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ORIGINAL ARTICLE

Effects of a pharmacist-led structured medication review in primary care on drug-related problems and hospital admission rates: a randomized controlled trial

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Abstract

Objective. To determine whether a pharmacist-led medications review in primary care reduces the number of drugs and the number of drug-related problems. *Design.* Prospective randomized controlled trial. *Setting.* Liljeholmen Primary Care Centre, Stockholm, Sweden. *Subjects*. 209 patients aged ≥ 65 years with five or more different medications. *Intervention*. Patients answered a questionnaire regarding medications. The pharmacist reviewed all medications (prescription, non-prescription, and herbal) regarding recommendations and renal impairment, giving advice to patients and GPs. Each patient met the pharmacist before seeing their GP. Control patients received their usual care. *Main outcome measures.* Drug-related problems and number of drugs. Secondary outcomes included health care utilization and self-rated health during 12 months of follow-up. *Results.* No significant difference was seen when comparing change in drug-related problems between the groups. However, a significant decrease in drug-related problems was observed in the intervention group (from 1.73 per patient at baseline to 1.31 at follow-up, $p < 0.05$). The change in number of drugs was more pronounced in the intervention group ($p < 0.046$). Intervention group patients were not admitted to hospital on fewer occasions or for fewer days, and there was no significant difference between the two groups regarding utilization of primary care during follow-up. Self-rated health remained unchanged in the intervention group, whereas a drop ($p < 0.02$) was reported in the control group. This resulted in a significant difference in change in self-rated health between the groups ($p < 0.047$). *Conclusions.* The addition of a skilled pharmacist to the primary care team may contribute to reductions in numbers of drugs and maintenance of self-rated health in elderly patients with polypharmacy.

Key Words: *Drug-related problems, elderly, general practice, medication review, pharmacist, primary care, Sweden*

Introduction

Elderly patients with multiple diseases and polypharmacy risk suffering from drug-related problems (DRPs) [1–4], and a significant proportion of hospital admissions in the elderly are due to adverse drug events (ADEs) [1]. A DRP is defined as any undesirable event experienced by a patient involving or suspected of involving drug therapy and actually or potentially interfering with a desired patient outcome [5]. The definition used in Sweden is "anything that leads to health care utilization, morbidity or mortality" [6], and indicators of prescribing quality for drug treatment in the elderly have been developed by the Swedish National Board of Health and Welfare [7].

Pharmacists included in health care teams in hospitals have helped lower the cost of drugs and reduce hospitalization [8–10]. Medication reviews for elderly patients with polypharmacy in assisted living facilities have produced favourable effects such as fewer falls [11].

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- The elderly are often prone to drug-related morbidity due to multimorbidity, polypharmacy, and deteriorating organ function. Drug-related problems may cause hospital admissions.
- The addition of a skilled pharmacist to the primary care team may contribute to reductions in numbers of drugs and to maintaining self-rated health in elderly patients with polypharmacy.

In primary health care many different study methods have been used in investigations of effects on health care utilization or quality of life (QoL), but so far none has proven superior [12–19]. However, methods where the pharmacist is part of a team seem to give better results [17]. According to Beney et al. more research is needed since many different methods are used, making it difficult to compare results and to identify the parts of the interventions that are successful [20].

Aims

The primary aim of this study was to assess whether a structured, randomized, and controlled intervention by a pharmacist at a primary health care centre would decrease the number of drugs and the number of DRPs. Secondary aims were to evaluate the impact on self-rated health and health care utilization.

Material and methods

Setting

The study was performed during a 15-month period at a primary care centre in Stockholm serving 24 000 inhabitants.

Subjects

Subjects to be included were persons aged ≥ 65 years with five or more medications who were already scheduled for an appointment with a GP. Patients who were not fluent in Swedish, could not answer for themselves, or had participated in an earlier pilot study were excluded. For all patients fulfilling the inclusion criteria, gender, age, and, when applicable, reason for exclusion, were recorded.

Study design

The study was a randomized controlled trial. We compared patients with a scheduled GP consultation who received normal care with patients who received preparatory structured pharmaceutical advice.

All patients fulfilling the inclusion criteria were contacted by telephone (see Figure 1). Those who agreed to participate were sent a questionnaire addressing all their medications (prescription, non-prescription, and herbal drugs) and DRPs and were then randomized. The intervention group met a pharmacist prior to the GP visit and the control group received normal care. After 12 months, all patients were contacted by telephone and were sent a new questionnaire. Control patients were offered a medication review after the conclusion of the trial.

