Effect of Medication Reconciliation at Hospital Admission on Medication Discrepancies During Hospitalization and at Discharge for Geriatric Patients

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BACKGROUND: Medication discrepancies have the potential to cause harm. Medication reconciliation by clinical pharmacists aims to prevent discrepancies and other drug-related problems.

OBJECTIVE: To determine how often discrepancies in the physician-acquired medication history result in discrepancies during hospitalization and at discharge. Secondary objectives were to determine the influence of clinical pharmacists' interventions on discrepancies and to investigate possible patient-related determinants for experiencing discrepancies.

METHODS: This was a retrospective, single-center, cohort study of patients who were admitted to the acute geriatric department of a Belgian university hospital and followed up by clinical pharmacists between September 2009 and April 2010. Patients were limited to those 65 years or older who were taking 1 or more prescription drug. Medication reconciliation at admission, during hospitalization, and at discharge was conducted by an independent pharmacist who gathered information via chart reviews.

RESULTS: The reconciliation process at admission identified 681 discrepancies in 199 patients. Approximately 81.9% (163) of patients had at least 1 discrepancy in the physician-acquired medication history. The clinical pharmacists performed 386 interventions, which were accepted in 279 cases (72.3%). A quarter of the medication history discrepancies (165; 24.2%) resulted in discrepancies during hospitalization, mostly because the intervention was not accepted. At discharge, 278 medication history discrepancies (40.8%) resulted in discrepancies in the discharge letter, accounting for 50.2% of all 554 discrepancies identified in the discharge letters. The likelihood for experiencing discrepancies at admission increased by 47% for every additional drug listed in the medication history.

CONCLUSIONS: Discrepancies in the physician-acquired medication history at admission do not always correlate with discrepancies during hospitalization because of clinical pharmacists' interventions; however, discrepancies at admission may be associated with at least half of the discrepancies at discharge. Clinical pharmacist–conducted medication reconciliation can reduce these discrepancies, provided the erroneous information in the physician-acquired medication history is corrected and each intentional change in the medication plan is well documented during hospitalization and at discharge.

KEY WORDS: clinical pharmacist, elderly, hospital admission, hospital discharge, medical history taking, medication discrepancies, medication reconciliation.

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Acquiring a complete and accurate medication history is an important step when a patient is admitted to the hospital.[1] Because the admission medication history is generally used to determine the medication regimen during hospitalization, any discrepancy in this history may result in a discrepancy during hospitalization. During hospitalization, medications may be stopped or changed, and new agents are frequently added. At hospital discharge, the patient, the general practitioner (GP), and the community pharmacist should receive complete information about these changes, resulting in a correct and complete list of the actual discharge medications.

Most studies define discrepancies as inconsistencies between 2 or more medication lists, although the definition varies, depending on the methodology used.[2-6] Discrepancies can lead to medication errors and adverse drug events and have the potential to cause harm.[3,7-9] Therefore, investigating the incidence and type of medication discrepancies in combination with the development of discrepancy prevention methods is crucial for improving patient safety and lowering health care costs arising from adverse drug events.[10-14] Elderly patients are particularly vulnerable to medication discrepancies because they often have multiple disease states requiring treat-

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ment with multiple medications. They also have a higher risk for adverse drug reactions caused by age-related pharmacokinetic and pharmacodynamic changes.[15-17]

In numerous studies, medication discrepancies were investigated during hospital admission and/or at discharge for different hospital settings (intensive care unit, internal medicine department, geriatric department, emergency department, surgical setting), and high incidences of medication discrepancies were reported.[2-5,8,18-20] In a systematic review (22 studies, 3755 patients) Tam et al. concluded that errors in prescription medication histories occurred in up to 67% of admissions.[21]

Medication reconciliation is recommended by the Institute for Healthcare Improvement and the National Institute for Health and Clinical Excellence as a possible solution for preventable adverse drug events.[22,23] Several institutions have implemented manual and electronic services. The involvement of clinical pharmacists in medication reconciliation has resulted in improved care, although standard methods to evaluate outcomes (clinical and cost-effectiveness) are lacking.[2,4,5,8,9,23-34] In previous studies, the majority of clinical pharmacists' interventions were accepted by physicians, but the outcomes of these interventions during hospitalization and at discharge were never investigated.[2,8,31,33]

Clinical pharmacist–conducted medication reconciliation is a very intensive and time-consuming activity. Because of the limited number of pharmacists available in Belgian hospitals, the identification of patient-related risk factors for discrepancies may be useful for selecting patients with the highest risk.

In the present study, we evaluated the effect of clinical pharmacist–conducted medication reconciliation at hospital admission on the occurrence of medication discrepancies during hospitalization and at discharge. We also determined how many discrepancies in the discharge letter originated from a medication history discrepancy at hospital admission. Finally, we analyzed the impact of age, sex, residential situation (home or nursing home), the number of drugs in the medication history, the number of consulted information sources for documenting the medication history, and the number of discharge medications on medication discrepancies.

Methods

SETTING AND DESIGN

This was a retrospective, single-center, cohort study of patients admitted to the 29-bed acute geriatric department of a Belgian university hospital in Brussels (Universitair Ziekenhuis Brussel, Belgium) between September 14, 2009, and April 13, 2010. These patients were consecutively followed by the clinical pharmacists whenever possible. An independent pharmacist (Pieter Cornu, PhD student) was specially assigned to gather information via chart reviews and to conduct a retrospective reconciliation.

