Acceptance and importance of clinical pharmacists' LIMM-based recommendations.

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Title: Acceptance and importance of clinical pharmacists' LIMM-based recommendations

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Reason for publication: This study evaluates the quality of a systematic model, the Lund Integrated Medicine Management model (the LIMM model), in terms of clinical significance of recommendations made by clinical pharmacists. We hope that the LIMM-model may inspire clinical pharmacists to work more systematically and inspire these pharmacists to evaluate their own clinical pharmacy services.

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Abstract

Objective
The objective of this study was to evaluate the quality of the clinical pharmacy service in a Swedish hospital according to the Lund Integrated Medicine Management (LIMM) model, in terms of the acceptance and clinical significance of the recommendations made by clinical pharmacists.

Method
The clinical significance of the recommendations made by clinical pharmacists was assessed for a random sample of inpatients receiving the clinical pharmacy service in 2007.
Two independent physicians retrospectively ranked the recommendations emerging from errors in the patients' current medication list and actual drug-related problems according to Hatoum, with rankings ranging between 1 (adverse significance) and 6 (extremely significant).

Results
The random sample comprised 132 patients (out of 800 receiving the service). The clinical significance of 197 recommendations was assessed. The physicians accepted and implemented 178 (90 %) of the clinical pharmacists' recommendations. Most of these recommendations, 170 (83 %), were ranked 3 (somewhat significant) or higher.

Conclusion
This study provides further evidence of the quality of the LIMM model and confirms that the inclusion of clinical pharmacists in a multi-professional team can improve drug therapy for inpatients. The very high level of acceptance by the physicians of the pharmacists' recommendations further demonstrates the effectiveness of the process.

Impact on clinical pharmacy practice
- In order to optimise drug therapy in inpatients, it is important to develop a systematic and integrated approach to the management of medications from the time of admission, during the hospital stay and at discharge.
- The Lund Integrated Medicines Management (LIMM) model is a systematic approach that individualises and optimises drug treatment in inpatients.
- Clinical pharmacists using the LIMM model contribute to improved drug therapy in inpatients.

Introduction

The Lund Integrated Medicines Management (LIMM) model has been under development for more than ten years. This model offers a systematic approach to individualising and optimising drug treatment for inpatients. The system starts on admission to hospital and ends with a summary written for and communicated to the patient, the primary-care provider and/or the community care provider at discharge. In the LIMM model, systematic activities based on structured, evidence-based tools are used to review and reconcile the patients' medications. When following the model, clinical pharmacists are responsible for conducting a full medication review, including reconciliation of medications on admission. Previous studies have associated improved appropriateness of medications and reduced unscheduled drug-related hospital revisits with the LIMM system [1]; however, it is also important to establish the acceptance and clinical relevance of the recommendations made by clinical pharmacists using the model.

The relevance of the interventions of clinical pharmacists has been investigated previously [2-7]. In those studies, however, different evaluation scales were used. To our knowledge, no standardised method of evaluating clinical pharmacy services is available. However, Hatoum *et al.* [3] used a ranking system for the interventions of clinical pharmacists that focused on the value of the service by assessing the potential impact of their recommendations, and this ranking system was also used by Overhage and Lukes [5] as one dimension in their two-dimensional scale.

Objective of the study

The objective of this study was to evaluate the quality of the clinical pharmacy services in a Swedish hospital using the LIMM model, focusing on the acceptance and clinical significance of the recommendations made by clinical pharmacists.

Methods

The study was conducted in two internal medicine wards at the University Hospital of Lund, Sweden. The LIMM-based clinical pharmacy service was implemented in January and October, 2007, in the respective wards. All patients receiving this service in 2007 are subsequently referred to as LIMM patients.

