

COMPREHENSIVE MEDICATION HISTORY: THE NEED FOR THE IMPLEMENTATION OF MEDICATION RECONCILIATION PROCESSES

POPOLNOST INFORMACIJ O ZDRAVLJENJU Z ZDRAVILI PRED SPREJEMOM V BOLNIŠNICO IN POTREBA PO IMPLEMENTACIJI PRINCIPOV USKLAJEVANJA ZDRAVLJENJA Z ZDRAVILI

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Abstract

Introduction: Providing comprehensive medication history (CMH) upon hospital admission is of outmost importance for proper patient evaluation and prescription of drug treatment. The aim of this study was to evaluate the implementation of medication reconciliation in clinical practice.

Methods: Patients admitted to a teaching hospital in Slovenia were randomly selected and included in the study. For each patient a CMH was obtained by a research pharmacist using various sources of information. Next, the medication history in the hospital medical record was reviewed. The prescribed drugs were assessed for completeness of information, and possible discrepancies between both medication histories were recorded and classified.

Results: Overall, 108 patients with a median age of 73 years were included in the study. The research pharmacist recorded the use of 651 medicaments, with all relevant details being available for 94.9% of these drugs. Of the 464 medicines listed in the hospital medical record, only 42.0% were considered complete. A comparison of the medication history and the medical record with the CMH revealed at least one discrepancy in 72.4% of the drugs listed. The majority of the identified discrepancies were often present both in the medication order on the drug chart (76.2%) and in the discharge letter (69.9%). Most medication discrepancies were due to drug omissions (20.9%) and commissions (6.5%).

Conclusion: The high rate of discrepancies between the recorded drug history and CMH reported in our study stresses the need for the implementation of medication reconciliation. The participation of pharmacists in the reconciliation process, described in this study, resulted in more complete and accurate drug histories acquired.

Key words: pharmaceutical care, pharmacotherapy, clinical pharmacy, hospital, medicine, medicines, medication reconciliation, seamless care

Izvirni znanstveni članek
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Izvleček

Uvod: Popolnost informacij o zdravljenju z zdravili pred sprejemom v bolnišnico je pomembna pri nadaljnji obravnavi bolnika. Opisana raziskava preučuje smiselnost implementacije principov usklajevanja v proces zdravljenja z zdravili.

Metode: V raziskavo so bili naključno vključeni bolniki sprejeti v Bolnišnico Golnik KOPA. Informacije o zdravljenju z zdravili je poleg tistih pridobljenih ob sprejemu, z uporabo različnih virov informacij samostojno pridobil tudi farmacevt. Ocenili smo popolnost informacij, zapisanih v anamnezi in pridobljenih s strani farmacevta, ter ugotovljene razlike kategorizirali.

Rezultati: Raziskava je zajela 108 bolnikov z mediano starosti 73 let. Farmacevt je ugotovil uporabo 651 zdravil, za 94,9% katerih je dobil vse potrebne informacije o imenu, odmerku, režimu odmerjanja in načinu administracije.

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Pri istih bolnikih je bila v anamnezi zapisana uporaba 464 zdravil, 42,0% zapis katerih je bil popoln. Pri primerjavi informacije zapisane v anamnezi in pridobljene s strani farmacevta je bila vsaj ena razlika ugotovljena pri 72,4% zdravil, ista razlika je bila pogosto prisotna tudi na terapevtski listi (76,2%) in v odpustnici (69,9%). Izpust zdravila (20,9%) in predpis zdravila, ki ga bolnik doma ni prejemal (6,5%), sta bila najpogostejša razloga za ugotovljene razlike.

Zaključek: Veliko število razlik v zabeleženih in pridobljenih informacijah o zdravilih, ki jih je bolnik jemal pred sprejemom v bolnišnico, kaže na potrebo po implementaciji principov usklajevanja zdravljenja z zdravili v sedanjo klinično prakso. Vključitev farmacevta v ta proces, kot je opisano v tem prispevku, je izboljšalo popolnost in pravilnost informacij o zdravilih.

Ključne besede: farmacevtska skrb, farmakoterapija, klinična farmacija, bolnišnica, medicina, zdravila, usklajevanje zdravljenja z zdravili, brezšivna oskrba

1 Introduction

Treatment with medicines is an integral part of daily clinical practice. For the safe prescribing of medicines, complete information on the drugs a patient is using is of outmost importance (1). Acquiring medication history for patients admitted to hospital is important not only because it serves as a basis for assessing the effectiveness and safety of current drug treatment and for further treatment decisions, but also because medicines *per se* can be the cause of hospitalization, either directly or as a result of an interaction (2, 3). Inaccuracies in medication history may be responsible for duplication or discontinuation of drug therapy, as well as for failure to detect drug interactions or other drug related problems (1).

