Medication reconciliation—is it possible to speed up without compromising quality? A before–after study in the emergency department

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ABSTRACT

Objective The aim of this study was to investigate whether it was possible to decrease the time used for medication reconciliation (MR) in the emergency department without compromising quality. A more efficient method will enable more patients to receive MR as early as possible after admission to hospital.

Methods Potential key factors for improvement of the standard method of MR by clinical pharmacists were identified through an observational period. A revised method was developed, focusing on decreasing time spent on the patient interview by use of a condensed checklist and probing questions based on information from a prescription database. Non-inferior quality (proportion of patients with at least one identified medication discrepancy and number of identified medication discrepancies per patient) of the revised method was evaluated using a before–after study design with 200 individuals in each group. Non-inferiority limit was set at 10%. The Mann-Whitney U test was used for statistical evaluation of the difference in time use per patient in the MR process between the before and after group.

Results Mean age of the included patients was 78 years in both groups. The time used for MR in the after group was 34% shorter (37 min vs 56 min, p<0.0001) compared with the before group. The revised method was shown to be non-inferior compared with the original method with respect to the proportion of patients with at least one identified discrepancy (81%, 95% CI 76% to 86% vs 79%, 95% CI 73% to 84%). Also, non-inferiority was shown for the number of identified discrepancies per patient, where the average number of discrepancies per patient was 1.9 (95% CI 1.7 to 2.1) in both groups.

Conclusion This study showed that it was possible to speed up the MR process without compromising its effectiveness in identifying medication discrepancies.

INTRODUCTION

Transitions between different care settings are associated with increased risk of errors in medication lists due to challenges in the transfer of information.[1] This represents a patient safety challenge.[1] The WHO recommends medication reconciliation (MR) as a process to assure medication accuracy at transitions of care.[2 3] MR is defined by the WHO as 'the formal process in which healthcare professionals partner with patients to ensure accurate and complete medication information transfer at interfaces of care'.[3] Studies on the effect of MR on clinically relevant endpoints such as adverse events or healthcare utilisation show conflicting results.[1 4–6] However, pharmacist-led MR has been shown to decrease significantly the number of discrepancies in medication lists and is therefore considered an important contributing factor in ensuring patient safety on care transitions.[5]

There is a lack of consensus on the conduct of MR and a substantial variability of processes and settings is reported.[7] Despite variations in protocols, the patient is regarded as essential in achieving a best possible medication history.[3 8 9] Therefore, an interview with the patient or other person responsible for the individual's medication is recommended, as this is regarded as the best source of up-to-date information on medication use.[3 10] The medication information should be verified with other sources, such as previous patient records, prescription databases, the patient's general practitioner or home care providers.[3 8 9]

As a correct medication list is a key element in the provision of correct medical treatment, the MR should be performed shortly after hospital admission. The time frame available for performing the MR is often limited in the emergency department, as patients are usually transferred to a ward shortly after admission. Therefore, the time spent on MR is an essential factor to ensure correct medication lists for patients before transfer. Few studies have reported the time spent on the MR process in the emergency situation; however, Nguyen and co-workers report an average time of MR of 59 min in the emergency department.[11] In Stavanger University Hospital, an internal project revealed similar data with respect to time use (unpublished data). Electronic sources of medication information for the individual have become more available during the last decade. In Norway, a national Summary Care Record was introduced in 2015.[12] The increased availability of electronic sources of information may represent a potential for increasing the efficiency of the MR process. On this basis, the present study was designed to investigate the possibility of speeding up the MR process in the emergency department without compromising the quality of the obtained medication list.

METHODS

Study design

This was an experimental study with a before–after design performed to evaluate the efficiency and quality of a revised method for MR. The study was performed in the emergency department of

Stavanger University Hospital, Norway, from December 2018 to May 2019. Observation of current practice during collection of before data was used to identify areas for improvement. The results from the observational phase were used to develop a revised method. Individuals were consecutively included after implementation of the revised method, and data collected from these individuals were used to evaluate the efficiency and quality of the revised method. The study was designed as a non-inferiority study, where the aim was to develop a method that was more efficient (less time-consuming) and non-inferior with respect to quality (higher quality defined as lower number of medication discrepancies). The MRs were performed by clinical pharmacists (n=7) working in the emergency department on a routine basis, and all pharmacists contributed to the data collection in both the before and after groups.

