# Medication reconciliation is a prerequisite for obtaining a valid medication review

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## ABSTRACT

**INTRODUCTION:** The objective of this study was to compare medication reconciliation and medication review based on number, type and severity of discrepancies and drug-related problems (DRPs), denoted errors.

**MATERIAL AND METHODS:** This was a retrospective study conducted at the Department of Cardiology, Hillerød Hospital. Medication reconciliation compared the prescriptions in patient records, an electronic medication system (EMS) and in discharge summaries (DS). The medication review was based on the EMS. The two methods were performed on the same data material. To assess the clinical importance of the errors, a four-point scale was applied.

**RESULTS:** A total of 75 patient records were included. In all, 198 discrepancies were identified by medication reconciliation, 2.6 per patient. The most frequent discrepancies were omission of a drug in the DS and discrepancy between the drugs noted in the patient record and the EMS. 15% of the discrepancies were potentially serious or fatal, 62% were potentially significant and 23% were potentially nonsignificant. A total of 129 DRPs were identified by medication review, 1.7 per patient. The most frequent DRPs were sub therapeutic dosage, inappropriate dosage regimen and untreated medical condition. 35% of the DRPs were potentially serious or fatal, 29% were potentially significant and 36% were potentially non-significant.

**CONCLUSION:** Medication reconciliation identified a higher number of errors than medication review, but the number of serious errors identified by medication review was higher than that identified by medication reconciliation. The two methods identified different types of errors and should be used concurrently to supplement each other. **FUNDING:** not relevant.

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More than every fourth death in Denmark is due to cardiovascular disease and most cases are preventable [1]. Age and number of drugs are positively correlated with discrepancies [2, 3] and drug-related admissions, and cardiovascular agents are the most frequent type of drugs involved [4]. These hospital admissions are expensive for society and distressing for patients [4, 5]. Mandatory medication reconciliation is an example of a quality assurance method used in hospitals to reduce the number of adverse drug events and forms part of the accreditation standards in The Danish Healthcare Quality Programme [6]. Medication reconciliation is reconciliation of a patient's medicine. It is performed by the physician in order to prevent unintended changes and to avoid discrepancies in the medication. An accurate medication list at hospital admission is essential for the evaluation and further treatment of patients. Studies have shown that this method reduces the number of discrepancies [7-9].

Medication review is another method of assuring quality and reducing the number of adverse drug events. It is a process in which the patient's medicine is assessed in order to identify drug-related problems (DRPs) and to ensure optimal drug therapy [10]. Previous studies report that review of patients' medication by pharmacists identify and solve many DRPs [11, 12]. In Denmark, medication review has recently become part of The Danish Healthcare Quality Programme [13], but it is only implemented in some wards. This method may identify different types of errors than medication reconciliation and the two supplement each other. The two methods have not previously been compared and the objective of the present study was therefore to compare medication reconciliation and medication review by identifying discrepancies and DRPs and access the severity of the discrepancies and DRPs identified. The study was carried out as a master thesis study at the Faculty of Pharmaceutical Sciences, University of Copenhagen.

### MATERIAL AND METHODS

This retrospective empirical study was based on records from patients admitted to the Department of Cardiology, Hillerød Hospital, for a minimum of 24 hours within the period from 1 January to 3 April 2009. To be included in the study, patient records should contain a medical chart (MC) and a discharge summary (DS). The DS was to contain a minimum of two drugs. Furthermore, a medication list in the electronic medication system (EMS) was required. Data were collected from 9 March to 3 April 2009.

## Definitions

Discrepancies are defined as discrepancies in drug, strength, dose, frequency and time of the dosage between MC (paper form), EMS and DS. DRPs are defined

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Dan Med J 2013;60(4):A4605 as an undesirable patient experience that involves drug therapy and that actually or potentially interferes with a desired patient outcome [14]. The term "discrepancy" is used in medication reconciliation, and the term DRP refers to medication review. The term error covers both discrepancies and DRPs.

