



The need for medication reconciliation: a cross-sectional observational study in adult patients

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KEYWORDS

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Summary

Background: Poor communication of drug therapy at care interface often results in medication errors and adverse drug events. Medication reconciliation has been introduced as a measure to improve continuity of patient care. The aim of this cross-sectional observational study was to evaluate the need for medication reconciliation.

Methods: Comprehensive information on pre-admission therapy was obtained by a research pharmacist for adult medical patients, admitted to a teaching hospital, specialised in pulmonary and allergic diseases, in Slovenia. This information was compared with the in-patient and discharge therapies to identify unintentional discrepancies (medication errors) whose clinical significance was determined by an expert panel reaching consensus.

Results: Most of the included 101 patients were elderly (median age: 73 years) who had multiple medications. Among their in-patient drugs (880), few discrepancies were a medication error (54/654), half of which were judged to be clinically important. A higher rate was observed in the discharge drug therapy (747): 369 of the identified discrepancies (566) were a medication error, over half of which were judged as clinically important. A greater number of pre-admission drugs, poorly taken medication histories and a greater number of medication errors in in-patient therapy predisposed patients to clinically important medication errors in discharge therapy.

Conclusions: This study provided evidence in a small sample of patients on the discontinuity of drug therapy at patient discharge in a hospital in Slovenia and its implications for patient care. To ensure continuity and safety of patient care, medication reconciliation should be implemented throughout a patient's hospital stay.

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Introduction

With the ageing of population, the average patient has multiple diseases and is treated with multiple medications, predisposing patients to a higher risk for adverse drug events (ADE).¹⁻⁴ Poor communication at points of patient transfer further potentiates the risk for medication errors (ME) and ADEs when patients move across the healthcare interface.⁵⁻¹⁸ At hospital admission, at least one ME was

present in up to 67% of patients and almost 60% of the errors had the potential to cause harm.⁵ At hospital discharge, at least one unexplained change in pre-admission therapy was present in nearly half of patients and caused an ADE in 11% of patients where medication reconciliation services were not applied.⁸ It is important to differentiate between MEs and ADEs. An ME is defined as any preventable event that may cause or lead to inappropriate medication use or patient harm, whereas an ADE is an actual untoward medical event that occurs during treatment with a pharmaceutical product.^{19,20} Thus, an ME can but does not always result in an ADE.

The aforementioned facts emphasize the importance of keeping accurate and complete medication histories for safe

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patient care. However, many situations in everyday clinical practice threaten the accuracy and integrity of obtained medication histories.^{12,14,17}

Poor medication history taking can lead to discrepancies between patients' pre-admission and in-patient therapy. These discrepancies may have no professional intent (*unintentional discrepancies*) or may be done with a professional intent (*intentional discrepancies*) as changes in drug therapy are required due to a patient's condition or treatment goals.¹⁷ Although only unintentional discrepancies can be classified as *medication errors*, also intentional discrepancies in an in-patient therapy may lead to errors in the discharge therapy as an intentionally, but only temporally discontinued drug might not be restarted at discharge.^{6,17}

These discrepancies have important implications for the continuity of patient care and, most importantly, patient safety.⁹ Medication reconciliation, defined as the process of verifying medication use, identifying variances, and preventing MEs, addresses this problem and has been recognised as one of the cornerstones of patient safety.^{9,21} This study was undertaken as a first step towards the implementation of medication reconciliation at a teaching hospital in Slovenia. The aim of the study was to provide evidence of the need for medication reconciliation by evaluating the number of discrepancies between patients' pre-admission therapy and in-patient and discharge therapy and evaluate their implications for patient care.

Materials and methods

Study design, settings and patients

The study was designed as a prospective, descriptive, cross-sectional observational study, performed at a teaching hospital, specialised in pulmonary and allergic diseases, in Slovenia between August and October 2008. The study was approved by the Institutional review board.

Each day, three patients were selected from the patients admitted to a medical ward the previous day using a list of random generated numbers. To be eligible, the patients had to be over 18 years, had to be able to provide their medication history in Slovenian and report the use of at least one drug. Patients were asked to state their consent to participate verbally. Patients admitted for allergy testing, those discharged within three days from admission and those who died during hospital stay, were excluded.