The study was approved by the institutional Medical Ethics Committee. Access to patients' medical records was granted by the Medical Advisory Board for all participating pharmacists.

STUDY POPULATION

Patients were eligible for inclusion if aged 65 years or older and using at least 1 prescription drug before hospital admission as documented by the clinical pharmacists. Patients were excluded if they were transferred to another ward or hospital, if an interview was not possible (patient unable to communicate and no relative available for interview), if their medical treatment was changed to palliative therapy, or if they died. Patients were also excluded if the discharge letter could not be retrieved or if the medication section in the discharge letter was missing.

DATA COLLECTION AND INTERVENTIONS

The physician (resident or junior residency physician, supervised by a senior geriatrician) acquired medical and medication history information at hospital admission. In addition to patient recall, the physician used sources of information such as the emergency department or a previous hospital admission, interview of relatives, contact with the GP, and/or letters from GPs or nursing homes. This information was documented by the physician in the electronic medical record (geriatric ward admission form).

At hospital admission, clinical pharmacists also acquired medication histories of patients admitted to the geriatric ward to obtain more complete and correct medication histories. Within 48 hours of the admission, the clinical pharmacist's interview was done independently and without knowledge of the physician's medication history. The pharmacists used a previously developed structured questionnaire to elicit information about drugs that are not typically spontaneously mentioned during medication history interviews.[5] For every drug, the dosage, brand, frequency, time, and route of administration were noted. Patient demographics (sex, age, native language) and clinical status were checked and documented before the interview to determine the patient's cognitive status for interviewing purposes. In case a patient interview was not possible, a relative was interviewed using the same structured questionnaire. Like the physician, the clinical pharmacists used all available information sources. When there was incomplete information or doubt about the correctness of the acquired information, the patient's community pharmacist, GP, and/or nursing home was contacted. All information sources used were listed for every patient. For every interview, the clinical pharmacist recorded the total time required for information collection and documentation.

Upon identification of a drug discrepancy, clinical pharmacists intervened by contacting the physician using a structured paper form and a message in the electronic medical record. If no change was made in the medication regimen, the physician was contacted by telephone or in person. No interventions were carried out at hospital discharge. In the present stage of the implementation of clinical pharmacy services in the hospital, the clinical pharmacists intervened only at admission and during the hospital stay.

These procedures are routine practice in the geriatric department. For the present study, the physician- and clinical pharmacist–acquired medication histories were collected by the independent pharmacist for the retrospective reconciliation. For every intervention, the independent pharmacist (not involved in the original medication reconciliation process) verified in the electronic medical record whether or not the advice of the clinical pharmacist was accepted and whether the physician corrected the information in the original medication history (electronic geriatric ward admission form).

All discharge letters prepared during the study period were collected by the independent pharmacist from the electronic medical record.

RETROSPECTIVE RECONCILIATION

All of the physician-recorded medication histories generated during the study period were compared with the corresponding clinical pharmacist–recorded medication histories by the independent pharmacist. Any missing or incorrect drug information was considered a discrepancy. Discrepancies were categorized into different types: omitted drug (home medication not mentioned in the medication history), previously stopped drug (discontinued home medication documented as actual home medication), discrepant dose, missing dose, discrepant brand, missing brand, discrepant frequency, missing frequency, incorrect drug (incorrect pharmaceutical formulation, combination product instead of single product or vice versa, or different active component), or a typing error (drug name misspelled). Each discrepancy at admission was followed up to evaluate whether it was resolved during hospitalization and/or at discharge.

The independent pharmacist performed the retrospective reconciliation without knowledge of the discrepancies identified on hospital admission by the clinical pharmacists. In addition to the follow-up of admission medication history discrepancies, the independent pharmacist compared the home medication(s) listed in the discharge letter with the clinical pharmacist–recorded medication history at hospital admission. This comparison was conducted to determine the total number of discrepancies in the discharge letter and to determine how many of these discrepancies were the result of an original discrepancy between the physician- and pharmacist-acquired medication history. The physician was expected to document all adjustments to original home medications in the discharge letter for the GP by stating whether a drug was stopped or changed. Therefore, any missing or discrepant drug information was considered a discrepancy. Documented changes were considered intentional and were therefore not classified as discrepancies.

STATISTICAL ANALYSIS

Descriptive and statistical analyses were carried out with Excel 2003 (Microsoft, Seattle, WA) and IBM SPSS Statistics version 19 (SPSS Inc., Chicago, IL). The Kolmogorov-Smirnov test was used for testing the normality of the results ($N > 50$). In cases of parametric data, the mean (SD) were used. In cases of nonparametric variables, the median and range were used. Given their non-normal distribution, a Wilcoxon signed-rank test was used to compare the number of drugs correctly identified by the clinical pharmacists versus those correctly identified by the physicians in the medication history. Univariate and multivariate binary logistic regression analyses were conducted to identify possible independent variables associated with the presence of discrepancies at hospital admission and discharge. The dependent variable was the presence or absence of any medication discrepancy. The independent variables analyzed were age, sex, residential situation (home or nursing home), number of drugs in the medication history, and number of consulted information sources for documenting the medication history. For discharge, the number of discharge medications was an additional variable. All independent variables were analyzed in a univariate model, and significant predictors were then combined in the multivariate model. The independent predictor variables were included in the models using the enter method (forced entry method). Statistical analyses were performed with a 0.05 significance level, and 95% confidence intervals were calculated if relevant.

