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RESEARCH ARTICLE

Medication report reduces number of medication errors when elderly patients are discharged from hospital

Patrik Midlöv · Lydia Holmdahl · Tommy Eriksson · Anna Bergkvist · Bengt Ljungberg · Håkan Widner · Christina Nerbrand · Peter Höglund

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Abstract *Objective* To investigate whether a Medication Report can reduce the number of medication errors when elderly patients are discharged from hospital. *Method* We conducted a prospective intervention with retrospective controls on patients at three departments at Lund University Hospital, Sweden that where transferred to primary care. The intervention group, where patients received a Medication Report at discharge, was compared with a control group with patients of the same age, who were not given a Medication Report when discharged from the same ward one year earlier. *Main outcome measures* The main outcome measure was the number of medication errors when elderly patients were discharged from hospital. *Results* Among 248 patients in the intervention group 79 (32%) had at least one medication error as compared with 118 (66%) among the 179 patients in the control group. In the intervention group 15% of the patients had errors that were considered to have moderate or high risk of clinical consequences compared with 32% in the control group. The differences were statistically significant ($P < 0.001$). *Conclusion* Medication errors are common when elderly patients are discharged from hospital. The Medication Report is a simple tool that reduces the number of medication errors.

Keywords Elderly · Geriatric medicine · Hospital discharge · Medication errors · Medication report · Patient safety · Prescribing · Seamless care · Sweden

P. Midlöv (✉)
Tåbelund Primary Health Care Centre, Solv 33, Eslov 24131, Sweden
e-mail: patrik.midlov@skane.se

P. Midlöv · C. Nerbrand
Department of Clinical Sciences, Family Medicine, Malmö University Hospital, Malmo, Sweden

L. Holmdahl
Department of Medicine, Lund University Hospital, Lund, Sweden

T. Eriksson
Hospital Pharmacy, Lund University Hospital, Lund, Sweden

A. Bergkvist
Hospital Pharmacy, University Hospital Malmö, Malmo, Sweden

B. Ljungberg
Department of Infectious diseases, Lund University Hospital, Lund, Sweden

H. Widner
Department of Neurology, Lund University Hospital, Lund, Sweden

P. Höglund
Department of Clinical Pharmacology, Lund University Hospital, Lund, Sweden

Impact of the findings on practice

- Medication errors are common at all levels in the care of elderly patients. Medication errors occur in hospitals as well as in primary care.
- Medication errors are common when elderly patients are discharged from hospital.
- Medication reconciliation using a Medication Report is a simple tool to reduce medication errors at discharge from hospital.

Introduction

On average elderly people in Swedish nursing homes use ten drugs [1]. Polypharmacy increases the risks of adverse drug reactions, interactions and incorrect drug use [2], thus increases the risk of drug-related problems and drug-related costs. Discrepancies between what physicians prescribe and what patients take are common [3]. Older age and polypharmacy are the most significant correlates of discrepancy. In a US study [4] it was estimated that for each dollar spent on drugs on patients in nursing facilities, 1.33 dollars was needed to take measures against problems directly related to drug use. Other studies [5–7] have shown that 15–22% of hospitalised elderly patients are admitted because of drug-related problems. In a previous study it was found that elderly patients on average had two medication errors each time they were transferred from hospital to primary care [8]. Other studies have shown that medication errors are common both at admission to hospital [9, 10] and at discharge from hospital [11, 12]. There are different reasons for these errors. The patients' general practitioner (GP) does not always receive notice of discharge [13] or correct information on the patient's medication [14].

Based on our previous study we developed a tool, the Medication Report, to reduce the number of medication errors. The Medication Report is a structured and detailed list of the patient's medication changes during the hospital stay. This is part of the information that is given at discharge to the patient, the patients' general practitioner (GP), and the nurse in the community health care or at the nursing home. We conducted an intervention study in order to evaluate if use of the Medication Report reduces the number of medication errors when elderly patients are transferred from hospital to primary care.