The clinical pharmacy intervention

A medication review, including reconciliation of admission medications, was conducted according to the LIMM model in order to identify, solve and prevent drug-related problems and medication discrepancies in the patient's medication list. The full LIMM-based clinical pharmacy service has been described previously by Hellström *et al.* [1]. Briefly, on week days, a clinical pharmacist reconciled patient medications shortly after the patient was admitted, and reviewed and monitored the medications during the hospital stay. Patients were followed up at least twice weekly on week days, before the morning rounds, to enable identification of new drug-related problems and to monitor previously identified problems. During the ward rounds, the drug-related problems and medication discrepancies which the pharmacist considered to be the most relevant were discussed within the multi-professional team (physicians, nurses, carers and paramedics). Based on these discussions, the physicians then adjusted the drug therapy and current medication list as appropriate. The pharmacist also recorded the drug-related problems/discrepancies and suggested interventions in the LIMM medication review form, to allow retrospective review.

Data collection

Two pharmacy students retrospectively assigned the patients consecutive ID numbers and compiled the identified and documented drug-related problems/medication discrepancies. Drug-related problems were classified as *potential* (an event was not present but there was a risk of future events) or *actual* (an event was present or the patient's health was currently affected). Medication discrepancies for which the reviewing pharmacists could not identify any clinical reason (unintentional changes) were deemed to be medication errors. The medication discrepancies were also classified as: *omitted drug* (the drug had not been registered in the drug list), *additional drug* (the drug had been erroneously added to the drug list), *wrong dosage form*, *dosage too low*, *dosage too high*, and *non-compliance*. The drug-related problems were also classified as [8]: *need for additional therapy*, *unnecessary drug therapy*, *wrong drug*, *dosage too low*, *adverse drug reaction*, *dosage too high* and *non-compliance*. If recommendations were made by the pharmacist, the actions taken by the physician were classified as: *recommendation accepted and implemented*, *recommendation accepted but not implemented* (due

to lack of time or forgetfulness), *recommendation already implemented by the physician*, and *recommendation not accepted*.

Assessment of clinical significance

The clinical significance of the clinical pharmacists' recommendations was assessed for a random sample of the LIMM patients. A random number generator was used to obtain the sample from the assigned ID numbers. A clinical pharmacist (EA) compiled the information on the actual drug-related problems/medication errors, the involved drugs or the untreated indications, the clinical pharmacists' recommendations and the patients' characteristics (age, sex, known diagnoses and reason/s for hospitalisation). Based on this information, two physicians (one geriatrician, L.H., and one GP with a special interest in geriatrics, P.M.) independently ranked the clinical significance of the recommendations according to potential impact on patient care, according to Hatoum's ranking system [3]. The rankings ranged between 1 (adverse significance - i.e. the recommendation supplied by the clinical pharmacist could have lead to an adverse outcome) and 6 (extremely significant - i.e. the information was vital, qualifying as a life and death situation). Recommendations with inconsistent rankings were discussed by the physicians until consensus was reached.

Ethical consideration

The ethics committee of the University of Lund, Lund, Sweden, did not consider ethical approval to be necessary and had no objections to the study.

Results

A total of 800 LIMM patients received the clinical pharmacy service in 2007. The pharmacists' recommendations for a random sample of 132 patients (17%) were assessed for clinical significance. Patient characteristics are presented in **Table 1.**

Clinical significance of pharmacists' recommendations

Errors in the current medication list and/or actual drug-related problems were identified for 88 (67%) of the 132 sample patients. A total of 256 recommendations related to these errors and drug-related problems were identified; 197 of these were assessed for clinical significance. The remainder were not assessed because the documentation was not found (n=40), the recommendation took the form more of a discussion (n=4), the drug-related problem was re-assessed as potential (n=4) or was not recommended (n=5), two drug-related problems resulted in only one recommendation (n=2) or other reasons (n=4).

Of the 197 recommendations, most (127; 64 %) emerged from the medication review and monitoring, while 70 (36%) emerged from the admission medication reconciliation (**Table 2)**.