Results

PATIENT DEMOGRAPHICS AND STUDY POPULATION

A total of 199 patients who were followed-up by the clinical pharmacists were included in the study. Twenty-one patients were excluded because of death during hospitalization (n = 12), no reported use of medications (n = 3), transfer to another hospital ward (n = 2), inability to obtain a medication history (n = 2), medication not mentioned in the discharge letter (n = 1), and switch to palliative therapy (n = 1). The study population consisted of 70 (35.2%) males and 129 (64.8%) females with a mean age of 83.7 (5.8) years (range 66-103).

Most patients (75.9%) resided at home prior to hospitalization; 24.1% were residents of a nursing home. The most frequent reasons for admission were a decline in health status, a fall, dyspnea, pneumonia, and cognitive disorders. Most of the admissions (78.4%) were unplanned.

SOURCES OF INFORMATION

The clinical pharmacists collected information for 134 patients through direct patient interview. Only 8 patients brought their home medications, and 35 patients had a personal medication history with them. A patient's relative or central caregiver was interviewed in 47 cases. A letter from the nursing home was available in 24 cases, and in 12 additional cases, the nursing home was contacted for more information. Emergency department records, also accessible by the physicians, were consulted electronically in 76 cases; in 22 cases, information from previous hospitalizations was used. A letter from the GP was available in 70 cases, the GP was contacted in 30 cases, and the community pharmacist was contacted in 52 cases. A total of 510 information sources were consulted, with a median of 3 (range 1-5) sources per patient. The clinical pharmacist spent a median time of 10 minutes (range 2-45) conducting the interview. A median time of 5 minutes (range 1-7) was necessary to check and document the patient's demographics and clinical status before conducting the interview. In cases in which a telephone contact with the nursing home, GP, or community pharmacist was needed, an additional median time of 9 minutes (range 2-13) was required. As a result, the addition of 1 telephone contact increased the average total time to 24 minutes.

ACCURACY OF CLINICAL PHARMACIST–ACQUIRED MEDICATION HISTORIES

The clinical pharmacists recorded a total number of 1438 home medications. Of 199 patients included, 24 (12.1%; 95% CI 7.5 to 16.6) had at least 1 discrepancy in the clinical pharmacist–acquired medication history. The retrospective reconciliation process carried out by the independent pharmacist revealed 44 discrepancies (for 34 drugs; 2.4% of drugs) in the clinical pharmacist–acquired medication histories. The most common type of discrepancy was omission of a brand name (representing 61.4% of all discrepancies, Table 1). The omitted drugs (7, 15.9% of all discrepancies) were detected using the electronic medical record, which indicated that these drugs were actual home medications. For these omitted drugs, the patient's GP or outpatient pharmacist was contacted to verify that the drugs were home medications that were correctly identified in the physician-acquired medication history.

CLINICAL PHARMACIST–RECORDED VERSUS PHYSICIAN-RECORDED MEDICATION HISTORIES

Whereas the clinical pharmacists correctly identified 1404 drugs (without any discrepancy), the physicians correctly identified 891 drugs. A median of 4 (range 0-13) drugs per patient were correctly detected by the physicians versus 7 (1-16) drugs per patient by the clinical pharmacists (Wilcoxon signed-rank test, $p < 0.001$). Of 199 patients included, 163 (81.9%; 95% CI 76.6 to 87.3) had at least 1 discrepancy in the physician-acquired medication history, while 59 (29.6%; 95% CI 23.3 to 36.0) patients had 5 or more discrepancies. The median number of discrepancies was 3 (0-16) per patient.

The most common type of discrepancy in the physician-recorded medication history was omission of a drug (representing 51.0% of all discrepancies, Table 1), followed by drugs that were documented by the physician as actual home medications, although they had been previously discontinued (13.9%).

CLINICAL PHARMACISTS' INTERVENTIONS

The clinical pharmacists performed 386 interventions, which were accepted in 279 cases (72.3%; 95% CI 67.8 to 76.7). Acceptance is defined as a correction in the medication planning as advised by the clinical pharmacist or that the clinical pharmacist's intervention was correct, but a well-founded reason for not changing the therapy was documented by the physician. For 107 (27.7%; 95% CI 23.3 to 32.2) other interventions, the advice was either not accepted or not acknowledged. Of the 279 accepted interventions, the physician-documented original medication history was adapted accordingly in the electronic medical record in 155 (55.6%) cases. Only physicians can update the original medication history. Clinical pharmacists have access to this medication history but cannot make changes.

