Medication problems are frequent and often serious in a Danish emergency department and may be discovered by clinical pharmacists

Christian Backer Mogensen[1], Anette Rehn Thisted[2] & Inger Olsen[2]

ABSTRACT

INTRODUCTION: Transferring a patient from one health-care sector to another implies a risk of medication errors. It is of interest to evaluate whether a specialist in clinical pharmacy is beneficial for the patients in the emergency departments (ED).

The aim of the present study was to report the incidence, categories and seriousness of medication problems discovered by clinical pharmacists in an ED and to evaluate if it is possible for pharmacists to identify those groups of patients who are most at risk of medication problems.

MATERIAL AND METHODS: A pharmacist reviewed the patient files in the ED. If the pharmacists provided any kind of recommendations, a note was made describing the problem and a suggestion for a solution. After the study period, two medical specialists reviewed the files and rated the suggestions according to four levels of importance.

RESULTS: A total of 1,696 patient files were reviewed after excluding patients who had received no medication. A total of 420 pharmacist notes were written, corresponding to 25% of all the included admissions. 47% of the pharmaceutical suggestions were considered serious. Increasing age and one drug as opposed to 2-9 drugs were associated with serious recommendations. In the multivariate analysis, only age above 70 years remained of significance for the identification of patients with a risk of a serious medication problem.

CONCLUSION: A considerable amount of serious pharmaceutical problems were found in the ED. These problems had not been observed by the physicians and they were especially prevalent among the elderly and patients who were only prescribed a single drug.

FUNDING: The Amgros research foundation financed salaries for the independent specialists who reviewed the patient files.

TRIAL REGISTRATION: not relevant.

Danish health care is currently facing major changes initiated by the Danish National Board of Health in 2007 [1]. Around 20 hospitals have been designated ''acute hospitals''and it is expected that the vast majority of acutely admitted patients will pass through the emergency departments (ED) of these hospitals which offer immediate access to a range of specialists and diagnostic facilities.

Transferring a patient from one health-care sector to another, e.g. from the patient's home to a hospital, implies a risk of loss of information concerning medication [2, 3]. Clinical pharmacy has a proven effect on patient safety in other areas [4-8]. As the majority of emergency admissions pass through the ED, it is of interest to evaluate whether the addition of a specialist in clinical pharmacy would be beneficial for the quality of care. However, a systematic review from 2006 revealed that even though pharmacists have been involved in the ED for decades, only six studies on pharmacist recommendations could be found [9]. In the UK and Australia, small intervention studies suggested moving the pharmacists to the ED [10, 11]. In the US, pharmacist-acquired medication histories were more complete than those acquired by other health-care professionals [12]. A recent study of medical emergency admissions from Denmark showed that approx. 34% of the pharmacist reviews of the patients' files resulted in recommendations for changes in medication; recommendations which were subsequently followed by the physicians in 80% of cases [13].

In 2008, Kolding Hospital established one of the first small-scale EDs in Denmark based on the principles and recommendations from the National Board of Health [1]. The ED at Kolding Hospital receives approx. 9,000 patients annually for admission with general surgical, vascular surgical, medical, cardiologic or orthopaedic conditions. The patients' average stay is 23 hours and the discharge rate to home is around 65%. Random samples have shown that 88% of the admitted patients receive prescription medicine.

The aim of the present study was to report the incidence, categories and seriousness of medication problems discovered by clinical pharmacists in an ED and to evaluate if it is possible to identify those groups of patients who would benefit most from a medication review.

MATERIAL AND METHODS

The study period spanned from August 2008 to March 2009. Four clinical pharmacists with 1-7 years of working

ORIGINAL ARTICLE

1) Emergency Department, Kolding Hospital
2) Pharmacy Department, Hospital Lillebælt

Dan Med J 2012;59(11):A4532

TABLE 1

Basic information for patients with pharmaceutical recommendations.

	n	%
Patients, total	324	
Gender		
Male	129	40
Female	195	60
Age, years		
0-49	65	20
50-59	40	13
60-69	69	21
70-79	69	21
> 79	81	25
Specialty		
Internal medicine	139	43
General surgery	130	40
Orthopaedic surgery	37	11
Vascular surgery	10	3
Other (gynaecology, paediatrics)	8	3
Drugs per patient, n		
1	26	8
2-3	34	10
4-5	53	16
6-9	106	33
> 9	105	33

experience from hospitals participated. Every morning on working days, one of the pharmacists went through as many patient files as possible from the past 24 hours of admissions during a three-hour period.