Aim of the study

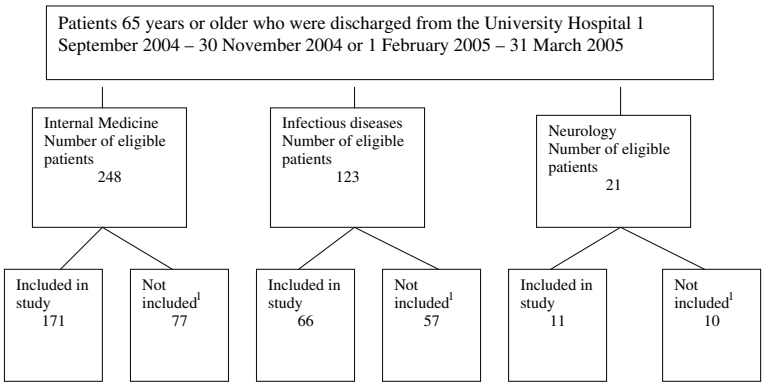
The aim of this study was to investigate whether a Medication Report can reduce the number of medication errors when elderly patients are discharged from hospital.

Method

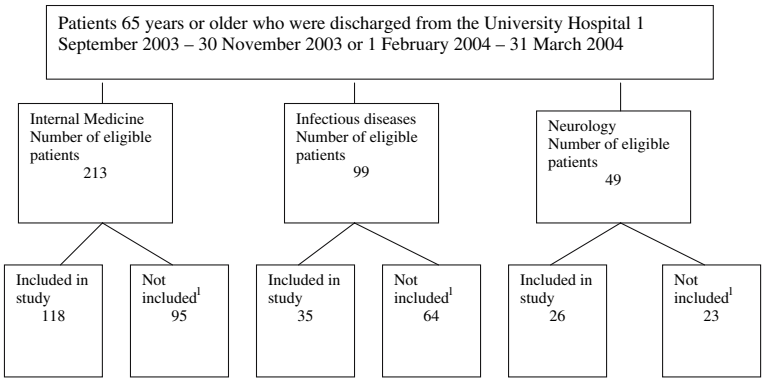
Subjects

All patients 65 years or older who were discharged from the departments of internal medicine, neurology or infectious diseases, a total of seven wards, at Lund University Hospital during September 1–November 30, 2004 or February 1–March 31, 2005 were eligible if the patients after discharge from the hospital would be treated by a GP and receive their medications from a nurse either in their own home or in a nursing home. The control group consisted of patients 65 years or older who had received hospital care in any of the participating departments during September 1–November 30, 2003 or February 1–March 31, 2004. The numbers of eligible and included patients are shown in Flow Diagrams 1 and 2. The time periods were chosen to avoid any seasonal differences between intervention and control group. December and January were avoided due to staff shortages and difficulties to include and collect patient data.

In this study we only included patients that lived in a nursing home or received their medications from a community health care nurse. There are two reasons for our choice of patient groups. These patients are known to use many medications and often need medical care and they all receive their medication from a nurse that has to register all medications that are actually given. In this way we knew exactly what medications the patients took before, during and after hospital care.



Flow diagram 1 Intervention group



Flow diagram 2 Control group. Explanation for superscript 1—Main reason for not including patients was No medication records from the community nurses. Even if it was planned that the patient should receive their medications from a nurse this was sometimes not the case. E.g. if a spouse gave the medications there were no medication records from the community nurses

Intervention

During the study period the participating departments gave extended discharge information. The main difference from the regular information that had been written previously was that we now included the structured Medication Report (see Fig. 1). This report describes all medication changes during hospital stay and the reasons for these changes. The Medication Report is an integrated part of the discharge summary including a short description of reasons for admission, actions taken and planned, and also a structured updated list of the patients' current medication based on

Fig. 1 Example: Medication Report

Universitetssjukhuset i Lund

REGION SKANE

Dep Medicine
Univ Hospital, S-221 85 LUND

Born: 12 Dec 1912
Name: Sven Svensson

Physician during hospital care: Lydia Holmdahl
General practitioner: Patrik Midlöv

Hospital care: 1 Feb 2005 – 8 Feb 2005

DISCHARGE SUMMARY

You have been in hospital care because of fever and respiratory insufficiency. X-ray examination confirmed a diagnosis of pneumonia. There were also signs of heart failure. You have been treated with antibiotics and diuretics.
You will be transferred to a nursing home, Sunny Hill in Eslöv, and your General Practitioner will visit you there within the next week.

Medication report

- **Furosemide has been increased from 1 to 2 tablets per day due to increased heart failure.**
- **Spironolactone has been added due to low potassium level.**
- **Doxycycline (antibiotic) has been added for another week due to pneumonia.**

MEDICINE preparation, dose	**Effect**	**Morning**	**Noon**	**Evening**	**Night**	**Note**
Tabl Furosemide 40 mg	Diuretic	1	1			
Tabl Spironolactone 25 mg	Diuretic and to retain potassium	1				
Tabl Digoxin 0.13 mg	Against atrial fibrillation	1				
Tabl Zolpidem 5 mg	Sleep				1	
Tabl Doxycycline100 mg	Antibiotic	1				Until 15 February
Mixt Lactulose	Against constipation	20 ml				
Tabl Paracetamol 500 mg	Against pain	1	1	1		
Tabl Cobalamin 1 mg	Vitamin B 12	1				

available information. This report is made by the hospital physician and was sent to the GP, the nurse in the community health care or nursing home at the day of discharge, and given to the patients themselves.