Up to 27% of prescribing errors detected in hospitals can be attributed to incomplete drug histories taken at the time of admission. The growing interest in the identification and rectification of medication errors at the time of admission, transfer and discharge has led to the implementation of "medication reconciliation" (4). Medication reconciliation is the process of identifying the most accurate list of all medicines a patient is taking, including the data on the name, dosage, frequency and route of administration of each medicine. The obtained information can thereafter be used to provide patient care regardless of the patient care setting (5, 6).

The aim of the study was to evaluate the advantages of a comprehensive medication history (CMH) over a medication history taken at the time of admission. The number of discrepancies between both medication histories was reported as the primary outcome. The number of drugs recorded with all details necessary for drug identification and administration was reported as the secondary outcome.

2 Materials & Methods

2.1 Settings and patients

This prospective study of randomly selected hospitalized patients was conducted between August 2008 and October 2008 at the University Clinic of Respiratory and Allergic Diseases, Golnik, Slovenia.

Patients were eligible for inclusion if they were admitted to a medical ward, if they reported the use of at least one medicine and if they were able to provide their medication history. Patients admitted for allergy testing, those who died during the hospital stay and those discharged within three days of admission, were excluded.

2.2 Data collection

The patient CMH was obtained by a research pharmacist through a detailed patient interview and by using various sources of information, such as the examination of the patient's medication vials and his/her own list of medicines, a review of the pharmacy record of prescription drugs dispensed for the patient, and consultation with the patient's caregivers (3, 6, 7, 8). Regardless of the source of information used, patients were asked to confirm every detail regarding medication use. The CMH obtained by a research pharmacist served the purposes of the study only, and was not part of the routine clinical practice in the study hospital. In a routine clinical setting, medication history was taken by the admitting physician on admission and was recorded in the hospital medical record. The latter may be reviewed by the clinician during hospitalization. Next, the information on the patient's medication history in the hospital medical record was reviewed, and details about the drug name, dose, regimen and route of administration were recorded.

The drug chart and the discharge letter were reviewed, and details on the prescription of medicines from the CMH were recorded.

2.3 Evaluation of collected data

Each medicine record was assessed for all the data needed by healthcare professionals for unambiguous identification and administration of the drug.

Next, the medication history recorded by the admitting physician was assessed against the CMH for possible discrepancies. Errors were categorised as medicine omissions or commissions, and as discrepancies in the drug name, dose, frequency or route of administration. If several discrepancies were detected per medicine, only the error considered by the researcher to have the biggest impact on patient care was documented for each drug.

There followed the evaluation of the prescription of medicines from the patient's CMH on the drug chart and in the discharge letter. The presence of discrepancies identified in the medication history taken upon admission was recorded.

2.4 Data handling and statistical analysis

Patient confidentiality was protected in handling the collected data and no names were recorded. Data were entered into SPSS 14.0 (SPSS Inc., ZDA) database. Patients' data are presented as absolute values and proportions; in calculating the proportions, the number of medicines recorded in the CMH is referred to as 100%. Median values and ranges are indicated where possible. Differences and associations were analysed using the paired sample t-test, independent sample t-test, Pearson's correlation and ANOVA, as appropriate. P values lower than 0.05 were considered significant.

3 Results

The study included 108 patients with a median age of 73 years (range 15 - 89 years), 61 were males (56.5%). The research pharmacist recorded the use of 651 medicines, the median being six medicines per patient (range: 1 - 19). Many medicines in the CMH belonged to the Anatomical Therapeutic chemical Classification (ATC) group Cardiovascular system (34.7%; 226/651), to the group Alimentary tract and metabolism (16.7%; 109/651) and to the group Nervous system (16.6%; 108/651) (Table I).

Different sources of information were used to acquire the CMH. Complete data on drug name, dose, frequency and route of administration were obtained for 94.9 % (618/651) of medicines. Most details on medicine use were provided directly by the patient; this was true for 59.0% (384/651), 49.0% (319/651), 85.7% (558/651) and 68.8% (448/651) of data on drug name, dose, frequency and route of administration, respectively (Table II). When patients were not familiar with all medicine details, they provided the missing information with the aid of their own list of medicines or medication vials. A large majority of data (over 80%) were thus collected through patient interviews, and by examination of patients' list of medicines and their medicine's vials. In 17.2% (112/651) of cases drug dosage could not be identified using the above information sources, yet the missing information was successfully retrieved by contacting a patient's caregivers or reviewing the pharmacy record (12.4%; 81/651).