Participants and sample size

The study was performed at Stavanger University Hospital, a large regional hospital responsible for the treatment of approximately 400 000 inhabitants in the Stavanger area in Western Norway. Around 90 persons are admitted to the hospital's emergency department each day. Not all patients have an MR done in the emergency department due to practical reasons (workflow in the emergency department, the patients' condition, limited working hours for the pharmacists in the emergency department). Therefore, the inclusion criteria of this study matched the regular criteria for MR by a pharmacist in the emergency department in our hospital, that is: (1) use of three or more prescription drugs; and (2) triage tag green, yellow or orange.[13] The exclusion criteria were: (1) patient unable to provide an informed consent; (2) patient already included in study (multiple admissions during the study period); and (3) patient had a contagious disease.

In the observation phase, 50 individuals were included. The sample size of the full study was estimated based on the data on detected discrepancies in the medication lists of the 50 individuals included in the observational period. The proportion of individuals with at least one discrepancy in prescription drugs, prn (as needed) drugs, and non-prescription drugs was 86%. Based on these data, a power of 80%, $\alpha=0.05$, and a non-inferiority margin of 10%, the estimated sample size for the full study was 149 in each group. After inclusion of 149 patients, the sample size was adjusted to 191, based on medication discrepancies detected in 81% of these patients. Withdrawal from the study was expected to be low, and we therefore included 200 individuals in each group. The non-inferiority margin of 10% was chosen as we expected a high number of medication discrepancies of minor clinical relevance. This was based on clinical judgement and a previously published report from Norway.[14]

Observation phase and before group

All participants in the before group had an MR performed according to the standard procedure at that time. This method was based on the admission step of the Integrated Medicines Management method and the WHO standard operating protocol assuring medication accuracy at transitions of care.[3 9] The medication list was provided from an electronic patient record, the Summary Care Record, available for all permanent residents of Norway.[12] The Summary Care Record is an online service that contains information about all drugs that an individual is prescribed, and all prescription drugs dispensed from a pharmacy. For patients referred from nursing home or home care services, a list provided by the level of care was used. To obtain a best possible medication history a clinical pharmacist performed a structured patient interview using a standardised interview guide with open questions, to explore which drugs and drug doses the patient was using before admission (figure 1). In addition, a detailed checklist with 19 specific questions was used (table 1A). All questions in the checklist were asked. The rationale for the checklist was to identify medications that patients tend to forget to mention during the interview. Individuals were consecutively included and the MRs of the first 50 individuals were closely monitored with respect to time spent per patient and medication discrepancies (proportion of patients with medication discrepancies, number of medication discrepancies per patient, and medication discrepancies detected by checklist). Also, for the first 50 individuals, the observed medication discrepancies were categorised as follows: (1) commission of drug (before admission the patient did not use a prescribed medication); (2) omission of drug (drug in use missing in the medication list); (3) incorrect strength of drug; (4) incorrect drug formulation; (5) incorrect dose; and (6) incorrect administration time. An overview of outcome measures and additional registrations is given in figure 2. Six of the pharmacists performed MRs during the observation phase.

BEFORE		AFTER
Step 1 **Gather sources of information** Medication list obtained from written sources (Summary Care Record, medication list from nursing home or home care) **Step 2** **Patient interview** Open-ended questions on medication use Systematic use of an extensive checklist	**Obtain a best possible medication history (BPMH)**	**Step 1** **Gather sources of information** No change **Step 2** **Patient interview** Purpose of interview clearly communicated to patient Specific probing questions based on identified information Systematic use of a condensed checklist
If possible, resolve detected discrepancies between BPMH and written sources of information	**Resolve discrepancies**	No change
Documentation of 1. complete and accurate history of preadmission medication 2. any unresolved discrepancies for prescriber to consider before writing medication orders	**Documentation**	Same items documented, But increased focus on 1. omission of non-essential information 2. writing point-by-point

Figure 1 Overview of the medication reconciliation process in the before and after groups.

Time spent at each step of the MR process—that is, identification of patient, collection of electronically recorded information on medication use, patient interview, and documentation—was registered by a researcher observing the work of all clinical pharmacists who performed the MR. Documentation included registration of list of drugs in use in the electronic data system, and documentation of resolved discrepancies or uncertainties to be addressed further.