The most common type of medication error in the admission medication reconciliation was *omitted drug*, while the most common types of drug-related problem identified in the medication review and monitoring were *wrong drug* and *unnecessary drug therapy*. A total of 90% [(69+109)/(70+127)] of the recommendations made by the clinical pharmacists were accepted and implemented by the attending physician. Most of the recommendations (83 %) were ranked 3 (somewhat significant) or higher and almost half (49%) were ranked 4 (significant) or higher. None of the recommendations were ranked 6 (extremely significant) and five were ranked 1 (adverse significance). An example of a recommendation ranked 1 follows: After a patient had been at the hospital for several days, the pharmacist recommended that treatment with ketobemidone injections be stopped because of duplication, since the patient was also receiving oxycodone tablets. However, at the time of admission, the medical records showed that the patient had problems with swallowing and the injections may have been required for this reason (it is not known if these problems were still present at the time of the recommendation).

The drug-related problem *wrong drug* was the type most frequently ranked 2 (no significance). These drug-related problems were the result of inaccurate ordering when using the generic and therapeutic substitution list after admission. The recommendations not accepted by the physician were ranked 3 (somewhat significant; n=3), 2 (no significance; n=1) and 1 (adverse significance; n=1).

Discussion

The high proportion of clinically significant recommendations in this study confirms the positive contribution to the care of inpatients by clinical pharmacists using the LIMM model to conduct medication reviews, monitor drug use and reconcile admission medications, and establishes the quality of the LIMM-based system. The very high level of physicians' acceptance of the pharmacists' recommendations further demonstrates the effectiveness of the process.

This study supports earlier studies that also demonstrated the value of clinical pharmacists' recommendations for inpatients [2-3, 5-6] and outpatients [4].The acceptance rate of the clinical pharmacists' recommendations was higher in our study (90 %) than in other studies (81 % [3], 84 % [4], 82 % [6]). This could have been because we only studied the clinical significance of recommendations emerging from actual drug-related problems and medication errors. Alternatively, the discrepancy might have been related to the method of communicating problems and recommendations between clinical pharmacists and physicians. In our model, this was done face to face. This method appears to be the most effective if a medication review is to be successfully implemented [9]. However, it is not possible to draw any definitive conclusions about the higher acceptance rate in our study, since the type (actual or potential) and the method of communicating were not described in detail in the other studies.

In our study, most of the recommendations (83 %) were ranked 3 (somewhat significant) or higher and 49 % were ranked 4 (significant) or higher. This is comparable to the results of Overhage and Lukes [5] (pharmacist-physician ranked), and Bosma *et al.* [6] (pharmacist ranked), but is higher than those of Bosma *et al.* [6] (physician ranked) and lower than those of Hatoum *et al.* [3] (pharmacist ranked) and Scullin *et al.* [2] (pharmacist ranked). It is possible that the profession of the person ranking the recommendations could explain some of these differences, since physicians have been shown to rank the clinical significance of pharmacists' recommendations lower than hospital pharmacists [4-6]. Five recommendations in our study were ranked 1 (adverse significance). Despite this low incidence, we are very interested in eliminating this potential source of adverse patient outcomes. The retrospective compilation of the recommendations might have increased the risk of misinterpretation by the investigator, as the documentation was sometimes inconclusive. However, none of the cases resulted in documented patient harm.

Conclusion

In conclusion, this study further establishes the quality of the LIMM-based model and confirms that clinical pharmacists in a multi-professional team can contribute to improved drug therapy for inpatients.

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Conflict of interest

The authors declare no potential conflicts of interest.

