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Introduction

Medication errors are common and may cause drug-related problems[1, 2]. Elderly patients are more susceptible to drug-related problems. A drug-related problem (DRP) is defined as "*an event or circumstance that actually or potentially interferes with desired health outcomes*" [3]. DRPs may lead to hospitalisation[4, 5] and increase the length of stay at the hospital[6-8]. Many of these drug-related problems are preventable[9, 10].

Medication errors can be of various types [11, 12] and when medication errors are reduced this may lead to reduction in drug-related problems and health care consumption [13].

There are experiences from hundreds of organisations showing that bad communication in medical care interfaces causes up to 50% of all medication errors in hospitals and up to 20% of adverse drug events[14]. Problems also arise outside of hospital as a result of poor communication within medical care interfaces; we have shown that mistakes in the medication reconciliation process at discharge from hospital can cause errors, risk of negative clinical consequences and also actual health care contacts due to the errors [13, 15]. Several national and international organisations state that errors in the medication reconciliation process is one of the major problems relating to patient safety and have suggestions for improvement[16]. In 2000-2001 we performed a study at the Department of Internal Medicine at Landskrona Hospital, to investigate errors in the medication lists when a patient is transferred between community care and hospital care[17]. We found several problems and have during the last couple of years used this setting, as well as departments at Lund University Hospital, to identify more problems. We have also developed tools to resolve problems such as medication errors and drug-related problems[13, 15, 18-21]. Since the previous study, a clinical pharmacy service including medication reconciliation and medication review in the Landskrona Integrated Medicines Management (LIMM) programme has been running[19, 20]. In this programme, started in 2005, the pharmacists assist the responsible physicians in preparing

a correct medication list upon admission. This approach is based on evidence and recommendations indicating that the pharmacist is the most suitable professional to produce a correct medication list[16]. In our setting, the pharmacist normally performs the reconciliation within 24 hours of a patient being admitted to hospital on normal office days.

We have shown that our developed medication report reduces not only error rate and the risk of negative clinical consequences, but also health care contacts due to medication errors when a patient is discharged from hospital[13, 15].We have further developed the concept into a structured written summary of important aspects and changes in the patients' drug therapy. The document, named "discharge information", is written for the patient and contains:

•General information (responsible physician, reason for admission to hospital, planned follow-up)

•Medication Report (a section with information on medication changes that were made and the reasons for these changes)

•Medication list (a list of current medications, dosage and indication for each medication)

At discharge, the document should be discussed with and given to the patient and, if applicable, sent to the community health care service and the patient's general practitioner (GP) within the same day.

We have previously shown that use of a specific medication dispensing system (ApoDos) increased the risk of medication errors in the transition of information[15, 17]. At discharge changes in the patients' medication must be communicated to the regional ApoDos dispensing unit. The awareness and priority of this is low among many hospital physicians; we therefore focused on this issue.

Aim of the study

The aim was to study medication errors, in the patient medication lists upon discharge from hospital care after introduction of medication reconciliation interventions, and to evaluate the clinical risks of these errors.

Method

In this study we were mainly interested in identifying and comparing errors in the discharge Medication Reconciliation process (identifying the most accurate list of a patient's current medicines) after interventions during hospital care, as well as comparing the results with our previous study[17]. These interventions are described in table 1. Since the paper-based medication lists in the hospital medical records were changed to electronic lists during the study period we decided to describe these periods separately, as this change could have major effects on the results of the study. Thus, we had three separate study periods.

Subjects, settings, data assessment, and definitions

Subjects, settings, and definitions

Elderly patients (> 65 years) living in nursing homes or in their own homes with care provided by the community nursing system in the town of Landskrona were invited to participate if they had also been treated at one of the three departments of internal medicine at Landskrona hospital during the study periods. The patients were discharged to either community care or nursing homes.

The clinical pharmacists identified the patients. One of the authors (LB) gave patients or their relatives written and verbal information. Written consent was collected from all participants.

Study periods and interventions

The three study periods were August 18 – October 29 2008 (period 1), October 30 2008 – March 31 2009 (period 2, medication list in the electronic patient medical records and quality control of discharge information), and April 1 – June 30 2009 (period 3, + focus on the

Specific medication dispensing, ApoDos). The interventions are described in detail in table 1. The interventions are mainly based on the LIMM-model, which is a systematic approach to individualise and optimise the drug treatment in elderly in-patients. Clinical pharmacists conduct the medication reconciliation upon admission of the patient to the ward and review and monitor medication during hospital stay according to the LIMM-model[21].