Simultaneously with evaluation of the observation phase and revision of the method, the data collection continued using the original method until a total number of 200 individuals had been included. These 200 individuals, termed 'before group', constituted the control group for evaluation of the revised method. Time spent on the MR process was only registered for the first

Table 1 (A) Original checklist and (B) revised checklist used in the medication reconciliation process.

	A: Original checklist		B: Revised checklist
	'Do you use any drugs for …'		
1	Anything else? (prescription/non-prescription)*	1	Do you use any drugs from a pharmacy or a convenience store that has not been ordered by a medical doctor?
2	Pain?	2	Do you have old medicines at home that you have used recently?
3	Heart/blood/blood pressure/cholesterol?	3	Have you used any medication that you got from someone else (friends, relatives)?
4	Abdominal discomfort (constipation, diarrhoea, acid reflux)?	4	Do you use any drugs for pain?
5	Diabetes/blood sugar?	5	…for abdominal discomfort?
6	Skeletal disorders (vitamin D, calcium, other)?	6	…for allergy?
7	Sleep?	7	Do you use eyedrops or nose spray?
8	Anxiety/depression?	8	Do you use herbal products or vitamins?
9	Allergy?		
10	Eyedrops? Eardrops? Nose spray?		
11	Drugs for inhalation?		
12	Injection?		
13	Skin (lotion, creams, patches)?		
14	Suppositories? Vagitories?		
15	Hormones?		
16	Prostate?		
17	Any other drug products (from a pharmacy, convenience store, internet)?		
18	Herbal products? Vitamins?		
19	Any drugs used weekly, monthly or yearly?		

* 'Anything else' refers to anything not previously mentioned during the patient interview.

50 patients, while medication discrepancies were recorded for all patients (n=200) in the before group (figure 2).

Results of the observation phase and revision of method

The median time for MR during the observation phase was 56 (range 19–114) min (see online supplemental file 1). The patient interview and documentation were the most time-consuming parts of the MR process, accounting for 30% and 39% of the total time, respectively.

A patient interview with the use of a checklist was performed in 44 of the first 50 (88%) individuals in the observation phase. For the remaining six individuals, someone else was managing their medicines (spouse, home care service), and this 'someone' was not available for interview. In these six cases, the checklist was not used. In the 44 individuals where the checklist was used, 49 medication discrepancies were identified by use of the checklist. Herbal products/vitamins (n=19, 39%), drugs used for pain (n=12, 24%) or abdominal discomfort (n=11, 22%) were the main categories where medication discrepancies were detected by use of the checklist. Ten of the 19 items in the original checklist did not reveal any medication discrepancies (items 3, 5, 7, 8, 12, 14, 15, 16, 17 and 19 in table 1A), and three items revealed only one medication discrepancy (items 6, 11 and 13 in table 1A).

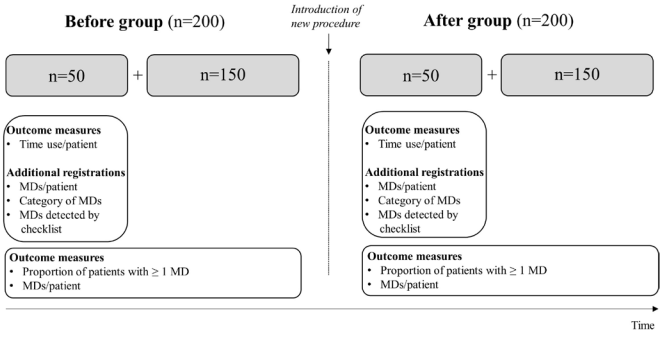

Figure 2 Overview of the outcome measures and additional registrations in the first 50 individuals and in the total sample in the before and after groups. MD, medication discrepancy.

Based on the findings from the observational period, a revised method for MR was developed. The results from the observation phase identified the patient interview and the documentation phase as main targets for revision of the MR process. A revised and condensed checklist for the patient interview was developed (table 1B), including only those items that detected two or more medication discrepancies during the observational period. Three questions regarding information not available in electronic sources were also included (items 1, 2 and 3 in revised checklist, table 1B). In addition to streamlining the checklist, the following changes were made to the patient interview: (1) open questions were replaced by a structured review of the information available in the electronic sources in consultation with the patient; (2) the pharmacist clearly stated the purpose of the patient interview to ensure that time was not spent on aspects irrelevant to the MR (figure 1). Legal aspects did not allow for substantial changes in the documentation process. However, the pharmacists were encouraged to produce point by point notes in a less wordy manner in the electronic patient record without skipping essential information (figure 1).