For 295 other discrepancies, there was no intervention. For the majority of these cases (218; 32.0% of all discrepancies; 95% CI 28.5 to 35.5), an intervention was not necessary, as the medication planning was correct, despite the discrepancy in the medication history. For example, when the frequency of a drug was omitted in the history, the standard frequency was given, which was the same as the one

Table 1. Types of Drug Discrepancies in Medication Histories

Type of Discrepancy	Discrepancies in Medication History, n (%)	
	Physician-Acquired	Clinical Pharmacist–Acquired
Omitted drug	347 (51.0)	7 (15.9)
Previously stopped drug	95 (13.9)	
Missing frequency	51 (7.5)	2 (4.5)
Discrepant frequency	49 (7.2)	
Discrepant brand	33 (4.8)	
Missing brand	32 (4.7)	27 (61.4)
Discrepant dose	29 (4.3)	
Missing dose	27 (4.0)	8 (18.2)
Incorrect drug	16 (2.3)	
Typing error	2 (0.3)	
TOTAL	681 (100)	44 (100)

at home. In 77 (11.3% of all discrepancies; 95% CI 8.9 to 13.7) cases, there was no intervention, although a discrepancy occurred during the hospitalization, indicating that an intervention was possibly warranted. These 77 discrepancies consisted of 50 omitted drugs, 10 previously stopped drugs that were administered, and 17 discrepant or missing doses/frequencies or incorrect drugs.

FOLLOW-UP OF MEDICATION HISTORY DISCREPANCIES DURING HOSPITALIZATION

Nearly one quarter of the medication history discrepancies resulted in a discrepancy during hospitalization (165; 24.2% of all medication history discrepancies; 95% CI 21.0 to 27.4). Of the 347 drugs omitted in the history, 107 (30.8%) resulted in a discrepancy during hospitalization (drug not given or given with an error, Table 2). The other 240 cases of omitted drugs (69.2%) were already resolved in the medication planning, mostly because the clinical pharmacist's intervention had been accepted or because the medication planning was correct from the start of the hospitalization, despite the discrepancy in the medication history. The following situations were not categorized as a discrepancy: when a reason for stopping or substitution of a drug was documented; when the duration of the hospitalization was shorter than the interval between 2 administrations; and when patients took one of their home medications, although the drug was missing in the medication history and this was known by the medical staff. There were 12 cases of discrepancies in which drugs, incorrectly listed in the medication histories because they were already discontinued before the hospital admission, were erroneously given to the patient. The fact that a medication was given intentionally could be derived from the physician's notes in the electronic medical record. In cases of a missing or discrepant dose or frequency, incorrect drug, or typing error, a discrepancy occurred during hospitalization in 46 cases (26.4% of all such discrepancies). For the other 128 cases of this type, the problem was already solved in the medication planning. Missing or discrepant brand (and generic) names did not result in any discrepancy during hospitalization because of substitution of these drugs to their corresponding formulary brand.

FOLLOW-UP OF MEDICATION HISTORY DISCREPANCIES AT DISCHARGE

Of the 681 original medication history discrepancies on admission, 278 resulted in discrepancies in the discharge letter (40.8% of all medication history discrepancies; 95% CI 37.1 to 44.5). At discharge, omitted drugs in the medication history were not prescribed or were prescribed with an error in 165 cases (47.6% of omitted drugs) (Table 2). A

Table 2. Consequences of Medication History Discrepancies

Type of Discrepancy	In Physician-Acquired Medication History	During Hospitalization	At Discharge
Omitted drug	347		
No discrepancy		240	182
correctly given/prescribed		186	166
documented intentional stop		27	10
documented intentional change		16	6
not necessary (1 time/week, 1 time/month, 1 time/year)		10	
patient used home medication		1	
Discrepancy		107	165
not given/prescribed		97	124
given with error (wrong dose, frequency)		10	41
Previously stopped drug	95		
No discrepancy		83	89
not given/prescribed		75	81
intentionally given		8	8
Discrepancy		12	6
Missing or discrepant dose/frequency, incorrect drug, or typing error	174		
No discrepancy		128	113
Discrepancy		46	61
Missing or discrepant brand	65		
No discrepancy		65	19
Discrepancy		0	46

total of 182 other omitted drugs (52.4% of omitted drugs) were correctly prescribed, or the change or withdrawal of the drug was documented in the discharge letter. Previously discontinued drugs, registered in the medication history as actual therapy, were prescribed in 6 cases (6.3% of previously stopped drugs). A missing or discrepant dose or frequency, incorrect drug, or typing error in the medication history resulted in a discrepancy at discharge in 61 of 174 cases (35.1%). In contrast with the situation during hospitalization, a missing or discrepant brand or generic name often led to a discrepancy at discharge (46 cases, 70.8% of missing or discrepant brand names). Almost every type of discrepancy occurred more frequently at discharge than during hospitalization, except for drugs that were prescribed even though they had been discontinued.

FLOWCHART OF MEDICATION HISTORY DISCREPANCIES FROM ADMISSION TO DISCHARGE

Even when interventions were accepted and the physician's medication history was corrected, 49 admission medication history discrepancies resulted in a discrepancy at discharge. For the majority of these errors, the intentional drug changes that occurred during hospitalization or at discharge were not documented in the discharge letter. Of the 124 cases in which the medication history was not adjusted despite acceptance of the intervention, discrepancies occurred again during hospitalization in 6 cases and at discharge in 33 cases, including those developing during the hospitalization.

Interventions that were not accepted or acknowledged did not always result in a discrepancy during hospitalization but did result in a discrepancy in the discharge letter in most cases (92 cases, 86.0% of unaccepted interventions).