The pharmacist reviewed the patient files in the ED using the same physical facilities as the physicians. Only files from patients for whom treatment plans had been made by at least one physician were included. Patients with no medication were excluded. The patients were placed randomly in the ED beds, and the pharmacists always began from the top of the bed list. A pharmacist recommendation was defined as any recommendation given to the physicians concerning the patient's medicine, apart from generic substitution. If the pharmacist provided a recommendation, a note was added describing the problem and suggesting a solution. There were no limitations for suggestions, either with regard to their number or contents. The recommendations were grouped as: lack of medication reconciliation, indications for treatment that did not lead to a prescription, incorrect dosage or dosing frequency, inappropriate medication, significant interactions with other drugs prescribed, prescription errors and prescription without any indication (including drug duplication). Notes were instantly available to the physicians in the electronic patient file. If a potentially disastrous situation was identified, the pharmacists immediately reported this to the physician responsible for the patient.

Study data included the patient's identification number, date, age, sex, medical specialty, number of physicians involved in the patient's treatment and type of specialty, number of medications prescribed, number and category of suggested recommendation. If a recommendation was provided, the file was reviewed by the pharmacists the following working day, and it was noted whether the suggested proposal had been taken into account.

After the study period, a specialist in internal medicine and a specialist in clinical pharmacology and geriatric diseases reviewed the files. The two specialists, who worked in other hospitals, did the review of the files independently of each other and were not allowed to see the other physicians' rating at any time. They had access to all parts of the patient files. The files reviewed were chosen randomly among all the files to which suggestions had been made by pharmacists. A representative sample size was calculated to be at least 280 files to fulfill a 95% confidence interval, assuming that 25% of the population of 9,000 admissions per year had a pharmacist note.

For each patient, the auditing physicians assessed whether the pharmacist suggestion was of minimal importance (category 1), moderate importance, with a risk of increased examination or treatment intensity (category 2), significant importance with a risk of increased examination or treatment intensity (category 3) or disastrous importance carrying a risk of permanent damage or death (category 4). For the final score, the highest rating given by either of the two physicians was used.

All variables were registered on pre-printed forms, which were entered into a database and analysed in STATA 7.0. All continuous data were reported as medians and interquartile ranges (IQR) and all categorical data as absolute numbers and percentage of occurrence. Uni- and multivariate logistic regression was performed to evaluate the ability of a model to identify patients who had a risk of medication problems, based on their gender, age, specialty (aggregated as medical or surgical specialty) and number of drugs prescribed. The risk of a serious suggestion was defined as a category 3 or 4 suggestion and expressed as odds ratios (OR) and 95% confidence intervals (95% CI).

Stepwise backward elimination with $p > 0.3$ as the elimination threshold was used in the multivariate analysis to find the final model.

The study was based on existing data collected from the patients' hospital records and involved no patient contact. Thus, no ethical approval was required. The study was registered with the Danish Data Protection Agency (J.no. 2010-41-4258).

Trial registration: not relevant.

RESULTS

During the study period, which consisted of 130 working days, a total of 1,696 patient files were reviewed after excluding patients who received no medication. A total of 420 pharmacist notes were written, corresponding to 25% of all the included admissions. Among these patients, a random sample of 324 patients was studied further. Their median age was 69 years (IQR: 54- 80 years). The median prescribed number of drugs was seven (IQR: 4-10 drugs). The age, specialty and number of drugs are displayed in **Table 1**.

The median number of physicians who had seen the patient was two (IQR:1-3 physicians), 173 patients (53%) were seen by a non-specialist only, 136 (42%) by a non-specialist as well as a specialist, and 15 (5%) by a specialist only.

The median number of recommendations per patient was one (IQR 1-2 recommendations).

Table 2 reports the most important recommendations for each patient with categories and seriousness. There were 153 (47%) serious recommendations.

Table 3 shows the univariate and multivariate logistic regression analyses of serious problems against different risk factors. In the univariate analysis, increasing age and one drug as opposed to 2-9 drugs were associated with a serious suggestion for intervention. There were 14 serious suggestions with only one drug involved. These suggestions were due to lack of a prescription of an important drug (e. g. lack of glucocorticoid in severe exacerbation of ulcerative colitis, lack of prescription of thiamine to alcoholic patients) or toxic dosage to patients in single-drug therapy (e.g. adult dosage to a child).

In the multivariate analysis, only age above 70 years remained of significance for the identification of patients with a risk of serious medication problems.