Data assessment

All medical records containing information on drug treatment were collected from hospital departments and the GPs. We also collected all medication lists from nurses in the community health care system or at nursing homes. We collected lists prior to and during hospital stay as well as after discharge from hospital. Three students separately and systematically collected information on the patients' drugs. All written information on medications e.g. therapeutic indication, drug names, dates of medication changes, doses, and concomitant drugs was collected. All errors were assessed by a physician (PM).

Identification of errors

We identified if there were any errors in the transfer of information i.e. if the drugs were not the same as before the transfer. We used the definition of medication error proposed by Leape et al. [15]. With this definition medication error is any error in the process of prescribing, dispensing, or administering a drug, whether there are adverse consequences or not. We checked if there were any changes in medications in the first medication list after a transfer of a patient. If such changes were mentioned in the medical records or any other written information at the GPs or community nurses it was not regarded as an error. Incorrect dosage interval was not considered an error if the total dosage/24 h had not been changed. Change of medication to a generic drug or withdrawal of drugs with long dosage interval, e.g. once monthly, was not regarded as an error. If drugs were added, withdrawn or the dosage had changed without any documentation in charts, medical records or medication lists, it was considered an error. The lists from community nurses were always considered to be the correct one since patients received all medications from a nurse according to these lists.

Evaluation of risk

Clinical risks, as a theoretical consequence of the errors, were evaluated for each patient with an error, separately by two physicians (P.M. and L.H.). Patients' risks were classified into one of three groups, (1) without clinical risk, (2) with moderate clinical risk and 3. with high clinical risk: e.g. gabapentin 300 mg twice daily was omitted for a patient with epilepsy and was evaluated as high clinical risk; venlafaxine was erroneously added after discharge from hospital and was evaluated as moderate clinical risk; zopiclone 5 mg was given instead of zopiclone 7.5 mg and was evaluated as without clinical risk.

When evaluating risks the two physicians used structured instructions and examples that were agreed upon by the entire research group. Discrepancies were solved through discussion.

Statistical analyses

In one previous study, 19 out of 35 patients had at least one medication error when they were transferred from hospital to primary care [8]. Thus out of 35 patients 16 had no medication error (46%). We assumed that the rate of medication errors was similar in this study. We hoped to increase the number of patients without a medication error from 46 to 57%. With a 5%-significance level and power = 80% we needed 150 patients in each group. Since the previous study had rather few observations, there was a considerable degree of uncertainty in these assumptions. We therefore decided to include more than 150 patients. There was also some uncertainty on how many of the patients that were discharged from the hospital could actually be included, i.e. if they received their medication from a community nurse (Flow Diagram 1 and 2). This was also a reason for us to include more than 150 patients in each group.

The level of agreement between the two physicians, who classified the level of risk, was evaluated by Cohen's kappa.

Results are generally given as frequencies, means (SD). In addition to comparing the global frequencies of errors for the two groups, we tested if there was a significant influence on the number of patients that had at least 1, 3 or 5 medication errors, since these limits were considered clinically important. The relative risk of an error and its confidence limits was calculated by Cox regression [16]. All statistical analyses were performed using SAS (ver 8.2, SAS Institute, Cary, NC, USA).

Ethics

The evaluation of the ethics committee at Lund University was that no formal approval was necessary. For the patients the only difference was that they now received written information on their medication. Their medical care was not affected in any way.

Results

Baseline characteristics are presented in Table 1. There was no significant difference in the frequency of errors at baseline.

There was a significant difference in favour of the intervention group in the number of patients with medication errors between intervention and control group (Table 2).

The most common medication error was that medications were erroneously added (commission error), with 0.64 per patient in the intervention and 1.29 in the control group. Corresponding values for erroneous change in dosage was 0.21 and 0.45 and for omission errors 0.12 and 0.45 respectively.