All medication history discrepancies for which no intervention was made and for which a discrepancy occurred during hospitalization resulted in a discrepancy in the discharge letter. Sometimes (27 cases, mostly resulting from incorrect or missing brand names) a discrepancy in the discharge letter occurred, even if no discrepancy occurred during hospitalization (Figure 1).

COMPARISON OF THE DISCHARGE LETTER WITH THE CLINICAL PHARMACIST–RECORDED MEDICATION HISTORY

The medications in the discharge letter were compared with those in the pharmacist-acquired medication history to determine the number of drugs that were stopped, omitted, changed, newly added, or prescribed although previously stopped, or that remained unchanged (Table 3).

This reconciliation process by the independent pharmacist revealed 554 discrepancies, with a median number of 3 discrepancies (range 0-10) per patient (Table 4). Of all 199 included patients, 172 (86.4%; 95% CI 81.7 to 91.2) had at least 1 drug discrepancy in their discharge letter and 37 (18.6%; 95% CI 13.2 to 24.0) presented with 5 or more discrepancies.

The most frequently occurring type of discrepancy in the discharge letter was drug omission (Table 4). In 316 cases (57.0%), drugs were omitted without documentation of an intentional stop or change. Half of the discrepancies at discharge (278; 50.2%; 95% CI 46.0 to 54.3) were the result of an original medication history discrepancy in the physician-recorded medication history at admission.

IDENTIFICATION OF PATIENT-RELATED RISK FACTORS

The univariate binary logistic regression analysis identified the number of correctly identified drugs in the clinical pharmacist–acquired medication history (OR = 1.48; 95% CI 1.25 to 1.74; $p < 0.001$) and the number of information sources consulted for documenting the medication history (OR = 1.84; 95% CI 1.22 to 2.79; $p = 0.004$) as significant risk factors for the presence of 1 or more medication discrepancies at hospital admission. Similar results were found with the multivariate model (Table 5). For every additional drug in the medication history, the likelihood of experiencing 1 or more drug discrepancies increased by 47% (adjusted OR = 1.47; 95% CI 1.24 to 1.74; $p < 0.001$). For every additional source of medication information used for documenting the medication history, the likelihood of detecting medication discrepancies increased by 78% (adjusted OR = 1.78; 95% CI 1.13 to 2.80; $p = 0.01$).

At hospital discharge, age (OR = 1.11; 95% CI 1.03 to 1.20; $p = 0.005$), the number of correctly identified drugs in the clinical pharmacist–acquired medication history (OR = 1.24; 95% CI 1.06 to 1.44; $p = 0.006$), and the number of drugs in the discharge letter (OR = 1.15; 95% CI 1.01 to 1.32; $p = 0.04$) were identified as significant risk factors in the univariate analysis (Table 5). In the multivariate model, only age (adjusted OR = 1.10; 95% CI 1.02 to 1.19; $p = 0.01$) and the number of correctly identified drugs in the clinical pharmacist–acquired medication history (OR = 1.19; 95% CI 1.01 to 1.41; $p = 0.04$) remained significant.

Discussion

The comparison of the physician- and clinical pharmacist–acquired medication histories revealed a high number of medication discrepancies that lie within the range of those found in the literature, although a wide variation in the occurrence of discrepancies has been reported depending on the terminology and methodology used.[2-5,8,18-20] In our study, the clinical pharmacist on average was found to correctly identify 3 more home medications per patient than the physician ($p < 0.001$). This can probably be attributed to the structured manner in which the interview was performed, the expertise of the clinical pharmacist, and the improved clinical state of the patient during the clinical pharmacist's interview. Earlier

research at the geriatric ward of our hospital already showed the benefits of conducting interviews in a structured manner.[5] Moreover, the pharmacist consulted a median number of 3 different sources of information per patient, which enhances the amount and accuracy of the drug information. The clinical pharmacists spent a median time of 15 minutes to prepare for and conduct the patient interview and a median time of 9 additional minutes for every telephone contact with a first-line health care provider. Although acquiring medication histories remains a time-consuming task, the literature indicates that the time investment is outweighed by the benefits.[35,36]

The analysis carried out by an independent pharmacist in our study also showed discrepancies in the clinical pharmacist–acquired medication histories, despite the fact that these are generally considered the gold standard in the literature.[6] Nevertheless, they remain the best available reference and overall are more complete and accurate than those obtained by physicians.

The acceptance rate of the clinical pharmacists' interventions (72.3%) is comparable with results from other studies.[5,34] However, even when an intervention was accepted, the original physician-documented medication history was corrected in only 55.6% of cases. This is an important issue because the original medication history is routinely used at hospital discharge to compose the discharge letter. The clinical pharmacist should verify whether the physician's documented medication history has been corrected; when this is not the case or if the intervention is not accepted, the discrepancy should be discussed with the physician.

In our study, interventions were made most of the time in case the original medication history discrepancy also manifested as a discrepancy in the medication planning. However, the clinical pharmacist failed to intervene for 77 (11.3%) medication history discrepancies, all resulting in a discrepancy during hospitalization. In the future, interventions should be made for every discrepancy in the medication history, regardless of whether the discrepancy occurred in the medication planning.