DISCUSSION

In this study, we report that 25% of all included admissions in the ED with a drug prescription could benefit from a review by a pharmacist, and that 47% of the recommendations were considered serious as they carried a risk of increased duration of treatment or permanent damage. None of these major medication problems had been identified by the physicians who had cared for the patient before the pharmacist review. Only age and number of drugs, and not gender or specialty, were associated with an increased risk of serious medication problems at the univariate analysis, and only age above 70 years remained of significance in the multivariate analysis.

Several factors may explain these results.

The patient flow in an ED is high, which leaves limited time for each patient. Furthermore, physicians may be focused on the primary patient complaint at admission, and the primary complaint is often not related to or does not imply medication problems. Information about medication is often limited during the initial hours of admission until the patient's relatives or primary

TABLE 2

Pharmaceutical recommendations.

	n	%
Recommendations, n		
1	221	68
2-3	88	27
> 3	15	5
Primary recommendation		
Lack of medication reconciliation	110	34
Untreated indication	47	15
Incorrect dosage/frequency	45	14
Inappropriate medication	45	14
Others[a]	26	8
Interactions	21	6
Prescription errors	20	6
Prescription without indication	10	3
Importance of recommendation		
Minimal	11	4
Moderate	160	49
Significant	143	44
Disastrous	10	3

a) E.g. intravenously instead of orally, mg instead of number, adverse reactions (1 patient only).

TABLE 3

Risk factors for serious medication problems.

	Serious recommendation		Univariate analysis			Multivariate analysis	
	n	%	OR	95% CI	p-value	OR	95% CI
Total	153	47					
Gender					0.53		
Female	89	46	1				
Male	63	49	1.2	0.7-1.8			
Age, years					0.004		
0-49	20	31	1				
50-59	15	38	1.4	0.6-3.1			
60-69	31	45	1.8	0.9-3.7			
70-79	38	55	2.8	1.4-5.6		2.2	1.1-4.0
> 79	49	60	3.4	1.7-6.9		3.0	1.4-5.0
Specialty					0.32		
Surgical	83	45	1				
Medicine	70	51	1.2	0.8-1.9			
Drugs, n					0.02		
1	14	54	1				
2-3	10	29	0.36	0.1-1.1			
4-5	19	36	0.47	0.2-1.3			
6-9	50	47	0.76	0.3-1.8			
> 9	60	57	1.14	0.5-2.7			

CI = confidence interval; OR = odds ratio.

Medication problems are frequent in a Danish emergency department.

health care can be contacted and will be able to assist in the medication reconciliation. The number of drugs prescribed to the patients is often considerable and may include drugs that are unfamiliar to the physicians or may give rise to possible interactions; resolving such issues requires time and updated detailed knowledge of pharmacology.

In this study, the reason for single-drug prescription problems was incorrect dosage which in itself may have a more pronounced effect in elderly patient [14]. It is, however, rather difficult to understand why a clear indication for therapy was not followed by a prescription in 15% of the cases; and this should encourage a review of prescription processes.

This study is limited by some factors. While a number of studies in clinical pharmacy have used independent pharmacists to evaluate the effect of the suggestion for intervention, this study used medical specialists. We did so to assess the pharmacist recommendations from a physician's point of view. We chose the highest rating from any of the two independent physicians as an indicator of the seriousness of the pharmacist's suggestion. This was done because these specialists covered different, important fields and clinical experiences. However, it could be argued that the rating should be based on a consensus among the experts instead; and that a pharmacist should have been participated in the assessment since pharmacists may have different opinions on the issue of seriousness.

Only few studies have explored the utilisation of clinical pharmacists in a Danish ED context. Grønkjær et al reported from Odense that clinical pharmacists found a need for intervention in 34% of individuals in an ED for medical patients, which is higher than our findings [13]. However, they included generic substitution which accounted for more than half of the suggestions. After exclusion of generic substitution, the Odense figures are lower than ours, which may be explained by the fact that Odense only included patients admitted at an internal medicine ED where the physicians may be more alert to drug problems than physicians in the department comprised by our study, which also included several surgical specialties. Outside Denmark, studies have indicated that clinical pharmacy expertise is beneficial in the ED [9, 15, 16].

The results of the present study have some clinical implications for ED services. We may reasonably believe that the physicians who cared for the patient before the pharmacist's review had already identified a range of pharmaceutical problems.