The effect of the intervention was measured 12 months after the intervention in terms of DRPs, utilization of medical services, and self-rated health.

Pharmacist intervention

The medication review was performed by a certified geriatrics pharmacist (CL). The method had been tested in a pilot study (79 patients). It involved a standardized semi-structured protocol that was open for patients' questions and remarks. Computerized patient records were checked for prescriptions, drug indications, and plans for evaluation. Drugs and dosages were evaluated to correlate with renal function, good practice [7], and the drug formulary [21]. A patient-centred technique was used, focusing on the patients' questionnaire answers to assess understanding of and concordance with drug treatment. The patients were also asked about prescribers other than their GP, and use of non-prescription and herbal drugs. Concluding pharmaceutical advice was given to patients and entered into the computerized patient record.

Drug-related problems

DRPs were classified based on Beers' criteria [22] and the structure proposed by Strand et al. [23] using a computer system. Information about DRPs was gathered from the questionnaires at baseline and after 12 months. Data were analysed by an independent certified geriatrics pharmacist (BE), blinded to patient group allocation.

Utilization of medical care

The utilization of medical care was measured as the number of contacts in outpatient care and hospital care during the 12 months following the intervention. Data were extracted from the records of Stockholm County Council using social security numbers, which gave 100% data coverage.

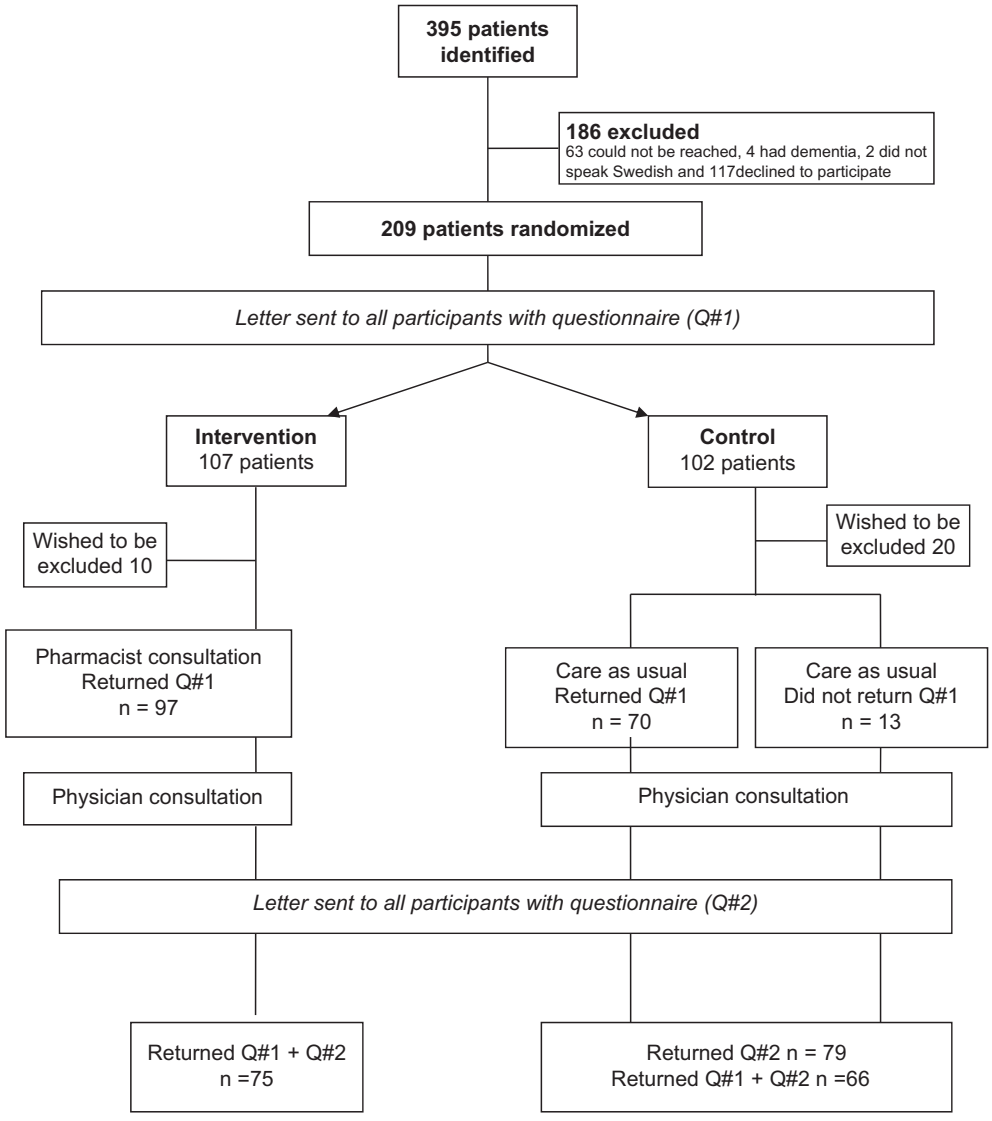

Figure 1. Overview of study design, patient inclusion, and completion of questionnaires.

Self-rated health

Patients assessed their health by answering a single question on general self-rated health with the response options "very good", "good", "fair", "bad", and "very bad" [24].

Statistical analysis

A power analysis was based on the pilot study. To detect a 25% change in DRPs with a power of 80% and an estimated dropout frequency of 10%, the sample size was calculated as 200.

Data are given as means with 95% confidence intervals (CIs), unless otherwise stated. Differences within groups (before vs. after intervention) were analysed by Wilcoxon matched-pairs test. The Mann–Whitney U test was used to test differences between groups. The chi-squared test was used to test for differences in the frequencies of diagnosis between groups. Differences in numbers of primary care visits, hospital admissions, and days hospitalized were analysed by Mann–Whitney U test as they did not fit the Poisson distribution.