Nearly one quarter of the admission medication history discrepancies resulted in a discrepancy during hospitalization. During hospitalization, the medication planning was often correct as a result of an accepted intervention or because the medication history discrepancy did not result in a discrepancy in practice (eg, because of switches from a drug with a missing brand to a formulary brand product). However, at discharge, several medication history discrepancies recurred in the discharge letter. First, intentional changes in the medication planning were often not documented in the discharge let-

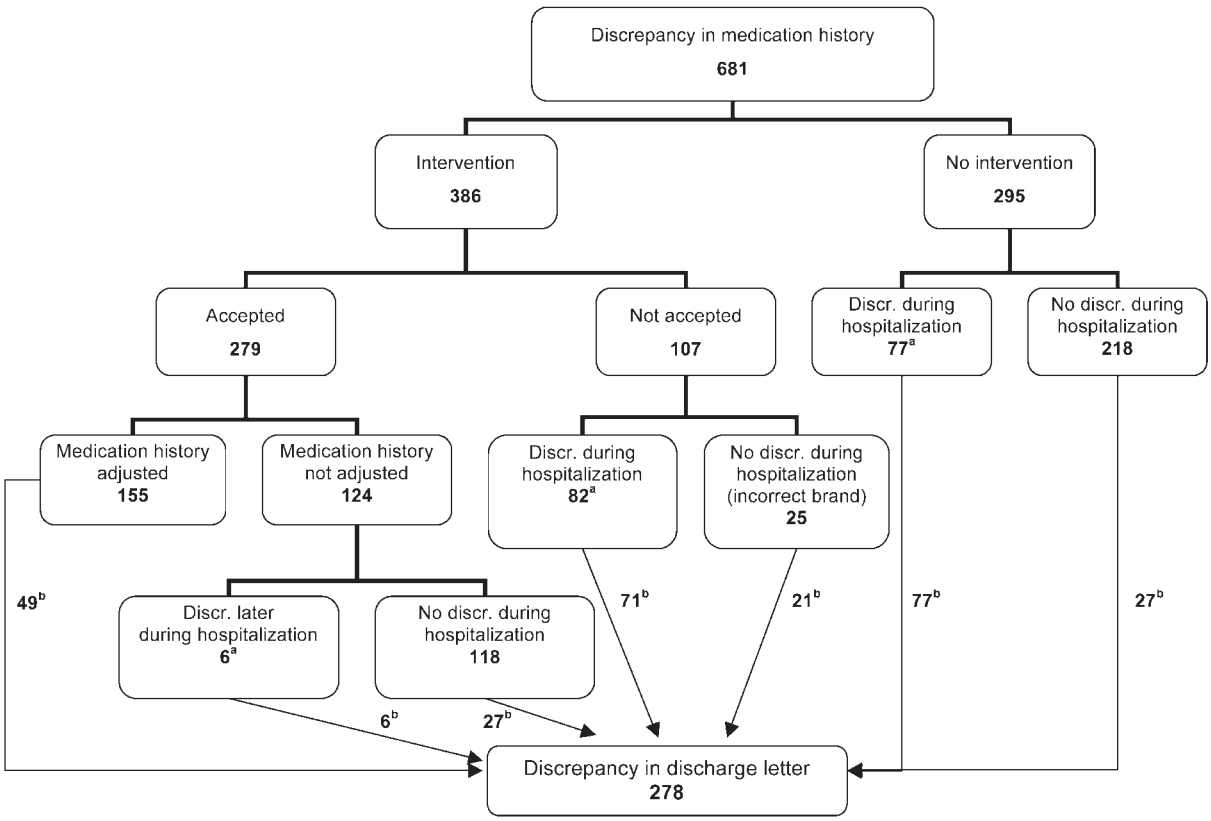

Figure 1. Flow chart of medication history discrepancies from patient admission through discharge. Discr. = discrepancy.
[a]Total discrepancy during hospitalization = 165.
[b]Total discrepancy in discharge letter = 278.

ter. The incidence of discrepancies would have been lower had intentional but undocumented changes not been considered discrepancies. However, absence of information concerning changes or discontinuations of drugs can result in medication errors after discharge. When the intentional discontinuation of a drug is not documented as such, the GP or patient might think that it was forgotten in the discharge letter and prescribe or use it anyway. Moreover, although the intervention may have been accepted, failure to correct the original medication histories obtained by the physician frequently resulted in the recurrence of discrepancies.

Comparison of the discharge letter with the clinical pharmacist–acquired medication history revealed a median number of 3 discrepancies per patient, and 86.4% of patients had at least 1 discrepancy at discharge. Similar numbers can be found in the literature, although large variations are present depending on the terminology and methodology used.[4,8,20,24] To compare the obtained results with results from other studies, it is also important to determine which medication lists were used in the reconciliation process. In some other studies,

Table 3. Drug Changes in Discharge Letter versus Medication History

Documentation	Drugs, n	% of Drugs in Clinical Pharmacist–Acquired Medication History
Medication history (clinical pharmacist)	1438	100
Discharge letter	1645	
stopped (documented in discharge letter)	140	9.7
omitted	316	22.0
changed	298	20.7
unchanged	684	47.6
Newly added	657	
Previously discontinued	6	