#### **Collection of data**

Medication reconciliation was performed as an audit of the physicians' work and was conducted by comparing the actual prescriptions in 1) MC versus EMS. 2) EMS versus DS and 3) MC versus DS. Furthermore, it was noted if documentation for changes in the medical treatment in the patient record was missing. The different medication lists were compared with regard to drug, strength, dosage, frequency and time of dosage by two researchers (MBO and AGL).

The discrepancies were empirically categorized into nine groups:

- 1) Discrepancy between drugs in MC and EMS (a drug is stated in the MC, but not in the EMS or vice versa)
- 2) Extra or analogous drug in the DS as compared with the EMS
- 3) Omission of drug in the DS compared with the EMS
- Uncertainty related to hazard drugs (drugs with a narrow therapeutic index)
- 5) Non-recognizable drug (an imaginary drug is stated)
- Uncertainty about the dosage (dosage is missing or discrepancy in dosage between two lists)
- 7) Unnecessary drug or untreated medical condition
- Non-significant discrepancy in dosage regimen (1 × 2 versus 2 × 1 with no clinical relevance)
- Other (e.g. doubt about end date for antibiotic treatment).

## TABLE 1

Four-point scale classification system.

Score: description	Definition
1: potentially fatal	Medication errors judged to imply a potential clinical risk of causing the death of the patient
2: potentially serious	Medication errors judged to imply a potential clinical risk of injuring the patient or causing a different course of treatment <sup>a</sup>
3: potentially significant	Medication errors judged to imply a potential clinical risk of causing discomfort <sup>b</sup> to the patient – without causing any harm or injury
4: potentially non-significant	Medication errors judged to be without any potential clinical risk for the patient or the course of treatment $^{\rm c}$

a) "Injury" includes errors that have a serious impact on the patient's current treatment or lead to permanent or temporary changes of the patient's medical condition.

b) "Discomfort" includes non-optimal dosage regimen, changes of dose that could lead to pain or dizziness. It also refers to any monitoring of the patient such as extra blood test or measurement of the blood pressure.

c) Includes non-significant discrepancies in dosage regimen, non-optimal dosage regimen, non-optimal choice of drug (compared to price) and unnecessary medication of the patient.



Mixed-up medicine.

The medication review was based on the medication list in EMS and the patient's clinical parameters. The medication review was conducted immediately after medication reconciliation and was performed on the same patients by MBO and AGL, both master students of Pharmaceutical Sciences. To decide whether a DRP was present, the following guidelines were used: medicin.dk (catalogue of registered drugs in Denmark), cardio.dk (guidelines from the Danish Society of Cardiology), irf.dk (guidelines from the Institute of Rational Pharmacotherapy) and interaktionsdatabasen.dk (database of drug interactions). The DRPs were empirically categorized into eight groups, inspired by Strand et al [14]. The eight categories were: 1) Untreated medical condition, 2) Nonoptimal drug, 3) Sub therapeutic dosage, 4) Over dosage, 5) Interaction, 6) Non-optimal dosage regimen, 7) Lack of monitoring and 8) Other.

#### **Clinical significance**

The severity of the discrepancies and the DRPs were assessed using a four-point scale modified from Lisby et al 2005 [15] (Table 1).

The errors were assessed by the two researchers (MBO and AGL), who agreed on the scorings. The following guidelines were used: medicin.dk and cardio.dk. The clinical significance of the errors was reviewed three times by MBO and AGL to strengthen the internal validity. Each drug was given a score on the four-point scale, despite the fact that the drug might cause more than one DRP (e.g. interaction which leads to adjustment of the dose). Afterwards, a senior physician (TJJ) reviewed all the discrepancies and DRPs to ensure the quality of the assessments. 6% of the discrepancies and 10% of the DRPs were also reviewed by a trained clinical pharmacist.