Specific medication dispensing system (ApoDos)

This is a complete list of all medications used by the patient. It is not a compulsory system. This system is however very common in Sweden and is used outside hospitals and particularly for elderly patients, with many medications, living in nursing homes or in their own homes. One reason for the use of this medication dispensing system is a supposed reduction in the risk of mistakes in medication handling. In brief, the medication dispensing system is a multi-dose system and, if possible, all medications that the patient should take at one time are machine-packed together in small, fully labelled plastic bags at a regional pharmacy-dispensing centre. For our setting, this means that the pharmacy instead of the nurse prepares the dosages. For ApoDos patients to receive correct medication (after discharge), changes must be made in a national electronic ApoDos database by the physicians using their individual access code. The ApoDos system and the electronic medical records are two different systems. Data cannot be transferred between the electronic ApoDos system and the medication list in the electronic patient medical records; the responsible physician must document changes in both systems. There is thus a risk of transcribing errors. Sometimes hospital physicians do not prescribe medications within the Medication Dispensing System, in that case, the prescriptions are not transferred.

Assessment of errors and risk

The pharmacists worked at the hospital and collected all medical records containing information on drug treatment from hospital departments and the general practitioners (GPs). Data from nursing homes and community nursing system were asked for and sent to the research group. We collected lists prior to and during hospital stay, as well as after discharge from hospital. All medication notes used for the transfer of information were collected.

We then identified if there were any discrepancies between medication lists i.e. if the drugs were not the same as before the transfer[17]. If there was any indication that change of medication was intentional, it was not regarded as an error. Comments or notes in any record or written documentation, e.g., indicated an intentional change. Incorrect dosage interval was not an error if the total dose/24 hours had not been changed. Change of generic medications or withdrawal of drugs with long dosage intervals, e.g. once monthly, was not regarded as an error. If drugs were added, withdrawn, or the dosage had changed without any documentation in medical records or medication lists, it was considered an error. At discharge, the in-hospital medication lists on the day of discharge were considered correct if no other information was documented as described in figure 1. This list was compared to the community care dispensing list when the first dose had been given. For ApoDos-patients, the ApoDos-list when first packages were delivered after 2-14 days was checked. The hospital should provide medications for the time until the first ApoDos packages are delivered.

Any unintentional errors in the transfer of information were identified and the clinical risks, as a theoretical consequence of the errors, were evaluated for each patient and classified into one of three groups, (1) without clinical risk, (2), with moderate clinical risk and (3), with high clinical risk, using the same process as previously described[15]. All evaluations of errors and risks were performed by two persons (LB and MS) independently, after briefing concerning the method and discussions based on cases and instructions. Their evaluations were compared

and agreed on. In case of disagreement, a third person (PM) was consulted. For each patient with an error, the evaluation was double-checked following the completion of the study. Prior to the evaluation of risks, instructions to be used in the study were agreed upon by the entire research group. Errors were classified into three categories; 1 high clinical risk, 2 moderate clinical risk and 3 no clinical risk. The research group had a list of examples and agreed on the categories. Examples were; the erroneous addition of warfarin which was evaluated as a high clinical risk; the erroneous addition of enalapril after discharge from hospital which was evaluated as a moderate clinical risk; the prescription of zopiclone 5 mg instead of zopiclone 7.5 mg which was evaluated, and found to pose no clinical risk.

Statistics and data analysis

Computer software R version 2.5.1 was used for all statistical analyses (R Foundation for Statistical Computing, Vienna, Austria). The R COIN procedure (Asymptotic Linear by-Linear Association Test) was used to compare the number of medication errors between period 1, 2 and 3 respectively, for patients using ApoDos.

Ethics

The ethical committee at Lund University approved the study no. 282/2008.

Results

Evaluation of errors

The two persons evaluating errors and risks agreed in all but seven cases. For these seven cases a third person (PM), was consulted and disagreements were solved through discussions.

At admission

Patients had 12 drugs on average. The rate of medication errors at admission to hospital was similar in the three periods, with the mean number of errors per patient being 0.92, 1.0 and 0.95 in period 1, 2 and 3 respectively. These errors occur prior to any intervention. The most

common medication error at admission to hospital care was that medications were erroneously omitted.

At discharge

Characteristics of included patients at discharge from hospital are described in table 2.

Errors at discharge

In period 3, no patients with the specific medication dispensing system had more than two medication errors whereas in period 1, three out of 16 patients and in period 2, six out of 27 patients had three or more medication errors (table 3). There were significant differences between period 1 and 3 (p=0.048), period 2 and 3 (p=0.037) but not between period 1 and 2 (p=0.41).