Of the 651 medicines in the CMH, 532 (81,7%) were listed in the pharmacy record; the pharmacy record can prove useful in retrieving medication history information.

Next, the hospital medical records were reviewed. They were not available for 5.6% (6/108) of the patients; for 11.1% (12/108) of patients no record on medication history was found in the hospital medical record. The remaining 83.3% (90/108) of patients had 464 medicines recorded in their hospital medical records. Less medicines per patient, a median of five, were identified in the hospital medical record than in the CMH (paired sample t-test, $p < 0.001$).

The evaluation of the medication history in the hospital medical record showed that the minority of medicine records (42.0%; 195/464) were complete, providing information on the drug name, dose, frequency and route of administration (Table III). The record often lacked information on the dose (31.3%; 145/464), frequency of administration (17.9%, 83/464) and name of the drug (6.9%, 32/464). In a small percentage (1.9%; 9/464), there was no clear information on the route of administration. Frequently, we found more than one missing piece of information per medicine record; however, this was not further analysed.

Next, the medication history in the hospital medical record was assessed against the CMH (Table I & IV). All patients were included in the analysis, regardless of the presence of the medication history in their hospital medical record.

Table 1. *Frequency of Anatomical Therapeutic chemical Classification (ATC) groups in the comprehensive medication history (CMH) with the relative frequencies of discrepancies in the hospital medical record. /*

Tabela 1. *Zdravila, ki jih je bolnik prejemal pred sprejemom v bolnišnico. Pogostnost po skupinah ATC (anatomsko-terapevtsko-kemične klasifikacija zdravil) in razlike med temi zdravili in terapijo zapisani v anamnezi*

Tabela 1.

ATC group ATC skupina	CMH		Discrepancies in hospital medical record Razlike v terapiji zapisani v anamnezi		Frequency of discrepancies within group Pogostnost razlik v posamezni skupini
	%	n	%	n	%
C: Cardiovascular system C: Srce in ožilje	34,7	226/651	29,9	141/471	62,4
A: Alimentary tract and metabolism A: Prebavila in metabolizem	16,7	109/651	18,0	85/471	78,0
N: Nervous system N: Živčevje	16,6	108/651	20,0	94/471	87,0
R: Respiratory system R: Dihala	10,1	66/651	10,2	48/471	72,7
B: Blood and blood forming organs B: Kri in krvotvorni organi	8,6	56/651	8,3	39/471	69,6
M: Musculo-skeletal system M: Mišičje in okostje	3,7	24/651	4,0	19/471	79,2
G: Genito-urinary system and sex hormones G: Genitourinarni trakt in spolni hormoni	3,1	20/651	2,5	12/471	60,0
H: Systemic hormonal preparations H: Sistemske hormonske pripravke	2,5	16/651	2,5	12/471	75,0
Other Drugo	2,5	16/651	3,0	14/471	87,5
Not applicable Ne ustreza	1,5	10/651	1,5	7/471	70,0

Table 2. Sources of information used in taking a comprehensive medication history.

Tabela 2. Viri informacij za oblikovanje seznama zdravil, ki jih je bolnik prejemal pred sprejemom v bolnišnico

	Name Ime		Dose Odmerek		Frequency Režim odmerjanja		Route Način uporabe	
	%	n	%	n	%	n	%	n
Information retrieved Pridobljene informacije	99,5	648/651	95,4	621/651	99,7	649/651	100,0	651/651
Patient interview Pogovor z bolnikom	59,0	384/651	49,0	319/651	85,7	558/651	68,8	448/651
Medication vials or list of medicines Pregled zdravil ali bolnikovega seznama zdravil	37,8	246/651	33,8	220/651	12,0	78/651	28,3	184/651
Caregivers Bolnikovi skrbniki	1,8	12/651	3,5	23/651	2,0	13/651	1,8	12/651
Pharmacy record Izpis zdravil iz kartice zdravstvenega zavarovanja	0,9	6/651	8,9	58/651	0	0/651	0	0/651
Other Drugo	0	0/651	0,2	1/651	0	0/651	1,1	7/651
Information not retrieved Informacije niso bile pridobljene	0,5	3/651	4,6	30/651	0,3	2/651	0,0	0/651

Table 3. Completeness of information in medicine record in the comprehensive medication history (CMH) and hospital medical record.