Data collection and evaluation

The selected patients were subjected to routine clinical practice: the admitting clinician obtained a medication history upon a patient's admission and recorded it in the hospital medical record as part of the admission process; the recorded medication history could be revised when the in-patient therapy was prescribed on the drug chart; and, upon the patient's discharge, the proposed drug therapy was communicated to the patient's GP through the discharge letter.

In addition to routine clinical practice, for the purpose of this study, accurate and complete information on the pre-admission drug therapy was obtained for every consenting patient by a research pharmacist. Using a

method recommended in the literature,^{5,22,23} information on drug therapy was retrieved through a detailed patient interview and the review of different sources of information (the patient's medications and own list of medicines, the patient's medical and pharmacy records, the patient and carers if a patient had a poor recall of drug therapy). The pharmacy record presents a list of all medicines that have been dispensed to a patient in a community pharmacy. Although the research pharmacist retrieved information on the prescription and over-the-counter (OTC) medicines as well as medicinal supplements and herbal preparations, this article focuses on the prescription medicines only. The information on pre-admission therapy retrieved by the research pharmacist was proved in our previous research to be more complete and more accurate than the one recorded in the medical records¹² and was, thus, used as a reference for further comparisons.

Details on the in-patient and discharge therapy were collected and compared with the pre-admission therapy to identify any discrepancy. Any change to the pre-admission therapy was identified as a discrepancy. Incomplete drug orders, for example, a prescription order lacking important information for the unambiguous identification and safe administration of a drug were also classified as a discrepancy. There could be a number of discrepancies for each drug, but only the most significant for patient's drug treatment was recorded. The research pharmacist notified the treating clinician about all discrepancies between the pre-admission and the in-patient therapy, subsequent changes to the drug therapy were done at the discretion of the treating clinician and were not followed in this study. The professional intention for each discrepancy was determined by (i) consulting the treating clinician on whether an in-patient drug discrepancy was committed intentionally or unintentionally, and (ii) reviewing the discharge letter to determine whether a discharge drug discrepancy was intentional or unintentional. Unintentional discrepancies were classified as MEs.

Rating the significance of medication errors

The clinical significance of MEs was determined through a consensus of an expert panel of 3 pharmacists (2 hospital pharmacists, 1 community pharmacist) and 3 clinicians (1 specialist in internal medicine, 1 surgeon, 1 GP). None of the panellists was actively involved in the study. A modified nominal consensus group method was used²⁴: first, the panellists were asked to rate the significance of the errors using a four-point scale (0 = not important, 1 = important, 2 = very important, 3 = potentially fatal), then the individual opinions were presented and discussed, and, finally, the panellists were asked to rerate the errors (Table 3). In cases where consensus was not reached with the second rating, the median value of the ratings was recorded. The clinical significance was assessed for each ME separately; in cases when a number of errors occurred in the treatment of one patient, it was not possible to assess their cumulative impact on patient care.

Data handling and statistical analysis

Confidentiality and anonymity of patients and clinicians were ensured throughout. The data were coded and

Table 1
Characteristics of drugs in pre-admission therapy and their record

	n/N	%
Number of drugs in pre-admission therapy ^a	625/625	100.0
ATC classification of drugs in pre-admission therapy		
ATC C	225/625	36.0
ATC N	102/625	16.3
ATC A	100/625	16.0
ATC R	66/625	10.6
ATC B	55/625	8.8
Other ATC classes	77/625	12.3
Drugs from pre-admission therapy recorded in the pharmacy record	526/625	84.2
Drugs from pre-admission therapy recorded in the medication history recorded in the medical record	417/625	66.7
Complete records (the identification of drug's use is possible)	175/625	28.0
Inaccurate records (differ from pre-admission therapy)	446/625	71.4

ATC: Anatomical Therapeutic chemical Classification; ATC C: Cardiovascular system; ATC N: Nervous system; ATC A: Alimentary tract and metabolism; ATC R: Respiratory system; ATC B: Blood and blood forming organs.

^a Information on patient's pre-admission therapy was obtained by a research pharmacist, based on a detailed patient interview in combination with different sources of information.

entered onto an SPSS version 14 database. In presenting and analysing the data, patients were defined as elderly if over 65 years of age¹ and medication errors whose clinical significance was rated as "important", "very important" or "potentially fatal" were termed as "clinically important". Patient data are presented as absolute values and proportions. Median values and interquartile ranges (IQR) are presented where appropriate. Differences and associations were analysed using Chi-square, paired t-test, independent sample t-test, ANOVA and Pearson's correlation, as appropriate. Values of p lower than 0.05 were considered significant.