Table 4. Type of Drug Discrepancies in Discharge Letter

Discrepancy	n (%)
Omitted drug	316 (57.0)
Discrepant brand	57 (10.3)
Incorrect drug	56 (10.1)
Discrepant dose	51 (9.2)
Discrepant frequency	38 (6.9)
Missing brand	26 (4.7)
Previously stopped drug	6 (1.1)
Double medication	2 (0.4)
Missing frequency	1 (0.2)
Missing dose	1 (0.2)
TOTAL	554 (100)

Table 5. Univariate and Multivariate Binary Logistic Regression Analysis of Patient-Related Risk Factors for Medication Discrepancies at Hospital Admission and Discharge

Characteristic	Hospital Admission				Discharge			
	Univariate Model OR (95% CI)	p Value	Multivariate Model OR (95% CI)	p Value	Univariate Model OR (95% CI)	p Value	Multivariate Model OR (95% CI)	p Value
Age	1.01 (0.95 to 1.07)	0.84			1.11 (1.03 to 1.20)	0.005	1.10 (1.02 to 1.19)	0.01
Sex								
male[a]								
female	1.62 (0.78 to 3.36)	0.20			1.57 (0.69 to 3.58)	0.28		
Residential situation								
home[a]								
nursing home	0.79 (0.35 to 1.78)	0.57			2.84 (0.81 to 9.87)	0.10		
Correctly identified drugs in the CP-acquired medication history, n	1.48 (1.25 to 1.74)	<0.001	1.47 (1.24 to 1.74)	<0.001	1.24 (1.06 to 1.44)	0.006	1.19 (1.01 to 1.41)	0.04
Information sources used for documenting the medication history, n	1.84 (1.22 to 2.79)	0.004	1.78 (1.13 to 2.80)	0.01	1.49 (0.96 to 2.33)	0.08		
Drugs in the discharge letter, n					1.15 (1.01 to 1.32)	0.04	1.05 (0.89 to 1.23)	0.57

CP = clinical pharmacist.
[a]Adjusted reference category.

no clinical pharmacist–acquired medication histories were available for the reconciliation process, generally resulting in a lower number of discrepancies found in the discharge letter.[4] Drugs omitted in the medication history were not detected in these studies and therefore were not considered to be omitted in the discharge letter.

Half of the discrepancies in the discharge letter originated from a discrepancy in the physician-recorded medication history. This suggests that at least half of the discrepancies at discharge could probably be prevented by acquiring and using accurate and complete medication histories at hospital admission and by documenting any change in the preadmission medication during hospitalization and at discharge. The number of discrepancies in the discharge letter that originate from a medication history discrepancy is probably underestimated because of the interventions of the clinical pharmacists at hospital admission and during hospitalization. The other half of discrepancies in the discharge letter originate during hospitalization without prior discrepancy in the medication history. These discrepancies could similarly be prevented by documenting intentional changes and the discontinuation of drugs. Therefore, medication reconciliation should be conducted on patient admission and at discharge to identify and resolve any undocumented or unintentional changes that can lead to medication errors. The discharge letter should give the GP a clear overview of the changes in the preadmission medication and of the pharmacotherapy after discharge.

Priority for medication reconciliation by clinical pharmacists can be given to geriatric patients receiving many medications at hospital admission because the likelihood of experiencing 1 or more discrepancies at admission increased by 47% for every additional drug. At discharge, the influence of patient-related risk factors was smaller. Thus, all patients should receive medication reconciliation at hospital discharge.

Our study has several limitations. It was performed in 1 hospital ward in a single hospital with a limited number of patients. Furthermore, procedures for acquiring medication histories and detecting discrepancies are those applied in our hospital. Therefore, the results of our study should only be extrapolated to a population with similar demographics (geriatric ward) and to hospitals with similar procedures. Another limitation is the possible introduction of recall bias because the clinical pharmacist usually conducted the interview after the physician had already interviewed the patient. Despite the multiple sources of information consulted by the clinical pharmacist, we cannot conclude that clinical pharmacist–acquired medication histories are always totally correct, as we also found a small number of discrepancies in them. Nevertheless, they can still be considered the best available reference.

Although medication discrepancies at hospital admission and discharge have been investigated in several studies, to our knowledge, the consequences of medication history discrepancies have not been reported. Therefore, our study adds important findings to data on medication discrepancies and medication reconciliation. Most discrepancies in medication histories did not lead to a discrepancy during hospitalization. This can mainly be attributed to the interventions initiated by the clinical pharmacist. However, to avoid discrepancies at discharge, incorrect information in the physician-acquired medication history should be corrected in response to the physician's acceptance of the clinical pharmacist's intervention. Accurate and complete medication histories are of utmost importance, as at least half of all discrepancies at discharge originate from discrepant medication histories. During hospitalization and at discharge, each intentional change in medication planning should be well documented. When performed using a consistent methodology, medication reconciliation at each transition of care offers a solution to prevent medication discrepancies.

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EXTRACTO

Efecto de la Reconciliación de Medicación en la Admisión Hospitalaria sobre las Discrepancias en Medicación Durante la Hospitalización y el Alta de Pacientes Geriátricos

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Ann Pharmacother 2012;46:484-94.