The mean number of medication errors was lower in period 3 for ApoDos-patients (table 4). There were few patients in all periods not using ApoDos, and therefore there are no comparisons between the periods regarding these patients, hence data for patients not using ApoDos is not presented in table 4. In total there were 14 patients not using the ApoDos system and for these patients, the total number of errors was six, with a mean of 0.4 errors per patient.

The most common medication error in period 1, 2 and 3 was that medications were erroneously added.

All documents regarding medications at discharge were found by the pharmacists to contain errors, i.e. the medication report, the discharge medication list, and the ApoDos medication list. In period 3, the pharmacist identified discrepancies and suggested changes in 26 cases; the physicians accepted and corrected 14 of these discrepancies.

Clinical risks

A total of 58 patients had medication errors and for these, the clinical risks were evaluated.

Most errors were evaluated as having low clinical risk (34 out of 58 patients with medication errors), and only for two patients the errors were evaluated as having high clinical risk (table 5).

Discussion

The elderly patients in this study used on average 12 drugs per patient. Even after our medication reconciliation interventions, medication errors were quite common when elderly patients were discharged from hospital care. The main risk factor seems to be the specific medication dispensing system (ApoDos). With this system there is slightly more than one error per patient. This is a small improvement compared to our previous study in the same setting[17]. In that study we also showed that patients without ApoDos had lower medication error rate than patients with ApoDos, thus there was a need for interventions to reduce the risks for patients with ApoDos.

When this system and the transfer process were supported by clinical pharmacists, the medication error rate dropped to the same level as for patients without the medication dispensing system. The error rate dropped to 0.46 medication errors per patient, which is at the same level as for patients without ApoDos, 0.43 medication errors per patient. One reason for the increased risk of error might be that ApoDos means an additional step in the prescribing process and all additional steps may increase the risk of errors.

The pharmacists presented the identified errors to the physicians orally. The reasons for not correcting these medication errors are not known.

There are different explanations to the medication errors. Errors at discharge can be due to errors at admission not being corrected properly, but also because of therapy changes not being documented and communicated correctly to involved units. In southern Sweden there is not a common electronic patient medical record and all medication lists must be sent between different levels of care and manually entered into different electronic medical records, hence

errors in transcription can occur in all steps. In our setting clinical pharmacists' perform medication reconciliation at admission. In this study, this activity is not included in the presentation of errors at admission. The reason for this is that, not only did we not focus on admission, but also, the clinical pharmacist activity occurs after the initial evaluation of medication errors.

Other studies have also shown that clinical pharmacy services may reduce the number of medication errors. In one such study, medication errors were reduced by 51 % when a pharmacist participated in daily medical rounds [22]. In another study the authors showed that medicine reconciliation by a pharmacist within an emergency department reduced the medication error rate [23].

Our study has some limitations. We have only included elderly patients living in nursing homes or in their own homes with care provided by the community nursing system. We do not know if our results are generalizable to all elderly patients. There are two reasons for our choice of patients. First, these patients are frailer and thus susceptible to adverse drug events. Second, all patients received their medications from staff at nursing homes, in their own home or at hospital, i.e. we knew exactly what medicines they used before, during and after hospital care. We have evaluated errors and also clinical risks, as a theoretical consequence of the errors, but we have not evaluated any actual clinical outcomes due to medication errors.

Conclusion

Medication errors are still common when elderly patients are transferred from hospital to community/primary care. The main risk factor seems to be the specific medication dispensing system (ApoDos) or rather the process on how to use it. When this system and the transfer process were supported by clinical pharmacists, the medication error rate dropped to the same level as for patients without this system. There is need for more research with comparisons between different types of interventions, as well as the evaluation of the effects of

interventions on clinical outcomes for these patients.

Conflicts of interest

There are no conflicts of interest.

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References

1. Lisby, M., L.P. Nielsen, and J. Mainz. Errors in the medication process: frequency, type, and potential clinical consequences. Int J Qual Health Care, 2005. **17**(1): 15-22.

2. Tam, V.C., S.R. Knowles, P.L. Cornish, N. Fine, R. Marchesano, and E.E. Etchells. Frequency, type and clinical importance of medication history errors at admission to hospital: a systematic review. CMAJ, 2005. **173**(5): 510-5.

3. Strand, L.M., P.C. Morley, R.J. Cipolle, R. Ramsey, and G.D. Lamsam. Drug-related problems: their structure and function. Dicp, 1990. **24**(11): 1093-7.