Results

Patient characteristics and details on pre-admission therapy

The study included 101 patients, most of whom were elderly (median age: 73 years, IQR: 65-79) and male (57.4%; 58/101). Patients were taking many drugs in their pre-admission therapy (median: 6, IQR: 4-9). The medicines' distribution in the Anatomical Therapeutic chemical Classification (ATC) resembled the distribution of medicines in the general Slovenian population.²⁵ Most drugs were recorded in the pharmacy record and in the medical records (Table 1); however, the latter often proved to be incomplete and inaccurate.

Medication errors in in-patient therapy

In the in-patient therapy, 74.3% (654/880) of the medicines were in discordance with the patients' pre-admission therapy but most were intentional discrepancies (85.6%; 560/654; Table 2; Fig. 1). The expert panel rated over half of the evaluable errors as clinically important (51.9%; Table 3). At least one ME was recorded in 33.7 % (34/101) patients and at least one clinically important ME in 18.8% (19/101) of patients. One patient experienced as much as five errors, four of which were determined clinically important.

The number of MEs in the in-patient therapy correlated with the number of drugs in patients' pre-admission therapy (Pearson's $r=0.558$, $p<0.001$) and with the number of discrepancies in their medication history in the medical record (Pearson's $r=0.428$, $p<0.001$).

Medication errors in discharge therapy

At patients' discharge, 75.8% (566) of the 747 prescribed drugs were in discordance with patients' pre-admission therapy and most discrepancies (65.2%; 369/566) were unintentional (Table 2; Fig. 1). The expert panel rated 58.0% (207/357) of the evaluable MEs as clinically important (Table 3). Errors due to a discrepancy in the dose or drug omission (Chi square, $\chi^2=75.496$, $df=6$, $p<0.001$) and errors in prescribing drugs from the ATC group C and less common ATC groups (Chi square, $\chi^2=35.880$, $df=5$, $p<0.001$) were associated with greater clinical importance, indicating areas in which special attention should be paid.

A median of three MEs were recorded per patient, with the great majority of patients experiencing at least one ME (84.2%; 85/101) and 71.3% (72/101) of patients presenting with at least one clinically important ME. One patient experienced as much as 11 MEs, all judged to have potentially important clinical implications.

The number of MEs in the discharge therapy correlated with patient age (Pearson's $r=0.235$, $p=0.018$), number of drugs in their pre-admission therapy (Pearson's $r=0.660$, $p<0.001$) and number of discrepancies in the recorded medication history (Pearson's $r=0.413$, $p<0.001$) or in the in-patient therapy (Pearson's $r=0.755$, $p<0.001$). Most importantly, the same characteristics predisposed patients to greater risk for clinically important discrepancies (drugs in pre-admission therapy: Pearson's $r=0.591$, $p<0.001$; discrepancies in drug history: Pearson's $r=0.437$, $p<0.001$; discrepancies in in-patient therapy: Pearson's $r=0.632$, $p<0.001$).

Table 2
Discrepancies and medication errors between pre-admission^a and in-patient therapy or discharge therapy, respectively.

	In-patient therapy		Discharge therapy	
	n/N	%	n/N	%
No. of discrepancies with pre-admission therapy	654/880	74.3	566/747	75.8
Reasons of recorded discrepancies				
Drug commission	207/654	31.7	155/566	27.4
Drug omission	173/654	26.5	163/566	28.8
Discrepancy in drug's dose	95/654	14.5	78/566	13.8
Drug substitution	92/654	14.1	83/566	14.7
Other	87/654	13.3	87/566	15.4
No. of medication errors ^b	54/654	8.3	369/566	65.2
Reasons of recorded medication errors				
Drug omission	34/54	63.0	149/369	40.4
Discrepancy in drug's dose	14/54	25.9	58/369	15.7
Drug commission	2/54	3.7	66/369	17.9
Drug substitution	2/54	3.7	49/369	13.3
Other	2/54	3.7	47/369	12.7
Clinical importance of medication errors ^c				
Not important	25/52	48.1	150/357	42.0
Important	18/52	34.6	186/357	52.1
Very important	9/52	17.3	20/357	5.6
Potentially fatal	0/52	0.0	1/357	0.3

^a Information on patient's pre-admission therapy was obtained by a research pharmacist, based on a detailed patient interview in combination with different sources of information; this information was used for further comparisons.