#### Statistics

The data were analysed using SPSS 16.0. Correlation be-

tween number of drugs and discrepancies and correlation between number of drugs and DRPs was made using Student's t-test. Comparison of the distribution of discrepancies and DRPs related to score was made using Pearson  $\chi^2$ -test. Statistical significance was defined at a level of 0.05, and data were described with a 95% confidence interval.

Trial registration: not relevant.

## RESULTS

#### Demographic data

A total of 75 patient records were included. In all, 29 (39%) of the patients were women and 46 (61%) were men. 80% of the patients were older than 60 years and the mean age was 71.7 years. The average patient used 5.9 drugs. Most of the patients had cardiologic diseases, but many also had other diseases such as diabetes or chronic obstructive lung disease.

#### **Medication reconciliation**

A total of 198 discrepancies were identified (2.6 discrep-

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Types of discrepancies identified by medication reconciliation.



ancies per patient). Furthermore, 109 undocumented changes in the medical treatment were recorded. This means that the physician had failed to state why a change had been made in the patient's medicine. 86.7% (n = 65) of the patients experienced discrepancies and 69.3% had between one and six discrepancies. There was a significant positive correlation between the number of drugs and the number of discrepancies (p = 0.007). **Figure 1** shows the discrepancies categorized into the nine groups.

The most frequent types of discrepancies were omission of drug in the DS compared with the EMS, discrepancy between drug in the MC and the EMS and uncertainty about the dosage. The senior physician (TJJ) agreed that all of the discrepancies were actual errors. The clinical pharmacist agreed with the senior physician's assessments in 75% of the cases. In 12.5% of the cases, she assessed the cases to be more serious and in 12.5% to be less serious.

The drugs most frequently involved in the discrepancies were warfarin, digoxin and antihypertensive agents.

#### Medication review

A total of 129 DRPs were identified (1.7 DRP per patient). 84% (n = 63) of the patients experienced DRPs and no patients had more than five DRPs. There was no significant correlation between the number of drugs and the number of DRPs. **Figure 2** shows the DRPs categorized into the eight groups.

The most frequent types of DRPs were sub therapeutic dosage, non-optimal dosage regimen, untreated medical condition and over dosage. The senior physician

#### FIGURE 2

Types of drug-related problems identified by medication review.



## FIGURE 3

affected by the errors with the given severity. n 140 120 100 80 60 40 20 0 1 3 Λ Severity Medication reconciliation Medication review

Number of discrepancies (N = 198) and DRPs (N = 129) related to the four-scale classification system. The numbers in the brackets are patients

DRP = drug-related problem; Rec = medication reconciliation; Rev = medication review. Score 1: potentially fatal; score 2: potentially serious; score 3: poten-

tially significant; score 4: potentially non-significant.

agreed that 50% of the DRPs were *actual* errors. The remaining 50% were classified as *potential* errors, because more information about the given situation was needed. The clinical pharmacist agreed with the senior physician's assessments in 92% of the cases.

The drugs most frequently involved in the DRP were warfarin, digoxin, antihypertensive agents, non-steroidal anti-inflammatory drugs (NSAID), diuretics, antidiabetes agents, prednisolone and medicine for chronic obstructive lung disease (COLD). Warfarin was the most frequent drug.

#### Severity of identified errors

Figure 3 compares the number and severity of discrepancies identified by medication reconciliation and the number and severity of DRPs identified by medication review related to score on the four-point scale. The Pearson  $\chi^2$ -test revealed a significant difference between the distribution of discrepancies and DRPs related to score (p = 0.000).

A total of 46 (23%) discrepancies were potentially non-significant, 122 (62%) were potentially significant and 30 (15%) were potentially serious or fatal. In all, 47 (36%) DRPs identified by medication review were potentially non-significant, 37 (29%) were potentially significant and 45 (35%) were potentially serious or fatal. The figure shows that almost twice as many patients were affected by discrepancies with score 3 compared with DRPs and twice as many patients were affected by DRP with score 2 compared with discrepancies. Anticoagulating agents, nitro-glycerine and drugs for COLD were the most common drugs involved in score 2 discrepancies. For medication review anticoagulating agents, furosemide, beta-2 antagonists, simvastatin and untreated anaemia were most commonly involved in DRP scored 2.