The results of the observational period and the content of the revised method was discussed among the group of clinical

pharmacists working in the emergency department and the physician in charge before implementation and evaluation.

Evaluation of revised method

On a specific date, all pharmacists working in the emergency department switched to the new procedure for MR. As for the before group, 200 individuals were consecutively included in the after group. Efficiency of the revised versus the original method was evaluated by time spent during the total MR process. The quality of the revised versus the original method was assessed by registration of discrepancies between the medication lists obtained from available electronic sources on admission, and the best possible medication history obtained by a clinical pharmacist, for the original and the revised MR method. Like the before group, time spent and medication discrepancies identified by the checklist were registered for the first 50 individuals, while overall medication discrepancies were recorded for all 200 individuals.

Data analysis

The Mann-Whitney U test was used to evaluate possible differences in age and number of drugs used in the before and after group. For the remaining demographic data (sex, triage tag) the Fisher χ^2 test was used to evaluate possible differences between the groups. The primary outcome was proportion of individuals with at least one detected medication discrepancy in the after group compared with the before group. This was selected as the primary outcome measure as it reflects the proportion of individuals in which the WHO goal of an up-to-date, complete and accurate medication list has not been met.[3] Secondary outcome measures were the number of medication discrepancies per patient and the total time spent on the MR per patient. Two-sided 95% confidence intervals (95% CI) were used to evaluate non-inferiority in the proportion of individuals with at least one medication discrepancy and the mean number of medication discrepancies per patient. The non-inferiority limit was set at 10% for both outcomes. Non-inferiority is demonstrated when the 95% CI of the difference in the outcome measure between the before and after groups does not cross the predefined non-inferiority margin (δ). The Mann-Whitney U test was used for statistical evaluation of the difference in time use for MR between the before and after groups, and for evaluation of the difference in detected medication discrepancies per patient with the original and revised checklist. $P<0.05$ was considered a statistically significant difference between the groups. IBM SPSS version 26 was used for statistical evaluation. The reporting of this study follows the CONSORT (Consolidated Standards of Reporting Trials) extension for reporting non-inferiority trials.[15]

RESULTS

Demographic data

In total, 400 individuals were included, 200 in the before group and 200 in the after group. The main reasons for not participating were lack of ability to provide informed consent and the person was not asked to participate due to workflow in the emergency department (figure 3). Demographic data are given in table 2. There were significantly more individuals with an orange triage tag in the after group (29/200, 15%) compared with the before group (11/200, 6%; p=0.0041). The other demographic variables (age, sex and number of drugs) showed no significant differences between the before and the after groups (table 2).

Evaluation of the revised method

The median total time used on MR was 34% lower with the revised method versus the original method (37 min vs 56 min)

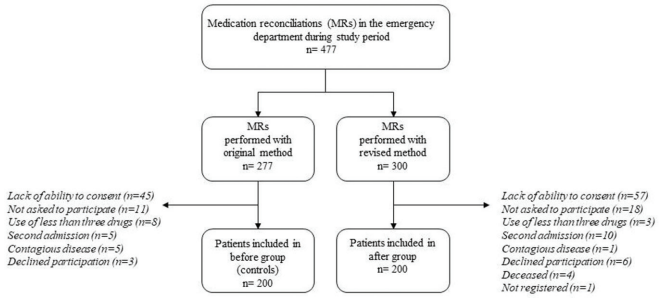

Figure 3 Participant flow diagram with reasons for exclusion.

(p<0.0001) (see online supplemental file 1). Statistically significant reductions in time were observed in the preparation, patient interview and documentation phases (see online supplemental file 1).

The total number of medication discrepancies detected in the before and after groups were 376 and 387, respectively. Differences in medication discrepancies revealed in the before and after groups are shown in figure 4. The revised method was shown to be non-inferior with respect to the proportion of patients with at least one identified medication discrepancy (81%, 95% CI 76% to 86% vs 79%, 95% CI 73% to 84%). Also, non-inferiority was demonstrated for the total number of detected medication discrepancies per patient which were identical in the before (1.9, 95% CI 1.7 to 2.1) and after (1.9, 95% CI 1.7 to 2.1) groups. Non-inferiority was also shown for all subcategories; regular prescription drugs, prn drugs and over-the-counter drugs (figure 4).