The pharmacist's review was done up to 24 hours after one or two physicians had evaluated the patient. It should be considered whether this is too late, since serious drug problems might already have occurred. As some of the problems identified were related to new prescriptions, a more expedient time for a pharmacist review may be during the first few hours of admission.

The question therefore is how the quality of medication care may be improved in the ED. This study suggests that physicians may benefit from focussing their attention on medication problems relating to elderly patients, whether they have few or many drug prescriptions. An additional option is to include clinical pharmacists in the team caring for emergency patients, acknowledging that physicians may not always be able to identify and correct the sometimes complex drug-related problems. In contrast to the physicians, the clinical pharmacists have the opportunity to only focus only on the medication aspect of quality of care. Additionally, pharmacists may help guide physicians and nurses to avoid prescription mistakes and assist in the often difficult tracing of the types of medication a patient has received prior to admission. However, including pharmacists in the emergency team also carries a risk of spreading the responsibility for the patient to yet another specialist group and it needs to be well agreed that the physician is ultimately responsible for the treatment of the patient. In conclusion, we found a considerable amount of serious medication problems in the ED which were not discovered by physicians; the issues identified were particularly prevalent among elderly patients. Further studies should be performed on the role of pharmacists in Danish Emergency Departments.

CORRESPONDENCE: *Christian Backer Mogensen*, Akutafdelingen, Kolding Sygehus, Skovvangen 2-8, 6000 Kolding, Denmark.
E-mail: christian.backer.mogensen@shs.regionsyddanmark.dk

ACCEPTED: 19 September 2012

CONFLICTS OF INTEREST: Disclosure forms provided by the authors are available with the full text of this article at www.danmedj.dk.

ACKNOWLEDGMENTS: We would like to express our gratitude to *Jette Ammentorp* for her contribution to the research idea and design of this study.

LITERATURE

1. Sundhedsstyrelsen. Styrket akutberedskab – planlægningsgrundlag for det regionale sundhedsvæsen. København: Sundhedsstyrelsen, 2007.
2. Christensen HR, Krolner BK. Medication problems in connection with transferral between sectors. Ugeskr Læger 2009;171:808-11.
3. Myhr R, Kimsas A. Medication errors when transferring within health care services. Tidsskr Nor Laegeforen 1999;119:1087-91.
4. LaPointe NM, Jollis JG. Medication errors in hospitalized cardiovascular patients. Arch Intern Med 2003;163:1461-6.
5. Leape LL, Cullen DJ, Clapp MD et al. Pharmacist participation on physician rounds and adverse drug events in the intensive care unit. JAMA 1999;282:267-70.
6. Weiner BK, Venarske J, Yu M et al. Towards the reduction of medication errors in orthopedics and spinal surgery: outcomes using a pharmacist-led approach. Spine (Phila Pa 1976) 2008;33:104-7.
7. Larsen MD, Nielsen LP, Jeffery L et al. Medication errors on hospital admission. Ugeskr Læger 2006;168:2887-90.
8. Gillespie U, Alassaad A, Henrohn D et al. A comprehensive pharmacist intervention to reduce morbidity in patients 80 years or older: a randomized controlled trial. Arch Intern Med 2009;169:894-900.
9. Cohen V, Jellinek SP, Hatch A et al. Effect of clinical pharmacists on care in the emergency department: a systematic review. Am J Health Syst Pharm 2009;66:1353-61.
10. Mills PR, McGuffie AC. Formal medicine reconciliation within the emergency department reduces the medication error rates for emergency admissions. Emerg Med J 2010;27:911-5.
11. Vasileff HM, Whitten LE, Pink JA et al. The effect on medication errors of pharmacists charting medication in an emergency department. Pharm World Sci 2009;31:373-9.
12. Carter MK, Allin DM, Scott LA et al. Pharmacist-acquired medication histories in a university hospital emergency department. Am J Health Syst Pharm 2006;63:2500-3.
13. Gronkjaer LS, Jensen ML, Madsen H et al. Successful implementation of pharmaceutical intervention at an acute medical admission unit. Ugeskr Laeæer 2011;173:1353-5.
14. Boparai MK, Korc-Grodzicki B. Prescribing for older adults. Mt Sinai J Med 2011;78:613-26.
15. Brown JN, Barnes CL, Beasley B et al. Effect of pharmacists on medication errors in an emergency department. Am J Health Syst Pharm 2008;65:330-3.
16. Rothschild JM, Churchill W, Erickson A et al. Medication errors recovered by emergency department pharmacists. Ann Emerg Med 2010;55:513-21.