^b An unintentional discrepancy was considered a medication error.

^c The clinical significance of certain medication errors could not be evaluated.

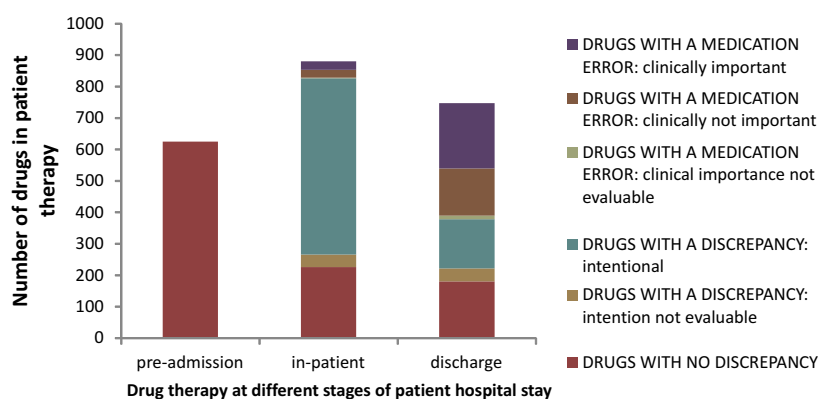


Fig. 1. Presentation of the number of discrepancies, medication errors and clinical important medication errors in patient in-patient and discharge therapy. A discrepancy was defined as any difference in the in-patient or discharge therapy with the pre-admission therapy, obtained by a research pharmacist, based on a detailed patient interview in combination with different sources of information. A medication error was defined as any unintentional discrepancy.

Discussion

Our study provided evidence on the discontinuity of drug therapy at times of patients' transitions to and from hospitals and its implications for the safety of patient care. The presented results urge the implementation of medication reconciliation practices throughout patient's hospital stay to ensure continuity of care and improve patient safety.

Medication errors in in-patient therapy

In our study, over 75% of the drugs prescribed during patient's hospital stay were in discordance with patient's pre-admission therapy which is comparable to previously published literature.^{5,7,10,11,17} However, this result is not alarming since the large majority of the identified changes were initiated intentionally by a clinician. The proportions of unintentional discrepancies reported in the literature vary (3.4%-75%),^{5,7,10,11,17}; our findings reflect the results of

Table 3
Examples of medication errors of different clinical importance

Clinical importance	Therapy	Example
Not important	In-patient	Patient (male, 62 years) was taking simvastatin tbl 40 mg once daily before hospital admission; no similar drug was prescribed during hospital stay.
	Discharge	Patient (male 76 years) was taking simvastatin tbl 40 mg once daily before hospital admission; another brand of simvastatin was prescribed in the discharge therapy.
Important	In-patient	Patient (female, 74 years) was taking theophylline SR cps 200 mg once daily before hospital admission; theophylline SR cps 200 mg twice daily was prescribed during hospital stay.
	Discharge	Patient (male, 84 years) was taking atorvastatin tbl 10 mg once daily before hospital admission; atorvastatin tbl 40 mg once daily was prescribed at discharge.
Very important	In-patient	Patient (male, 76 years) was taking aspirin GR tbl 100 mg once daily before hospital admission; no similar drug was prescribed during hospital stay.
	Discharge	Patient (male, 75 years) was taking metildigoxin tbl 0.1 mg once daily before hospital admission; the drug was not mentioned in the discharge therapy.
Potentially fatal	In-patient	No example of this clinical significance was recorded.
	Discharge	Patient (male, 15 years) with cystic fibrosis was taking azithromycin tbl 250 mg three days a week on a regular basis before hospital admission; the drug was not mentioned in the discharge therapy.

tbl: tablet; SR cps: slow release capsules; GR tbl: gastro-resistant tablets.

those studies where the treating clinician determined the discrepancies' intention. In these studies, the proportion of unintentional discrepancies may be underestimated as the clinician may have been biased when indicating that a discrepancy was intended.