Tabela 3. Popolnost podatkov o zdravilih, ki jih je bolnik prejemal pred sprejemom v bolnišnico, pridobljenih s strani farmacevta (CMH) in zapisanih v anamnezi

Assessed patients Obravnavani bolniki	CMH		Hospital medical record Anamneza	
	%	n	%	n
Incomplete Nepopolni podatki	5,1	33/651	58,0	269/464
Name Ime	0,3	2/651	6,9	32/464
Dose Odmerek	4,6	30/651	31,3	145/464
Route Način jemanja	0	0/651	1,9	9/464
Frequency Režim odmerjanja	0,2	1/651	17,9	83/464
Complete Popolni podatki	94,9	618/651	42,0	195/464

Footnote: * The completeness of information provided by the hospital medical record could not be assessed in 18 patients, who had no medicine recorded in their hospital medical record.

Of the 651 medicines recorded in the CMH, only 365 (56.1%) were listed in the hospital medical record. At least one discrepancy was detected in 72.4% of drugs. Hospital medical records with a missing medication history or incomplete medicine records did not allow the determination of the nature of discrepancy in 40.1% (261/651) of cases; however, the lack of data in the hospital medical record was *per se* classified as a discrepancy. Many discrepancies identified in the remaining 210 medicines were due to drug omission (20.9%; 136/651). Medicine commission was the second most frequent cause of discrepancy; during the CMH interview, the patients denied the use of 6.5% (42/651) medicines recorded in the hospital medical record. Omeprazole, morphine, furosemide, ramipril and acetylsalicylic acid were among the most frequently commissioned medicines. Fewer discrepancies resulted from a difference in the dose

(5.4%; 35/651) or in the frequency of administration (4.8%; 31/651). No discrepancy between the hospital medical record and the CMH was found for 27.6% (180/651) of medicines.

More discrepancies were recorded in male than in female patients (independent sample t-test, $p=0.030$), and in patients with polypharmacy in the CMH (Pearson's correlation, $r=0.543$, $p<0.001$). Patient age (Pearson's correlation, $r=0.069$, $p=0.476$) or the time of admission to hospital (ANOVA, $p=0.320$) were not correlated with the number of the identified discrepancies. A higher number of discrepancies (χ^2 -test, $p<0.001$) was found for the drugs of the following ATC groups: Nervous system (87.0%; 94/108), Musculo-skeletal system (79.2%; 19/24), Alimentary tract and metabolism (78.0%; 85/109) and Systemic hormonal preparations (75.0%; 12/16).

Table 4. *Discrepancies between medication history in hospital medical record and CMH.*

Tabela 4. *Razlike v informaciji o zdravilih, ki jih je bolnik prejemal pred sprejemom v bolnišnico, pridobljeni s strani farmacevta in zapisani v anamnezi.*

	%	n
Discrepancy present* Ugotovljena razlika	78,7	513/651
<i>The cause cannot be determined because of the missing medication history or incomplete medicine record.</i> <i>Vzroka ni moč ugotoviti zaradi manjkajoče anamneze zdravljenja z zdravili ali nepopolnega zapisa o zdravilih.</i>	40,1	261/651
<i>Reason can be determined</i> <i>Ugotovljen vzrok</i>	51,3	252/651
Medicine commission Dodatno predpisan zdravilo	6,5	42/651
Medicine omission Izpuščeno zdravilo	20,9	136/651
Discrepancy in the dose Razlika v odmerjanju	5,4	35/651
Discrepancy in the frequency of administration Razlika v režimu odmerjanja	4,8	31/651
Discrepancy in the name of medicine Razlika v imenu zdravila	0,8	5/651
Discrepancy in the route of administration Razlika v načinu aplikacije	0,5	3/651
No discrepancy present Ni bilo razlik	27,6	180/651

Footnote: *Because of medicines commissioned on hospital admission, the number of evaluated drugs (693) exceeds the number of drugs recorded in the CMH.

4 Discussion

Our study showed the advantages of a pharmacist-led medication history over the medication history recorded in the hospital medical record by the admitting physician. Moreover, the high level of discrepancies present in the medication history taken at the time of admission urges a change in the current medicine management with the implementation of the principles of medication reconciliation.