A patient interview with the use of the revised checklist was performed in 43 of the first 50 (86%) individuals in the after group. The remaining seven patients had someone else, not available for interview, managing their medication, and were therefore not able to respond. A total of 61 medication discrepancies were detected. There was no difference in the number of detected medication discrepancies per patient with the original and revised checklist (1.4 vs 1.1, p=0.2). Herbal products/vitamins (25/61, 41%), drugs used for pain (13/61, 21%) or abdominal discomfort (9/61, 15%) were the main categories where medication discrepancies were detected by use of the revised checklist

Categorisation of the medication discrepancies showed that omission of drug and incorrect dose were the two most detected medication discrepancies. Omission of drug constituted 44% of the total number of medication discrepancies in both groups, while the corresponding numbers for incorrect dose were 27% in the before group and 30% in the after group (online supplemental file 2).

DISCUSSION

The results of this study show that it is possible to speed up the MR process without compromising identification of medication discrepancies. By introducing a more targeted patient interview and a condensed checklist, the average time spent on MR per patient was reduced by approximately 34%. With no change in the number of staff performing MRs in the emergency department, the decrease in time per patient will result in a corresponding increase in the number of patients receiving a structured MR by the pharmacist before transfer to a ward. More than double the number of patients with an orange triage tag receiving an MR in the after group compared with the before group could be a result of this increased efficiency. These patients

Table 2 Demographic data of the before and after groups

	Before group (n=200)	After group (n=200)	P value
Age, years*	78 (10)	78 (9)	0.67
Number of drugs†‡	11 (3–31)	10 (3–28)	0.97
Sex			
Male	84 (42)	102 (51)	0.088
Female	116 (58)	98 (49)	
Triage tag colour			
Green	37 (19)	23 (12)	0.068
Yellow	152 (76)	148 (74)	0.73
Orange	11 (6)	29 (15)	0.0041

Data presented as numbers (%) unless otherwise stated.
*Data presented as mean (SD).
†Data presented as median (range).
‡Sum of prescription drugs (regular and prn (as needed)) and non-prescription drugs.

are in the emergency department for a shorter period compared with patients with a green triage tag, and thus the time spent on MR is crucial for the capacity to perform an MR while they are in the emergency department. Reconciling more patients while they are in the emergency department is in line with the recommendations from the WHO to reconcile medications early after admission to resolve potential problems early in the process.[3]

In the revised method for MR, we used the Summary Care Record as the foundation for the interview and targeted the interview to reveal any discrepancies between what was recorded in the Summary Care Record and the patient's actual drug use. The Summary Care Record contains information on all prescribed drugs, and all prescription drugs dispensed from a pharmacy, including dispensing dates, for each individual. Therefore, the Summary Care Record is a good source of information on medications and can serve as a foundation for a targeted patient interview. Also, many of the questions from the original checklist did not contribute to identification of medication discrepancies, likely because the Summary Care Record contained the necessary information. These questions were deleted in the revised checklist, which instead contained only questions that the electronic source did not cover, such as herbal products and non-prescription drugs. Evaluation of the revised checklist showed that it did not identify fewer medication discrepancies compared with the original checklist, and that the main medication discrepancies revealed by the checklist (both the original and the revised versions) were herbal products and non-prescription pain medication. A previous Norwegian study found that use of non-prescription medicines in older people is low and consists almost exclusively of paracetamol for pain relief.[16] More focus on a wider range of non-prescription drugs in the patient interview may be needed in countries with more medication available over the counter and thereby a higher use of non-prescription drugs in the population.