References

1. Hellstrom LM, Bondesson A, Hoglund P, Midlov P, Holmdahl L, Rickhag E, 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. doi: 10.1007/s00228-010-0982-3
2. Scullin C, Scott MG, Hogg A, McElnay JC. An innovative approach to integrated medicines management. J Eval Clin Pract 2007;13(5):781-8. doi: 10.1111/j.1365-2753.2006.00753.x
3. Hatoum HT, Hutchinson RA, Witte KW, Newby GP. Evaluation of the contribution of clinical pharmacists: inpatient care and cost reduction. Drug Intell Clin Pharm. 1988;22:252-9.
4. Lee J, McPherson ML. Outcomes of recommendations by hospice pharmacists. Am J Health Syst Pharm. 2006;63:2235-9. doi: 10.2146/ajhp060143
5. Overhage JM, Lukes A. Practical, reliable, comprehensive method for characterizing pharmacists' clinical activities. Am J Health Syst Pharm. 1999;56:2444-50.
6. Bosma L, Jansman FG, Franken AM, Harting JW, Van den Bemt PM. Evaluation of pharmacist clinical interventions in a Dutch hospital setting. Pharm World Sci. 2008;30:31-8. doi: 10.1007/s11096-007-9136-9.
7. Sorensen L, Grobler MP,Roberts MS. Development of a quality use of medicines coding system to rate clinical pharmacists' medication review recommendations. Pharm World Sci. 2003;25:212-7.
8. Cipolle RJ, Strand LM, Morley PC. Pharmaceutical care practice. New York: The McGraw-Hill Companies Inc; 1998.
9. Chen TF, Neto A. Exploring elements of interprofessional collaboration between pharmacists and physicians in medication review. Pharm World Sci. 2007;29:574-6. doi: 10.1007/s11096-007-9130-2

Table 1 Characteristics of LIMM patients and those in the random sample

Characteristics	LIMM patients (n=800)	Random sample patients (n=132)
Mean age (years) (SD)	80.6 (10.5)	81 (8.1)
Number of patients ≥ 65 years (n) (%)	740 (93)	126 (95)
Sex (male) (%)	380 (48)	64 (48)
Housing before admission (n) (%)		
Home without home care	452 (57)	80 (61)
Home with home care	190 (24)	32 (24)
Nursing home	157 (20)	20 (15)
Mean number of drugs (SD)		
At admission (continuous + as required)	9.1 (5.0)	9.3 (5.3)
At discharge (continuous + as required)	9.9 (4.9)	10.3 (5.2)
Initiated during hospital stay	2.8 (2.3)	2.7 (2.1)
Stopped during hospital stay	2.0 (2.6)	1.8 (2.2)
Mean number of days (SD)		
In the hospital	13.1 (12.4)	12.7 (13.5)
In the wards	10.6 (10.3)	10.3 (11.1)
Clinical pharmacy intervention (n of patients)		
Admission medication reconciliation only	81	21
Medication review only	130	21
Both clinical pharmacy services	589	90

Table 2 Type of medication error or actual drug-related problem (DRP) in relation to the clinical significance of the pharmacist's recommendations and the actions taken by the physician.

	Admission medication reconciliation												**Medication review and monitoring**											
Error/ DRP	**Total**	**Ranking***						**Actions#**					**Total**	**Ranking***						**Actions#**				
		1	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**		**1**	**2**	**3**	**4**	**5**	**6**	**1**	**2**	**3**	**4**	**5**
Omitted drug/ Need for additional therapy	46	1	4	24	11	6		46					24	1	2	5	14	2		21	2		1	
Additional drug/ Unnecessary drug therapy	4		1	2	1			4					29	1	2	9	16	1		27	2			
Wrong dosage form/ Wrong drug	6			4	1	1		6					41	1	19	7	13	1		31	6	1	3	
Dosage too	2			2				2					11	1		2	7	1		11				

low																								
Adverse drug reaction	-												14			1	9	4		12	2			
Dosage too high	11			8	3			11					8			2	6			8				
Non-compliance	1			1								1	-											
Total	**70**	**1**	**5**	**41**	**16**	**7**	**-**	**69**	**0**	**0**	**0**	**1**	**127**	**4**	**23**	**26**	**65**	**9**	**-**	**110**	**12**	**1**	**4**	

* Classification of clinical significance according to Hatoum *et al.* [4]: 1) Adverse significance, 2) No significance, 3) Somewhat significant, 4) Significant, 5) Very significant, 6) Extremely significant.

Classification of actions taken: 1) recommendation accepted and implemented, 2) recommendation accepted but not implemented, 3) recommendation already implemented by the physician, 4) recommendation not accepted, 5) Information missing.