4.1 Strengths and limitations

As most studies of discrepancies in medication history are retrospective and limited to reporting omission or commission discrepancies only, and as they rarely determine their professional intent, this study was conducted prospectively to assess a broad spectrum of unintentional discrepancies (4). Moreover, the discrepancies due to inaccurate medication history taken on hospital admission were evaluated throughout the hospital stay i.e. from admission to discharge. However, the study presents some limitations.

The study was limited to one hospital in Slovenia. Even if the results could not be generalized to other settings, this is the first study in Slovenia to address this issue. Multiple sources of information based on structured patient interviews were employed to obtain information on pre-admission drug use; the accuracy of the information in the CMH was not further validated and was considered as the gold standard in further analyses. This limitation was accepted since the method used to acquire CMH is recommended in the literature. It is further supported by the results of a standardized patient study, which showed pharmacists to be 100% accurate in providing histories of prescription and non-prescription drug use (4, 9, 10).

4.2 Findings

Our series included elderly patients, most of them receiving six or more drugs, among which many acted upon the cardiovascular system and CNS. Utmost care should be exercised in the drug management of this population of patients as they belong to a subgroup at highest risk for adverse drug events (11, 12).

The method employed to obtain the CMH has proved very effective and provided us with all needed details on nearly all medicines listed in the CMH (94.9%). The patients themselves provided all data for nearly half of the medicines in the CMH. They showed better recall of information on the frequency (85.7%) and route of

administration (68.8%) than on the name (59.0%) and dose (49.0%) of the drug. The patients in this study recalled more drug details than did the patients in the study by Pickrell *et al.*, who before a pharmacist's intervention recalled only 37.4% of names, 24.2% of doses and 43.4% of administration frequencies (13). In the reported study, inspection of medication vials and review of patients' own list of medicines were successfully used to retrieve data that patients could not remember. Patients should be encouraged to bring their own medicines to hospital to aid in the acquisition of accurate medication histories (9).

The pharmacy record was seldom used to obtain the missing information on drug name (0.9%) or dose (8.9%). However, it may be a valuable help in patients with poor compliance or when verbal contact is not possible: 81.7% of medicines in the CMH were documented in the pharmacy record. Many pharmacy records were not updated within 90 days before the admission to hospital and as drug therapy may be changed during such a long time period, the validity of the information in the pharmacy record should be confirmed by the patient. At the time of writing, the management of the pharmacy record is undergoing a change: prescription drugs dispensed in a pharmacy will be available through a real time on-line electronic database, with promising implications for the acquisition of medication history for patients transferred across the healthcare interface (14). Results from other studies have supported the use of pharmacy records to reduce patient recall bias in daily clinical practice (1, 14).

A review of hospital medical records showed that the lack of a medication history record and the inaccuracy in recording medicine details resulted in only half of the medicines in the CMH being recorded and over half of the recorded medicines being incomplete. The latter did not provide data relevant for the identification of their use by the patient, with one third of the recorded medicines lacking information on dosage. Although the medication history in the hospital medical record does not serve as a medication order, the recorded information is often used when prescribing medicines on a drug chart. Moreover, the issue of missing information has to be resolved by the prescribing physician as it may lead to delays or omission of medicine doses.

The inaccuracy in obtaining and recording the medication history at the time of admission accounted for at least one discrepancy in 72.4% of the medicines in the CMH. Over one fifth of the drugs listed in the CMH were omitted by the physician, which resulted in a lower mean number of medicines per patient

compared to that in the CMH. Surprisingly, commission of a medicine was the second most common cause of discrepancy: patient denied the use of 42 drugs listed in the hospital medical record. Not only does this result show poor patient compliance, but also highlights the importance of basing the medication history on a patient's interview and double checking any piece of information retrieved from medical or pharmacy records with the patient. Errors in recording doses or frequency of drug administration accounted for a lower percentage, i.e. approximately 5% of the discrepancies detected. In interpreting these results, it should be considered that details on dose and frequency were often missing in the hospital medical record and that a higher rate of dose and frequency discrepancies may be expected if these details are recorded.