Results

Subjects

Between September 2004 and November 2005, 395 persons fulfilling the inclusion criteria were identified, of whom 186 were excluded (Figure 1). The remaining 209 persons were randomly assigned to the control or intervention group (Figure 1). Patient characteristics at baseline are given in Table I. The two groups were similar concerning age, sex, and

Table I. Patient characteristics at baseline for included patients (n = 209) and analysed patients (n = 141).

	Intervention group		Control group	
	All included patients (n = 107)	All analysed patients (n = 75)	All included patients (n = 102)	All analysed patients (n = 66)
Age (years)	79.0 (77.8, 80.2)	79.0 (77.6, 80.4)	79.7 (78.4, 81.1)	78.6 (76.8, 80.3)
Sex (% female)	65.4	67.5	68.6	68.9
Number of drugs per patient	8.5 (7.9, 9.1)	8.6 (7.8, 9.3)	7.4 (6.9, 8.0)*	7.4 (6.6, 8.2)*
Diagnoses per patient	5.1 (4.7, 5.4)	5.1 (4.7, 5.5)	4.5 (4.2, 4.9)*	4.7 (4.2, 5.2)

Notes: Data are given as means with 95% confidence intervals. *Significant vs. intervention.

number of diagnoses. There was no significant difference in the prevalence of chronic diagnoses between the groups, apart from for psychiatric disease (Table II). However, patients in the intervention group used a greater number of drugs (8.6 vs. 7.4 drugs per patient, $p < 0.05$). After 12 months there was a mean reduction in the number of drugs per patient in the intervention group (from 8.6 to 7.9, $p < 0.05$), but not in the control group, where a mean increase from 7.4 to. 7.5 (not significant) was detected. The change in the number of drugs differed significantly ($p < 0.046$) between the groups.

Drug-related problems

DRPs were analysed in all patients returning both questionnaires (75 patients in the intervention group and 66 patients in the control group) (see Figure 1).

Table II. Prevalence of chronic diagnoses in 102 control group patients and 107 intervention group patients at baseline.

	Control group (n = 102) %	Intervention group (n = 107) %
Hypertension	61	67
Hyperlipidaemia	39	48
Diabetes	28	26
Ischaemic heart disease	40	40
Cardiac decompensation	15	26
Atrial fibrillation	16	20
Peripheral artery disease	13	8
Cerebrovascular disease	11	16
Thyroid disease	13	14
Polymyalgia rheumatica	10	8
Malignant disease	18	21
Pulmonary disease	21	18
Pernicious anaemia	22	23
Gastrointestinal disease	18	19
Osteoporosis	15	14
Psychiatric disease	23	12
Diseases of the urinary tract	14	12
Chronic pain	24	29

Note: There was no significant difference in the distribution of diagnoses between groups ($p = 0.113$), apart from for psychiatric disease.