TRASFONDO: Las discrepancias en medicación tienen el potencial de causar daño. La reconciliación por farmacéuticos clínicos tiene como objetivo prevenir discrepancias y otros problemas relacionados con medicamentos.

OBJETIVO: Determinar cuan frecuentemente las discrepancias en el historial de medicación obtenido por el médico resultan en discrepancias durante la hospitalización y el alta. Determinar la influencia de las intervenciones de los farmacéuticos clínicos sobre las discrepancias. Investigar posibles determinantes relacionados con el paciente de la experimentación de discrepancias.

MÉTODOS: Estudio retrospectivo, en un solo centro, de un cohorte de pacientes (≥65 años, ≥1 medicamento recetado) admitidos al departamento de geriatría aguda de un hospital universitario Belga y seguidos por farmacéuticos clínicos entre septiembre 2009 y abril 2010.

La reconciliación de medicación en la admisión, durante hospitalización, y el alta fue llevada a cabo por un farmacéutico independiente que recopiló información mediante la revisión de expedientes.

RESULTADOS: El proceso de reconciliación en la admisión identificó 681 discrepancias en 199 pacientes. Aproximadamente 81.9% (163) de los pacientes tuvo por lo menos una discrepancia en el historial de medicación obtenido por el médico. Los farmacéuticos clínicos llevaron a cabo 386 intervenciones, las cuales fueron aceptadas en 279 casos (72.3%). Una cuarta parte de las discrepancias en el historial de medicación resultaron en discrepancias durante la hospitalización (165; 24.2%), mayormente porque la intervención no fue aceptada. En el alta, 278 discrepancias en el historial de medicación (40.8%) resultaron en discrepancias en la carta del alta, lo cual representó 50.2% de todas las 554 discrepancias identificadas en las cartas del alta. La probabilidad de experimentar discrepancias en la admisión aumentó en 47% por cada medicamento adicional incluido en el historial de medicación.

CONCLUSIONES: Las discrepancias en el historial de medicación en la admisión no siempre correlaciona con discrepancias durante la hospitalización debido a las intervenciones de farmacéuticos clínicos; sin embargo, las discrepancias en la admisión pueden ser asociadas con por lo menos la mitad de las discrepancias en el alta. La reconciliación de medicación llevada a cabo por un farmacéutico clínico puede reducir estas discrepancias, si la información errónea recogida por el médico en el historial de medicación es corregida y cada cambio intencional en el plan de medicación se documenta bien durante la hospitalización y en el alta.

Traducido por Ana E Vélez

RÉSUMÉ

L'Effet de la Réconciliation des Médicaments à l'Admission sur les Discordances Médicamenteuses lors de l'Hospitalisation et à la Sortie de Patients Gériatriques

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Ann Pharmacother 2012;46:484-94.

CONTEXTE: Des discordances de médicaments peuvent causer des effets nocifs. La réconciliation par les pharmaciens cliniciens vise à prévenir les discordances et autres problèmes liés aux médicaments.

OBJECTIFS: Déterminer la fréquence des discordances dans l'histoire médicamenteuse obtenue par le médecin qui aboutissent à des discordances lors de l'hospitalisation et à la sortie. Déterminer l'influence des interventions des pharmaciens cliniciens sur les discordances. Analyser les éventuels déterminants liés aux patients des discordances.

MÉTHODE: Etude de cohorte rétrospective et monocentrique sur des patients (≥65 ans, ≥1 médicament prescrit) suivis par des pharmaciens cliniciens entre septembre 2009 et avril 2010 dans le service de gériatrie d'un hôpital universitaire belge. Réconciliation des médicaments à l'admission, durant l'hospitalisation et à la sortie a été réalisée par un pharmacien indépendant obtenant les informations nécessaires dans les dossiers médicaux.

RÉSULTATS: Le processus de réconciliation à l'admission a identifié 681 discordances chez 199 patients Environ 81.9% (163) des patients avait au moins une discordance dans l'histoire médicamenteuse obtenue par le médecin. Les pharmaciens cliniciens ont effectués 386 interventions, qui étaient acceptées dans 279 cas (72.3%). Un quart des discordances dans l'histoire médicamenteuse a entraîné des discordances durant l'hospitalisation (165; 24.2%), principalement parce que l'intervention n'était pas acceptée. A la sortie, 278 discordances dans l'histoire médicamenteuse (40.8%) ont aboutis à des discordances dans la lettre de décharge, représentant 50.2% des 554 discordances identifiées dans les lettres de décharge. La probabilité que des discordances se produisent à l'admission augmente de 47% pour chaque médicament supplémentaire noté dans l'histoire des médicaments.

CONCLUSIONS: Des discordances dans l'histoire des médicaments à l'admission n'aboutissent pas toujours à des discordances lors de l'hospitalisation due aux interventions des pharmaciens cliniciens; néanmoins, les discordances à l'admission semblent aboutir à au moins la moitié des divergences à la sortie. La réconciliation des médicaments effectuée par la pharmacien clinicien peut réduire ces discordances, à condition que l'information erronée dans l'histoire médicamenteuse est corrigée et que chaque changement intentionnel dans le plan de la médication est bien documentée pendant l'hospitalisation et à la sortie.

Traduit par Alain G Dupont