase inhibitor (tadalafil), 1 bisphosphonate (alendronate), 1 hormone treatment against prostate cancer (goserelin), and 1 fish oil capsule.

Of all 508 drugs reported, 77% were originals and 23% were generics. Of all 353 cardiovascular drugs, 73% were originals and 27% were generics.

### Differences Between Current Medication and Admission Letter/Medication List

In the next step, we compared the medications reported by the patient at hospital admission with the admission letters and the written instructions the patients brought to the hospital.

Only 88% (91 of 103) of the admission letters reported whether the patient was taking any medication (and if yes, which medication). Of these 91 patients, 15 patients were taking generics and not the originals documented in the admission letter; 18 patients were taking 21 drugs in another daily dosage than stated in the admission letter and 18 patients were taking 28 drugs in other frequencies or tablet strengths than stated in the admission letter.

Seventeen percent (5 of 29) of patients with a medication list written by a doctor reported taking 7 generics and not the originals listed on the medication list; 1 patient who had written his/her own medication list had changed to another generic in the meantime; 1 patient was taking 1 drug in another dosage than written on the doctor's medication list; and 2 patients were taking a total of 4 drugs in other dosage intervals or tablet strengths than indicated on the medication list.

By comparing data from all 3 different sources to assimilate the putative correct medication list, we found that a total of 86 medications were not identical, leaving the hospital doctors uncertain as to how the patient's medication should be continued.

### Change of Medication

The main reason why hospital doctors need to be aware of the established drug regimen is that patients should stay on the same drugs during hospitalization and after discharge, unless there are medical reasons for changing certain drugs. Thus, we examined in how many patients medication was changed for medical reasons, and analyzed how often modifications of already prescribed and new prescriptions of cardiovascular drugs were made. Medication was modified in 73% of all patients, and 53% of all patients received new cardiovascular drugs (defined as antihypertensive or anticongestive drugs, platelet inhibitors or anticoagulants, and lipid-lowering drugs). Table 3 shows data on cardiovascular drug modifications and new prescriptions.

### Polypharmacy

Next, we analyzed whether patients were given a medication list to ensure correct drug intake and facilitate communication at interfaces of care. Only 4 of 103 patients had no medication at all, whereas 68 patients had to take 4 or more drugs. Overall, only every third patient (31 of 99 patients) had been given written instructions by his/her doctor on how to take his/her medication. Five of them had forgotten

**TABLE 3. Modifications and New Prescriptions at Hospital Discharge**

Any Modification in Medication (n)		New Prescriptions of Cardiovascular Drugs (n)	
None	27	None	47
1 modification	26	1 new prescription	29
2 modifications	27	2 new prescriptions	19
3 modifications	18	3 new prescriptions	4
4 modifications	2	4 new prescriptions	1
Total amount of modifications	142	Total amount of new prescriptions	83
Patients whose cardiovascular medication is changed	73	Patients receiving new cardiovascular drugs	53

Total number of patients in this analysis = 100 (2 patients transferred to the cardiovascular surgery and 1 patient left from the hospital without giving the treating physician the chance to define a discharge medication).

their list at home or had lost it. Thus, only 26 patients (26%) entered the hospital with a written instruction from their doctor. Of those 68 patients taking 4 or more drugs, only 30 (44%) had received written instructions from their doctors on how to take their medication; 6 (9%) had written their own drug list with instructions on how to take their medication. Figure 1 shows the poor relationship between polypharmacy and written instructions.

Patients who are admitted and bring their current medication are a big help to the doctor for assessing medication. In our study, 74% (74 of 99) of patients with any medication brought it with them at hospital entry.

**Uncertainties**

When all 3 sources to evaluate patient’s medication were used and compared regarding brand names (originals versus generics), dosages, and frequencies, uncertainties remained for 24% (86 of 353) of cardiovascular drugs in 35% (36 of 103) of patients. Differences were not counted as uncertainties when patients could easily explain why there were discrepancies between these sources.

**DISCUSSION**

This study assessed drug documentation of more than a 100 patients who were electively admitted to a cardiology ward for coronary angiography. We analyzed admission letters, medication lists, and medication histories to answer 2 questions: (a) had patients received adequate written information about their medication to ensure correct drug intake? and (b) is the quality of medication documentation on elective hospital admission sufficient to ensure continuity in medication and to prevent medication errors?

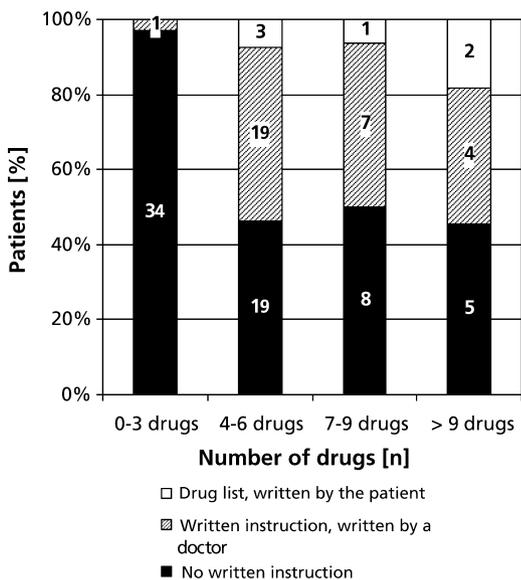
In our study, not even half of the patients prescribed 4 or more drugs had received written instructions (medication list)

from their doctors on how to take their medication. This finding is in agreement with a recent investigation in Sweden, where only 50% of patients who had recently been treated on a medical ward had received written information on drugs.<sup>10</sup> However, polypharmacy needs careful patient information about drugs and drug therapy to improve adherence.<sup>11</sup> Compliance with long-term medication in chronic diseases rarely exceeds 50%.<sup>12,13</sup> Because 80% of the medical information provided by health care practitioners is forgotten immediately by the patient,<sup>14</sup> information on how to take medication should be given in writing. Indeed, a recent study assessing medication errors in lung transplant recipients has shown that the lack of a medication list is associated with a higher rate of incorrect dosing.<sup>15</sup> Thus, we conclude that patient instruction needs to be substantially improved, using written instructions including detailed and clear-cut information about each drug. Medication lists should be regularly updated to reduce confusion when other doctors (specialists and hospital doctors) are involved.