4. Beijer, H.J. and C.J. de Blaey. Hospitalisations caused by adverse drug reactions (ADR): a meta-analysis of observational studies. Pharm World Sci, 2002. **24**(2): 46-54.

5. Lazarou, J., B.H. Pomeranz, and P.N. Corey. Incidence of adverse drug reactions in hospitalized patients: a meta- analysis of prospective studies. Jama, 1998. **279**(15): 1200-5.

6. Azaz-Livshits, T., M. Levy, B. Sadan, M. Shalit, G. Geisslinger, and K. Brune. Computerized survelliance of adverse drug reactions in hospital: pilot study. Br J Clin Pharmacol, 1998. **45**(3): 309-14.

7. Bates, D.W., N. Spell, D.J. Cullen, E. Burdick, N. Laird, L.A. Petersen, et al. The costs of adverse drug events in hospitalized patients. Adverse Drug Events Prevention Study Group. Jama, 1997. **277**(4): 307-11.

8. Classen, D.C., S.L. Pestotnik, R.S. Evans, J.F. Lloyd, and J.P. Burke. Adverse drug events in hospitalized patients. Excess length of stay, extra costs, and attributable mortality. Jama, 1997. **277**(4): 301-6.

9. Winterstein, A.G., B.C. Sauer, C.D. Hepler, and C. Poole. Preventable drug-related hospital admissions. Ann Pharmacother, 2002. **36**(7-8): 1238-48.

10. Mjörndal, T., M.D. Boman, S. Hägg, M. Bäckström, B.E. Wiholm, A. Wahlin, et al. Adverse drug reactions as a cause for admissions to a department of internal medicine. Pharmacoepidemiol Drug Saf, 2002. **11**(1): 65-72.

11. Dean, B., M. Schachter, C. Vincent, and N. Barber. Prescribing errors in hospital inpatients: their incidence and clinical significance. Qual Saf Health Care, 2002. **11**(4): 340-4.

12. Runciman, W.B., E.E. Roughead, S.J. Semple, and R.J. Adams. Adverse drug events and medication errors in Australia. Int J Qual Health Care, 2003. **15 Suppl 1**: i49-59.

13. Midlöv, P., E. Deierborg, L. Holmdahl, P. Höglund, and T. Eriksson. Clinical outcomes from the use of Medication Report when elderly patients are discharged from hospital. Pharm World Sci, 2008. **30**(6): 840-5.

14. IHI MedReconcilliation. Prevent Adverse Drug Events. [cited 2011 December 16]; Available from: http://www.ihi.org/IHI/Programs/Campaign/ADEsMedReconciliation.htm.

15. Midlöv, P., L. Holmdahl, T. Eriksson, A. Bergkvist, B. Ljungberg, H. Widner, et al. Medication report reduces number of medication errors when elderly patients are discharged from hospital. Pharm World Sci, 2008. **30**(1): 92-8.

16. National Institute for Health and Clinical Excellence. Technical patient safety solutions for medicines reconciliation on admission of adults to hospital. 2007 [cited 2011 December 16]; Available from: http://www.nice.org.uk/guidance/index.jsp?action=byID&o=11897.

17. Midlöv, P., A. Bergkvist, A. Bondesson, T. Eriksson, and P. Höglund. Medication errors when transferring elderly patients between primary health care and hospital care. Pharm World Sci, 2005. **27**(2): 116-20.

18. Bondesson, A., L. Hellström, T. Eriksson, and P. Höglund. A structured questionnaire to assess patient compliance and beliefs about medicines taking into account the ordered categorical structure of data. J Eval Clin Pract, 2009. **15**(4): 713-23.

19. Bergkvist, A., P. Midlöv, P. Höglund, L. Larsson, A. Bondesson, and T. Eriksson. Improved quality in the hospital discharge summary reduces medication errors--LIMM: Landskrona Integrated Medicines Management. Eur J Clin Pharmacol, 2009. **65**(10): 1037-46.

20. Bergkvist, A., P. Midlöv, P. Höglund, L. Larsson, and T. Eriksson. A multi-intervention approach on drug therapy can lead to a more appropriate drug use in the elderly. LIMM-Landskrona Integrated Medicines Management. J Eval Clin Pract, 2009. **15**(4): 660-7.

21. Hellström, L.M., A. Bondesson, P. Höglund, P. Midlöv, L. Holmdahl, E. Rickhag, et al. Impact of the Lund Integrated Medicines Management (LIMM) model on medication appropriateness and drug-related hospital revisits. Eur J Clin Pharmacol, 2011. **67**(7): 741-52.