With the revised MR process, the median time spent on each patient was 37 min. Studies from various settings (emergency, geriatric and internal medicine wards) report time use between 23 and 92 min per patient.[11 17 18] In this regard, the method used for MR in this study may be considered sufficiently efficient. Still, as the time spent on MR is crucial for the number of patients receiving an MR while in the emergency department, there should be a continuous focus on the potential for improvement. Further effort to decrease time spent on collection of information from the patient could focus on strategies for patient self-service in MR. For example, self-report by use of tablet computers in the waiting room has been tested and shows that patients are able to identify medication discrepancies.[19 20] In addition to the patient interview, this study revealed that documentation was also time consuming. We considered strategies for reducing time spent on documentation; however, this was challenging due to legal issues. Nevertheless, the pharmacists were encouraged to condense their documentation reports. This resulted in a reduction of time use of 25%. However, we did not investigate whether the condensed reports

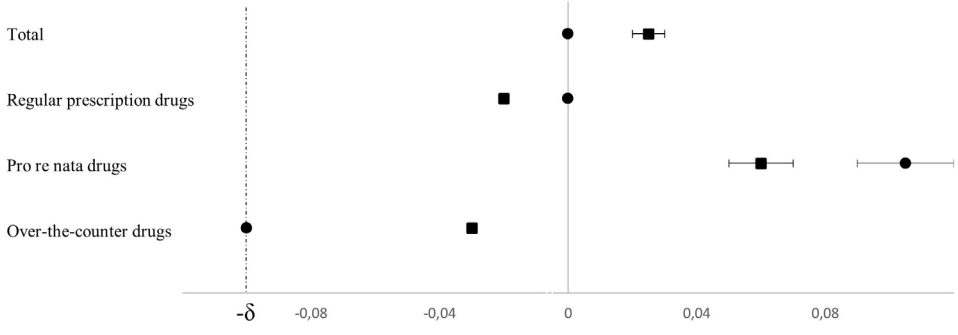

Figure 4 Difference in medication discrepancies revealed before (n=200) and after (n=200) implementation of a revised method for medication reconciliation. Squares indicate patients with at least one medication discrepancy, circles indicate number of medication discrepancies per patient. Error bars indicate 2-sided 95% confidence intervals of the difference between revised and original method. Symbols without error bars represent values where the confidence interval is 0 (i.e. results of original and revised method were identical). The dashed line at -δ indicates the non-inferiority margin; values in the region to the right of the line indicates non-inferiority.

communicated as well as the previous reports with other staff in the hospital.

The before–after design was chosen as it is suitable when a routine change is implemented in clinical practice. However, the study design is the main limitation of the present study as it cannot be ruled out that other factors may have changed during the time course of the study. This limitation was minimised by a relatively short time frame (total time of data collection of 6 months) and no change in staff performing the MRs during the data collection period. Also, it is possible that the decreased time use in the after group could partly be due to the Hawthorne effect, that is, that the pharmacists working in the emergency department knew that time spent on the MR was being measured and this could have affected their work efficiency.[21] This might explain the significant decrease in time use for preparation, although no changes were deliberately made to speed up this process. An additional limitation to this study is the lack of evaluation of clinical relevance of the detected medication discrepancies. It is possible that despite the non-inferiority of the revised method in detecting medication discrepancies, it could be inferior in detecting medication discrepancies of moderate to major clinical relevance. Also, an important limitation to the generalisability of the study is the use of the Summary Care Record as a source of information on prescription drugs. This database allows for streamlining the patient interview and checklist. In countries lacking a national electronic prescription record the MR protocol presented in this study may not be easily adaptable.

CONCLUSION

The present study showed that it was possible to speed up the MR process without compromising its efficiency at identifying medication discrepancies. Despite a significant increase in efficiency observed in this study, continued work is warranted to improve the efficiency of MR further so that more patients can receive an MR as soon as possible after admission to hospital.

Key messages

What is already known

⇒ Medication reconciliation is recommended at transitions of care, but the method is time-consuming.

What this study adds

⇒ This study shows that it is possible to speed-up the reconciliation process by the application of information from a prescription database, a targeted patient interview, and use of a condensed checklist.

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Competing interests None declared.

Patient consent for publication Not applicable.

Ethics approval The study was approved by the Data Protection Service at Stavanger University Hospital (2018/209). The study was also evaluated by the Regional Committee for Research Ethics (2018/1941), which concluded that approval from the Data Protection Service was sufficient. All patients (both before and after groups) provided written consent to participate in the study.