Other studies comparing pharmacist-acquired medication histories with those obtained by physicians reported similar results, with an unintentional discrepancy being reported for around 60% of medicines (13, 16). The percentage of medicines presented with a discrepancy was lower (approx. 30%) in studies evaluating only omission and commission errors (1). In the reviewed literature, omission errors are the most common cause of discrepancies, followed by differences in drug dose (1, 4, 5, 13); the share of omission and dose discrepancies reported in this study may be found within the varying prevalence of these two categories of discrepancies. Our study identified a similar rate of commissioned drugs (6.5%) as studies by Lau *et al.* and Nassaralia *et al.*, reporting a drug commission in 2.7% and 8.6% of medicines in CMH, respectively (1, 5).

A higher rate of discrepancies was noted in male patients with several medicines listed in the CMH. A higher rate of discrepancies was noted also for the ATC-system drugs targeting the nervous system, musculo-skeletal system, alimentary tract and metabolism, and for systemic hormonal preparations. However, the high rate (over 60%) of discrepancies present in individual ATC groups does not allow for the distinction between ATC groups at higher risk for discrepancies; more attention should be paid to every single medicine, regardless of the ATC group.

A medication history recorded in the hospital medical record has no value as a medication order, and discrepancies between the medication history and the CMH are often discarded as lacking any real implication for patient care. However, the results of our study clearly show that inaccuracy in obtaining a medication history at the time of admission all too often leads to a prescription error. In fact, 76.2%

and 69.9% of discrepancies in the hospital medical record persisted in the medication order on the drug chart and in the discharge letter, respectively. The clinical significance of these discrepancies was not evaluated in this study and no direct implication for patient care can be drawn. However, similar studies showed that discrepancies in medication history may have important clinical consequences. In the study by Cornish *et al.*, 140 unintended medication discrepancies were identified at the time of admission, 38.6% of which were considered by an expert panel to cause moderate to severe discomfort, or even clinical deterioration (14). In the study by Vira *et al.*, who more strictly defined a clinically significant discrepancy as an error causing death, permanent or temporary disability, prolonged hospital stay, readmission, or the need for additional treatment or monitoring, the number of clinically important discrepancies was only 15% (1, 14). The aforementioned findings suggest that a large number of discrepancies in medication histories detected in hospital medical records and their persistency throughout the hospital stay may have detrimental implications for patient care.

Our study identified a high rate of discrepancies in the medication history taken upon hospital admission. Not only may these errors be responsible for reduced quality of patient care, they may also prevent the identification of important medical problems with detrimental consequences for patient health. A systematic approach is needed to improve the quality of medication history acquisition at the time of admission. Physicians may benefit from additional training in obtaining medication histories, the use of pharmacy records upon admission should be promoted, and patients should be encouraged to bring to the hospital their own medicine list or their medications to ease acquisition of accurate and complete medication histories (4, 5, 14).

Often, time restrictions on admission and the patient's illness do not allow for a detailed interview about the patient's drug history (4, 17). Thus, the principles of medication reconciliation should be embraced in order to improve the continuity of patient care on hospital admission and at discharge. The results of our study urge the implementation of a new service with the aim of obtaining a CMH soon after a patient's admission. Different healthcare professionals, including physicians, nurses and pharmacists, may participate in the acquisition of this second medication history. However, pharmacist-acquired drug histories were shown to be more accurate and complete than those acquired by other healthcare professionals (7, 9, 10, 13,

17). In our study, very accurate CMHs were obtained through pharmacists' participation in the medication reconciliation process. The aforementioned service may be incorporated into routine clinical practice with the aim of improving continuity of patient care.

When establishing a new service, its benefits have to be considered against the cost of additional pharmacy staffing. As no relevant data are available for Slovenia, the data published for North America may serve as a guide. Vira *et al* estimated the time needed to conduct medication reconciliation upon admission to be 15 minutes per patient (7). The costs of the pharmacist-performed admission reconciliation were estimated to be \$64 per clinically important unintended admission medication variance. This was described as an economically attractive option given that direct costs of an adverse drug event were estimated to be over \$2000. Similar conclusions were drawn by Cornish *et al*, who limited admission reconciliation to patients at high risk for drug-related complications (17). These data support the development of clinical pharmacy activities and the investment into pharmacist-led medication reconciliation in order to reduce the costs of adverse drug events.

5 Conclusions

A high rate of discrepancies in the medication history taken at the time of admission, and a high level of incomplete information on drug use in the medical record were reported, emphasizing the need for implementing medication reconciliation practices. The intervention used in our study provided comprehensive drug histories, recording the use of more medicines and more information on the medicines used than did the drug history recorded in the medical record. Pharmacists' participation in medication reconciliation, as described in this study, is an example of how to improve the continuity of patient care when transferred across the healthcare interface.

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