Significant changes were seen in the before-and-after comparison in the intervention group, but not in the control group (Table III). A between-group analysis of the change in number of DRPs revealed no significant differences ($p = 0.72$). The mean decrease in number of DRPs was 0.43 (95% CI 0.10, 0.75) in the intervention group and 0.27 (–0.02, 0.57) in the control group. The decrease in the intervention group was mainly due to a significant improvement in compliance ($p = 0.048$) (Table III).

Utilization of medical care

There was no significant difference between the two groups regarding utilization of primary care during the 12-month follow-up period (Figure 2). Patients in the intervention group were admitted to hospital on fewer occasions compared with the control group (mean 1.7 vs. 2.7, median 1 vs. 2). The length of hospitalisation during the follow-up period was also lower in the intervention group compared with the control group (mean 12 vs. 18 days, median 6 vs. 12.5 days). However, none of the observed differences were statistically significant (Figure 2).

Self-rated health

On a 1–5 scale, there were no significant differences between the groups at baseline (intervention group 2.7 and control group 2.8) regarding self-rated health. Self-rated health remained unchanged in the intervention group, whereas it decreased significantly ($p < 0.02$) in the control group, resulting in a significant difference in change in self-rated health between the groups ($p = 0.047$). The mean change was 0.02 in the intervention group (95% CI –0.15, 0.19) and 0.27 (0.06, 0.48) in the control group.

Estimated cost of the intervention

The pharmacist had booked 30 minutes for each consultation, but including time for preparation and follow-up, each patient required approximately two

Table III. Drug-related problems at baseline and 12 months after a pharmacist medication review in primary care patients, for those returning both questionnaires (n = 141).

	At baseline per patient	95% CI	12 months after inclusion per patient	95% CI	Between-group comparison level of significance	Within-group comparison level of significance
Control group (n = 66)						
DRPs[1] total	1.37	(1.07, 1.69)	1.11	(0.84, 1.37)	n.s.	n.s.
ADEs[2]	0.53	(0.33, 0.73)	0.50	(0.34, 0.66)		n.s.
Wrong drug	0.33	(0.16, 0.50)	0.33	(0.19, 0.47)		n.s.
Compliance problems	0.21	(0.07, 0.31)	0.11	(0.02, 0.19)		n.s.
Dosage too low	0.09	(0.02, 0.16)	0.11	(0.03, 0.18)		n.s.
Dosage too high	0.12	(0.03, 0.21)	0.03	(−0.01, 0.07)		n.s.
Need for additional therapy	0.05	(–0.01, 0.10)	0.00		–	–
Unnecessary drug therapy	0.05	(–0.01, 0.10)	0.03	(−0.01, 0.07)		n.s.
Intervention (n = 75)						
DRPs[1] total	1.73	(1.42, 2.05)	1.31	(1.02, 1.59)	n.s	p = 0.02
ADEs[2]	0.64	(0.46, 0.82)	0.52	(0.36, 0.68)		n.s.
Wrong drug	0.32	(0.19, 0.45)	0.31	(0.18, 0.44)		n.s.
Compliance problems	0.37	(0.22, 0.52)	0.21	(0.09, 0.33)		p = 0.048
Dosage too low	0.17	(0.08, 0.27)	0.12	(0.04, 0.20)		n.s.
Dosage too high	0.17	(0.08, 0.27)	0.12	(0.04, 0.20)		n.s.
Need for additional therapy	0.04	(–0.01, 0.09)	0.03	(–0.01, 0.07)		n.s.
Unnecessary drug therapy	0.01	(–0.01, 0.04)	0.00		–	–

Notes: [1]DRP = drug-related problem; [2]ADE = adverse drug effect.

hours. The cost of implementing this intervention in everyday practice was estimated at €79 ($106) per patient, based on the estimated total cost of one clinically trained, experienced pharmacist.

Discussion

This trial showed that a structured medication review with a specially trained pharmacist within a primary care framework may have reduced the number of drugs and prevented a decrease in self-rated health. No significant between-group difference in change in number of DRPs was detected; a within-group reduction was seen in the intervention group, but not in the control group. No effect on hospital admissions was found. Reducing the number of drugs by medication reviews is in line with findings in other studies [25,26].

We found a mean of 1.73 DRPs per patient in the intervention group at baseline (control group 1.37 DRPs per patient), which is less than in other studies [10,19,25,27,28]. This could be explained by patients having more severe illnesses and registration of potential drug problems, rather than only actual problems, in these other studies. The most common DRPs in our study were ADEs and compliance problems. In other studies, common problems were unnecessary drug therapy and need for additional therapy or increased dosages [10,19,26,28]. The difference could be explained by different populations in the studies, i.e. patients in hospitals compared with patients in primary care.