#### DISCUSSION

This study based on data from 75 medical patients showed that the errors identified by medication reconciliation and medication review vary with regard to number, type and severity. These findings are not unusual compared to findings in previous individual studies, but it is the first time that medication reconciliation and medication review have been compared within a single study.

#### **Medication reconciliation**

The most frequent types of discrepancies were omission of drug in the DS compared with the EMS, drug discrepancy between the MC and the EMS and uncertainty about dosage. This corresponds well with previous studies which established that omission of drug and discrepant dosage, strength and frequency were the most frequent error types [3, 16, 17]. The implication of this is that the patient is at risk of missing everyday medicine or of receiving an incorrect dosage when discharged from the hospital. These types of error can cause readmissions or adverse drug events.

## Medication review

Sub therapeutic dosage, inexpedient dosage regimen, untreated medical condition and over dosage were the most frequent types of DRPs. A previous study demonstrated that these types of errors or similar errors were the most frequent ones [18]. The study by Krska et al was conducted in primary healthcare, but the population of the study was comparable to the population of the present study [12]. These types of errors can cause impairment of the patient's health and increase the probability of adverse drug reactions. Of 129 DRPs, only three interactions were detected. Subsequently, the database of drug interactions (interaktionsdatabasen. dk) has been improved. It now contains information on how drugs classes affect each other. Furthermore, hospital-specific medication has been added and interactions with herbal drugs have been enhanced [19]. If the study was repeated today, it is likely that more interactions would be detected.

## Drugs involved

The drugs most frequently involved in medication reconciliation and medication review were warfarin, digoxin, antihypertensive agents, NSAID, diuretics, antidiabetes agents, prednisolone and medicine for COLD. This corresponds well with a previous Danish thesis which showed that diuretics and digoxin were the main drugs involved in drug-related hospital admissions at the Department of Cardiology [20].

#### Severity of identified errors

In this study, 198 discrepancies, 109 undocumented changes in the medication in the patient records and 129 DRPs were identified. These high numbers show that there is a need for improvement to ensure the safety and continuity of patients' medical treatment. One reason explaining the difference between the number of errors identified by the two methods is that the discrepancies are easier to discover because of the comparison of two medication lists. Medication review is more complex because you have to asses the overall quality of the patient's medical treatment. This results in different types of errors being identified by the two methods. Medication reconciliation deals with the degree of congruence in the medical treatment, while medication review deals with the rationale and quality of the overall medical treatment.

Medication reconciliation revealed the higher number of errors, but medication review identified a higher number of serious errors. The higher number of serious errors identified by medication review is an important finding of this study because it shows that medication review matters. Medication reconciliation also revealed 109 changes in medicine not documented in the patient record, which is an important result because these nonreported changes can led to many errors. Medication review identifies sub therapeutic dosage and untreated medical condition among others, which were not identified with medication reconciliation, and these error types may have great clinical impact for the patient. This is why the method proved to identify so many potentially serious errors. On the basis of these results, medication review matters and should be implemented in hospital wards as it is a strong supplement to medication reconciliation.

A limitation of this study is that the categories of the errors were empirically based, but corresponded well with those reported by other studies. A total of 75 patients were included, but a larger sample would strengthen the validity of the study.

#### CONCLUSION

Medication reconciliation identified the higher number of errors, but the number of serious errors identified by the medication review was higher than that identified by medication reconciliation. The two methods identified different types of errors, and medication review should always be supplemented with medication reconciliation. This corresponds well with the fact that The Danish Healthcare Quality Programme recently decided to introduce a standard on medication review in heavily medicated patients.

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