22. Scarsi, K.K., M.A. Fotis, and G.A. Noskin. Pharmacist participation in medical rounds reduces medication errors. Am J Health Syst Pharm, 2002. **59**(21): 2089-92.

23. Mills, P.R. and A.C. McGuffie. Formal medicine reconciliation within the emergency department reduces the medication error rates for emergency admissions. Emerg Med J, 2010. **27**(12): 911-5.

Tables and figures

Table 1. Interventions and tools used in this study.

Intervention	Intervention tool, or support, and responsibility
Period 1+2+3	
Discharge Medication Reconciliation.	LIMM Discharge Information form [21] This document is written by the physician, for the patient and contains: •General information (responsible physician, reason for admission to hospital, planned follow-up) •Medication Report (a section with information on changes that were made to the medication therapy and reasons for these changes) [13, 15] •Medication list (a list of current medications, dosage and indication for each medication) At discharge, the document should be discussed with and given to the patient and, if applicable, sent to the community health care and the patient's general practitioner within the same day
Period 2+3 Medication list in the hospital electronic patient medical record	Melior Medication module, Siemens Corporation. Physicians are responsible for all prescribing.
Quality control of Discharge Medication Reconciliation	LIMM Quality Control form for Discharge Medication Reconciliation [19]. Performed by pharmacist who gives suggestions for change to the physician for corrections before patient discharge.

Period 3	
Focus on specific medication dispensing system (ApoDos).	Specific routines included that the physician should synchronise all discharge medication lists including the medication list in the ApoDos-system. This was achieved by organising educations, routines and increase interest based on patient safety. In addition to writing a correct medication list in the discharge summary the physician had to log on to the electronic web-based ApoDos-system and correct the medication list. Finally, the pharmacist checked the correctness of the ApoDos list, and made suggestions for changes to the physician.

Table 2. Characteristics at discharge of patients included in the three periods.

	Period 1	Period 2	Period 3
Number of patients at discharge	39	53	31
Number of patients with ApoDos at discharge (%)	32 (82)	49 (92)	28 (90)
Patient age, mean (range)	84.4 (65-99)	85.6 (69-102)	85.1 (66-95)
Female sex, number (%)	29 (74)	43 (81)	21 (68)
Number of days at hospital, mean, (range)	10.8 (2-30)	10.6 (3-32)	10.2 (2-29)
Number of drugs at discharge, mean (range)	11.5 (5-22)	10.7 (3-22)	11.3 (4-24)
Continuous use, mean (range)	9.1 (3-19)	9.3 (2-19)	9.2 (1-21)
On demand, mean (range)	2.5 (0-7)	1.4 (0-5)	2.2 (0-6)

Table 3. Number of ApoDos-patients in period 1-3 for each number of medication errors at discharge from hospital.

	0	1	2	3	4	5	6	7	8	9	10	11
Period 1, n=32	16	7	4	0	2	1	0	0	0	0	1	1
Period 2, n=49	22	13	8	3	0	2	0	0	1	0	0	0
Period 3, n=28	18	7	3	0	0	0	0	0	0	0	0	0

Table 4. Medication errors for patients with ApoDos at discharge from hospital in period 1, 2 and 3.

	Total number of errors (% error of all transfers)	Mean number of errors per patient	Number (%) of patients with at least three medication errors	Number (%) of patients with at least one medication error	Mean number of drugs (range)
Period 1 (n= 32)	49 (12.9)	1.5	5 (15.6)	16 (50)	11.9 (5-22)
Period 2 (n=49)	56 (10.6)	1.1	6 (12.2)	27 (55)	10.7 (3-22)
Period 3 (n=28)	13 (4.1)	0.46	0	10 (35.7)	11.3 (4-24)

Table 5. Classification and degree of clinical risk based on errors at discharge for period 1-3.

		Low	Moderate	High
Period 1 (n=39)	Patients with ApoDos (32)	6	10	0
	Patients without ApoDos (7)	0	0	0
Period 2 (n=53)	Patients with ApoDos (49)	19	6	2
	Patients without ApoDos (4)	2	1	0
Period 3 (n=31)	Patients with ApoDos (28)	6	4	0
	Patients without ApoDos (3)	1	1	0

Figure 1. Medication lists used to study the discharge process from hospital- to community care. The lists used for assessment of errors are marked in grey. The local dispensing list should normally be the medication list in the Discharge Information. The new ApoDos medication list and multi dose medications are delivered between day 2-14.