The changes in self-rated health were significantly different between the groups in favour of the intervention group. A few studies have measured the influence of interventions on QoL [18–20,26,29].

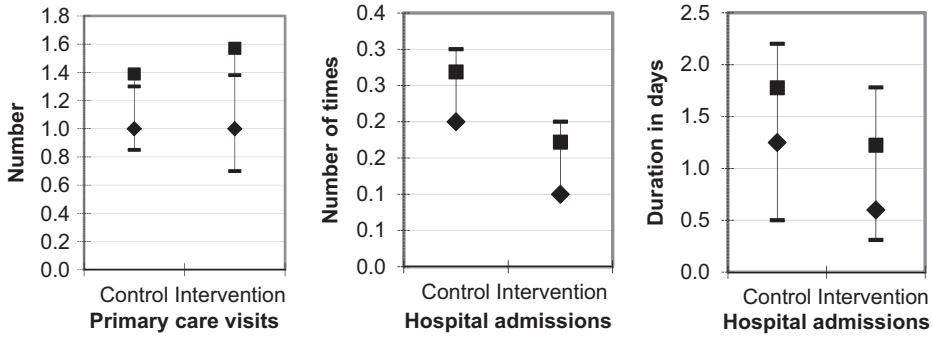

Figure 2. Primary care visits and hospital admissions (number and duration in days) recorded in the control and intervention groups during one year. Data are shown as the median (◆) with 95% CI (▬) and mean (■) values. None of the investigated parameters showed a statistically significant difference. n = 141 patients (75 in the intervention group and 66 in the control group).

These studies used a more extensive instrument and did not show a significant improvement as a result of the intervention.

Our findings are in line with other findings that medication reviews do not decrease health care utilization [18,19,26]. Results of medication reviews are complicated to analyse. It is not known which part or combination of elements in the review plays the key role. Our intervention was based on one pharmacist performing the medication reviews and did not include education of doctors or specified time for team discussions, as did the studies of, for example, Krska et al. [29] and Sorensen et al. [19]. Our intervention took place at a primary care centre, which gave the pharmacist access to full patient records, but limited the study to patients who actually visited the primary care centre. Another limitation is that withdrawal was uneven between the two groups, and that we do not have data concerning medications and DRPs for the patients who withdrew. Therefore we do not know if these patients differ from those who completed the study. With frail, older patients it is also difficult to choose the right follow-up time. We chose 12 months to avoid seasonal differences. However, 12 months is a long time and many things could have happened that would have influenced the results.

Cost-effectiveness is also difficult to assess. The mean total time spent by the pharmacist on each patient in our study was two hours, compared with 20–140 minutes in other studies [10,29]. Studies including home visits [18,19] estimate that two hours is required for each home visit, not including preparation, discussion with the patient's GP, and follow-up. According to Pacini et al. [30], the probability of such interventions being cost-effective is low. The cost of medication reviews mainly depends on the time allotted and it is thus difficult to compare costs between studies. We were unable to show any savings in the form of fewer hospital admissions or less use of primary health care, since this study was powered to detect a reduction of 25% in DRPs and not reductions in health care utilization.

The study was conducted at a primary care centre in an area with many elderly inhabitants. The perspective was on the individual patient's everyday drug use under normal circumstances, focusing on patients' understanding and possible problems (such as ADEs and interactions), rather than on problems arising in hospitals. The pharmacist was well integrated in the work at the health care centre, and thus had the chance for day-to-day interaction with doctors and other health care personnel. The key to achieving results lay in the pharmacist working with others within a clinical setting, rather than on their own. This is supported by many other studies [8,9,14,16].

All parameters for the intervention group appeared to change in the right direction, i.e. number of drugs, DRPs, self-rated health, and health care utilization. This indicates that this might be a suitable model for primary care. The self-rated health data suggest that medication reviews have positive effects, perhaps improving patients' understanding of their drug regimen and thereby increasing compliance.

A larger study involving more patients could hopefully show an effect on this and on health care utilization. There is also a need for studies comparing different interventions for optimizing pharmacotherapy in primary health care.

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Ethics

The study was approved by the Regional Ethical Review Board in Stockholm (application number 04-143/3).

Declaration of interest

There are no conflicts of interest in connection with the paper. The authors alone are responsible for the content and writing of the paper.

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