In our study, nearly one fifth of patients experienced at least one clinically important ME, reflecting other studies.^{5,13,17} Patients taking more medicines prior to hospital admission were shown, in our and other studies, to experience more MEs in their in-patient therapy.^{7,17} Moreover, a similar correlation was found with the number of inaccuracies in the medication history recorded in the medical record. In fact, drug histories in medical records often do not provide complete and accurate information on patient's pre-admission therapy;^{12,14,15,17} similar observations were made also in our study. Accurate and comprehensive medication histories should be aspired at all times as inaccuracy may lead to MEs in later stages of patient treatment.

In summary, in-patient therapy was characterised by a relatively low number of clinically important MEs, most originated from incomplete and inaccurate medication history taking.

Medication errors in discharge therapy

The results of our study identified a patient's discharge from hospital as a critical point in ensuring continuity and safety of care. Our results are similar to those of studies evaluating continuity of care in environments where no medication reconciliation was implemented.¹⁰ Although a lower proportion of MEs (around 25%) and patients suffering at least one ME (from 14 to 41%) was reported in settings where medication reconciliation practices were established at admission,^{10,11,13} their continued presence indicates the need for medication reconciliation at patient's discharge regardless of its use at time of a patient's admission.

Of even greater importance, MEs at patient discharge are not only very frequent but carry a great potential for detrimental effect on patient care. As the clinical

significance was rated for each drug separately, their true impact on patient care may be underestimated in patients with more discrepancies and more serious consequences may be expected e.g. in the patient experiencing 11 clinically important MEs. Our results are not alone in demonstrating the importance of medication reconciliation at hospital discharge for intercepting clinically important MEs,¹³ and reducing the rate of ADEs and hospital utilization.^{8,16}

Our and previous research identified patient age^{4,11,26} and number of drugs in pre-admission therapy^{4,26} as risk factors for ME and ADE; additional attention should be paid in drug management of these patients. Patients with more discrepancies in their medication history and in-patient therapy experienced more MEs and clinically important MEs at discharge from hospital. The importance of rectifying discrepancies in drug therapy as soon as they occur was evidenced also by other researchers: admission discrepancies were associated with the number of MEs at patient discharge¹¹ and many MEs occurring at time of hospital discharge were found to originate from a poor medication history.^{6,10}

Overall, a patient discharge therapy was characterised by a high number of clinically important MEs, evidencing patient discharge as a critical point in ensuring continuity of care. To tackle this problem, a comprehensive approach is needed: accurate drug histories should be aspired at all times as well as medication reconciliation at admission and discharge should be employed. Since medication reconciliation is a time demanding process,¹³ it should be implemented within a study framework, evaluating its benefits over routine practice and estimating the associated workload. Moreover, the competence of medication reconciliation providers is of utmost importance: among all healthcare providers, pharmacists have been shown to provide most complete and accurate drug histories and perform best at medication reconciliation;^{7,10,13,23,27} their participation in medication reconciliation would make the best use of the expertise of different healthcare professionals.

Strengths and limitations

Studies evaluating the need for medication reconciliation are often limited only to certain error types⁴ and only few studies evaluated the need for medication reconciliation across the entire patient episode.^{6,13,28} Moreover, other studies often introduced biases in determining the discrepancies' intention and their clinical significance by relying on the judgement of only few healthcare professionals, often actively participating in the study.^{4,10,13,14} All these limitations were addressed in designing our study.

However, the study presents some limitations. It was limited to one hospital in Slovenia and although the results cannot be generalized to other settings, it is the first study to address this issue in Slovenia. The method used to obtain the information on pre-admission therapy was taken from the literature without further revalidation; this limitation was accepted since it was showed in our previous research to be more complete and more accurate than the medication history recorded in the medical records.¹² The number of unintentional discrepancies in in-patient therapy may be underestimated as the treating clinician may have had a bias to indicate that a discrepancy was intended. And, finally, although the study provided objective estimations of the clinical significance of the identified MEs, the ADEs experienced by the patients should be assessed in further studies.

Conclusions

The results of our study urge the implementation of medication reconciliation practices to improve patient safety: admission and discharge from hospitals were shown to produce a large number of discrepancies in patients' drug therapy, many of which represent MEs with important implications for patient care. Although patients' discharge was characterised by more MEs, discrepancies and errors in the medication history and in in-patient therapy led to a higher number of errors in further steps; to ensure continuity of patient care, medication reconciliation should be implemented throughout patients' hospital stay.

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Conflict of interest statement

The authors declare that they have no competing interest.

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