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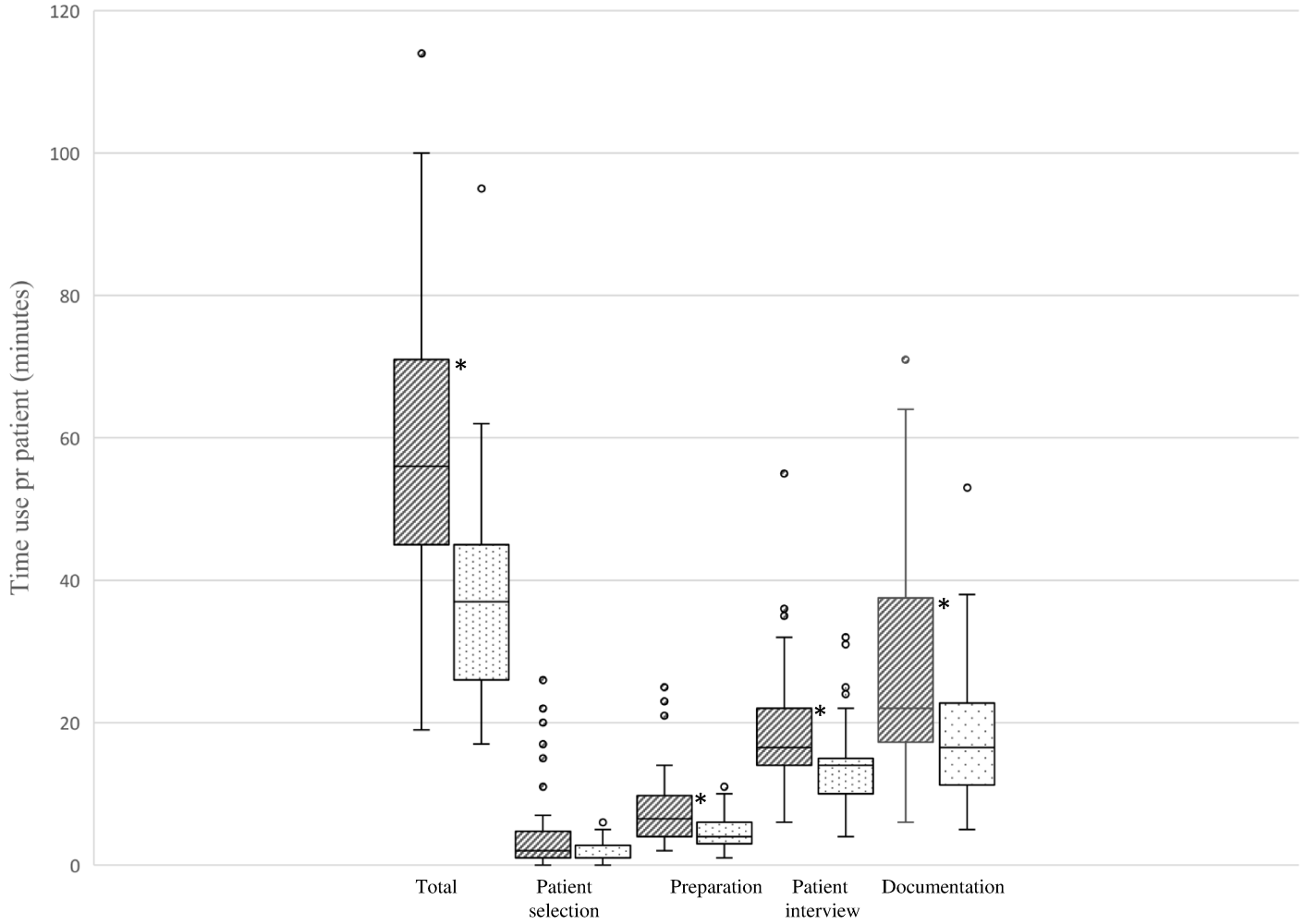
Supplementary file 1: Total time and time used during each step of the medication reconciliation process for the first 50 patients of each group. Scattered boxes represent the interquartile range of the before group, dotted boxes after group.



* statistically significant difference between before and after group (P<0.05)

Supplementary file 2:

Categorization of identified discrepancies in before (n=200) and after (n=200) group. Data presented as number (percentage*).

	Before (n=200)	**After (n=200)**
Total number of discrepancies	376 (100)	387 (100)
Commission of drug	92 (24)	83 (21)
Omission of drug	166 (44)	174 (44)
Incorrect strength of drug	3 (1)	4 (1)
Incorrect dose	101 (27)	115 (30)
Incorrect drug formulation	6 (2)	5 (1)
Incorrect administration time	8 (2)	6 (2)

* percentages do not add up to exactly 100% due to rounding of numbers