The clinical risks were evaluated with a high level of agreement between the two physicians, kappa = 0.85 (95% CI 0.78–0.92). In the active group 43 patients of 248 (17%) and in the control group 61 patients of 179 (34%) had errors that were evaluated as being without clinical risk. Corresponding values for moderate clinical risk, and high clinical risk were 32 (13%) and 48 (27%), and 4 (2%) and 9 (5%), respectively. The relative risk of an error with moderate or high clinical risk was 0.46 (95% CI 0.30–0.69) in the intervention group compared with the control group.

The distributions of degree of clinical risk were similar in the intervention and control groups. Among patients with at least one medication error in the intervention group 54% were without, 41% with moderate and 5% with high clinical risk. Among patients with at least one medication error in the control group 52% were without, 41% with moderate and 8% with high clinical risk.

Discussion

We evaluated the effectiveness of the Medication Report in reducing the number of medication errors when elderly patients were discharged from hospital. This study adds data showing that medication errors are common when elderly patients are discharged from hospital. This study also shows that the use of the developed structured Medication Report reduced the number of medication errors by more than 50%, no matter what degree of clinical risk, i.e. it reduces medication errors without clinical risk as frequently as errors with moderate or high clinical risk.

Table 1 Distribution of baseline characteristics in the intervention (n = 248) and control (n = 179) groups

	With medication report	Without medication report
Men/women	88/160	69/110
Age, years (range)	84.2 (65–100)	83.9 (66–99)
Living in nursing home	167	147
Living in own home	81	32
Department of acute medicine	171	118
Department of neurology	11	26
Department of infectious diseases	66	35
Number of medication errors in transfer at admittance to hospital (SD)	2.4 (2.3)	2.5 (2.5)
Number of medications for continuous use prior to hospital care (SD)	9.2 (3.9)	9.1 (4.3)
Number of medications for on demand use prior to hospital care (SD)	2.2 (1.8)	2.7 (2.1)
Number of medications for continuous use at discharge from hospital (SD)	8.7 (4.0)	8.4 (3.8)
Number of medications for on demand use at discharge from hospital (SD)	1.4 (1.5)	1.8 (1.7)

Table 2 Comparison in the number medication errors between intervention and control group when discharged from hospital to primary care

	Intervention group (n = 248)	Control group (n = 179)	Relative risk (95% Confidence Interval)	Significance level
Number (%) of patients with at least five medication errors	15 (6)	27 (15)	0.40 (0.21–0.75)	$P = 0.0045$
Number (%) of patients with at least three medication errors	38 (15)	66 (37)	0.42 (0.28–0.62)	$P < 0.001$
Number (%) of patients with at least one medication error	79 (32)	118 (66)	0.48 (0.36–0.64)	$P < 0.001$

There is a need for a systematic approach when patients are transferred between hospital and primary care. The Medication Report not only focus on correct transfer of information on medications (what), but also on documenting reasons for changes (why) and communicating this to the next level of care and to the patient. We believe that this information improves the quality of care.

We do not know if the Medication Report reduces the number of medication errors in other patient-groups. If we invent procedures that reduce the number of inappropriate drugs and medication errors for the frailest elderly we believe that healthier elderly patients also would benefit from this.

We evaluated the effects of the Medication Report by comparing the intervention group with a retrospective control group. To conduct randomised controlled studies on medication errors when elderly patients are transferred between hospital and primary care is not easy. We should have had to randomise patients in the participating clinics to a discharge with a Medication Report or without this information. The same physician should in that case sometimes make structured information on medications and sometimes not. It would have been very hard to maintain a distinction between intervention and control group and to keep the physicians motivated to participate.

Since we used retrospective controls there could be a risk that observed changes were due to confounders. We have however not been able to identify any probable confounder. There have been no organisational changes in the primary care or at the university hospital. There have been no changes in the computerised systems of medical records neither in hospital nor in primary care. There were no differences in the number of medication errors between intervention and control group when the patients were admitted to hospital. We believe that it is very unlikely that the observed great differences between intervention and control group at discharge from hospital could be due to a confounder.

We focus on what happens at transfer from hospital care to primary care. Other studies have also shown that medication errors at discharge from hospital are common [8, 11]. If there is poor information on the medication history when patients are admitted to hospital this could of course affect the accuracy of information on medication at discharge from hospital. In a review of 22 studies the authors concluded that medication history errors are common at the time of hospital admission [17]. Different interventions have had some effect on the number of medication errors or emergency department visits [18, 19]. We welcome studies that compare different interventions or combinations of interventions in this field.

Conclusion

Giving a medication report to patients at discharge from a hospital in Sweden reduces the number of and seriousness of medication errors significantly.

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