Appropriate information on medication lists includes defining the drug, the dosage, and the frequency. We suggest that brand names (original registered trade mark or generic brand names) should be stated on medication lists, not only the chemical name. Furthermore, when switching from originals to generics (or from 1 generic to the other), this should be stated carefully on medication lists. It is not always obvious and easy for patients to differentiate between generics as “the same drug” (meaning that one drug is replaced by another) and 2 different drugs to be taken in parallel.

In recent years, the process of medication reconciliation has gained more and more attention. Medication reconciliation aims at improving the quality and safety of health care by verifying medication use, identifying variances, and rectifying medication errors at interfaces of care. The basis of this process is a detailed medication history. Indeed, in our study, a substantial number of drugs taken by the patient was only detected when a structured medication history was taken on hospital admission (9% of all drugs). Although a structured medication interview did not reveal additional cardiovascular drugs, we believe that detailed knowledge of each drug is of importance. Calcium, for instance, which seems to be harmless, is frequently taken by patients and might interact with levothyroxine substitution in hypothyroidism.<sup>16</sup> The relevance of medication reconciliation is supported by 2 observations in our study: 12% of admission letters documented no current medication and uncertainties about current cardiovascular medication (defined as any difference between admission letters, written instruction, and patient history regarding brand names, dosages, or frequencies) were noted in 24% of cardiovascular drugs. We conclude that by improving medication documentation in admission letters and on medication lists, the process of medication reconciliation might be facilitated and the number of medication errors in hospitals might be reduced.

Another aim of medication reconciliation is to improve medication safety at hospital discharge. More than 15 years ago, a closer communication between hospital and community health care professionals was demanded at hospital discharge to ensure that patients are informed about and continue their



**FIGURE 1.** Insufficient written instruction for patients with polypharmacy. Relationship between number of drugs taken and written instruction.

discharge prescription.<sup>17</sup> After hospital discharge, only 66% of drugs recommended by the hospital are continued in outpatient care, whereas 21% are replaced by other drugs and 13% are discontinued.<sup>18</sup> These data underline that drugs should only be changed during hospitalizations when necessary. However, cardiac catheter interventions often make changes of the current medication and new prescriptions necessary (eg, an increase in the dose of diuretics based on measurement of the left ventricular filling pressure) or even obligatory (eg, prescription of clopidogrel in addition to aspirin after stenting). In our study, the medication on hospital admission was modified in 3 of 4 patients at hospital discharge, and every second patient received new cardiovascular drugs. Thus, detailed knowledge of prescribed medication on hospital admission is absolutely essential to assure appropriate medication regimens at discharge.

What can hospitals do to facilitate medication reconciliation on hospital admission? Hospitals should instruct patients in their invitation letters to take their drugs and written instructions (medication lists) with them on admission. Until now, the cardiology ward, where the current study was performed, instructed patients to bring their medication with them; however, patients have so far never received instructions to bring their medication lists with them. During our study, 74% of patients brought their medication with them on hospital admission; this percentage is similar to that of a recent study where 78% (instead of 15%) of patients brought their medication along after clinical appointment cards were stamped with this request.<sup>19</sup>

Our study has several limitations. First, because only 3 doctors took medication histories following a strict protocol, there was no analysis performed about inter-rater reliability of medication histories. Second, it is unclear whether patient history, although taken in a structured way, is the “gold standard” for drug information. Third, there was a substantial latency between the request of the referring physician and elective hospital entry, which might explain some of the discrepancies. Fourth, we did not strictly assess the reasons for the observed discrepancies, that is, when patients were not able to explain the reasons for medication discrepancies (which were then not counted as discrepancies), referring physicians were not contacted. Fifth, we used a narrow definition of a 100% correct prescription/instruction about a given medication. Sixth, because analysis was performed in an academic medical center, the results may not be generally applicable to other settings. Seventh, we only assessed discrepancies and did not study potential or actual adverse drug events in detail.

## CONCLUSIONS

In conclusion, we have shown that there are many discrepancies between admission letters, written instructions, and what patients tell their physicians about their medication on elective hospital admission. This justifies the efforts made in the process of medication reconciliation. Because only every second patients with polypharmacy receives written instructions on how to take his/her drugs, written patient information should be enforced to improve drug adherence

and to minimize unnecessary drug changes when patients are treated by different doctors in primary and secondary care. Electronic medical records are being increasingly used in hospitals and practices, which might help to provide medication lists for patients more easily and to quickly pass over information about the current medication at interfaces of care. It remains to be shown whether they will improve the quality of medication information at hospital admission. However, electronic medical records will not replace a detailed patient history where patients should not only be asked what they are prescribed but mainly what they take, including supplements and other health products.

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