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Effect of an In-Hospital Multifaceted Clinical Pharmacist Intervention on the Risk of Readmission
A Randomized Clinical Trial

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IMPORTANCE Hospital readmissions are common among patients receiving multiple medications, with considerable costs to the patients and society.

OBJECTIVE To determine whether a multifaceted pharmacist intervention based on medication review, patient interview, and follow-up can reduce the number of readmissions and emergency department (ED) visits.

DESIGN, SETTING, AND PARTICIPANTS This randomized clinical multicenter study (Odense Pharmacist Trial Investigating Medication Interventions at Sector Transfer [OPTIMIST]) enrolled patients from September 1, 2013, through April 23, 2015, with a follow-up of 6 months completed on October 31, 2015. Consecutive medical patients in an acute admission ward who were 18 years or older and who used 5 or more medications were invited to participate. Of 1873 patients invited to participate, 1499 (80.0%) accepted. The medication review and patient interview were conducted in the hospital and followed up in collaboration with primary care. Analysis was based on intention to treat.

INTERVENTIONS The patients were randomized into 3 groups receiving usual care (no intervention), a basic intervention (medication review), and an extended intervention (medication review, 3 motivational interviews, and follow-up with the primary care physician, pharmacy, and nursing home).

MAIN OUTCOMES AND MEASURES The prespecified primary outcomes were readmission within 30 or 180 days and ED visits within 180 days. The primary composite end point was readmission or an ED visit within 180 days. Secondary outcomes were drug-related readmissions within 30 and 180 days after inclusion, and all-cause mortality and drug-related mortality.

RESULTS A total of 1467 patients (679 men [46.3%] and 788 women [53.7%]; median age, 72 years; interquartile range, 63-80 years) were part of the primary analysis, including 498 randomized to usual care, 493 randomized to the basic intervention, and 476 randomized to the extended intervention. The extended intervention had a significant effect on the numbers of patients who were readmitted within 30 days (hazard ratio [HR], 0.62; 95% CI, 0.46-0.84) or within 180 days (HR, 0.75; 95% CI, 0.62-0.90) after inclusion and on the number of patients who experienced the primary composite end point (HR, 0.77; 95% CI, 0.64-0.93). The study showed a nonsignificant reduction in drug-related readmissions within 30 days (HR, 0.65; 95% CI, 0.39-1.09) and within 180 days (HR, 0.80; 95% CI, 0.59-1.08) after inclusion and in deaths (HR, 0.83; 95% CI, 0.22-3.11). The number needed to treat to achieve the primary composite outcome for the extended intervention (vs usual care) was 12.

CONCLUSIONS AND RELEVANCE A multifaceted clinical pharmacist intervention may reduce the number of ED visits and hospital readmissions.

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Approximately 5% of all hospital admissions are thought to be attributable to adverse drug reactions.[1,2] Patients taking multiple drugs are at increased risk of drug-related problems, and medication errors, such as subtherapeutic treatment, overdosing, and adverse events, are all potential causes of hospital admission.[3-5] On average, 45% of all adverse drug reactions that lead to hospitalizations are preventable.[6] The transition from a hospital to a primary care setting is of particular concern because it is vulnerable to errors related to the communication of patients' medical treatment.[7-12] Pharmacist-led medication reviews have been proposed as a solution to some of these problems.[13]

Ample evidence suggests that pharmacist medication reconciliation or a discharge medication report can reduce the number of medication errors after discharge.[14-19] The evidence regarding the clinical consequences of the reduced number of medication errors, however, is equivocal. Most of these studies had fairly simple single-component interventions and were thereby not likely to be successful in terms of preventing hard clinical outcomes.[20] Accordingly, a recent meta-analysis[21] found no clear evidence of fewer hospital admissions or deaths after medication review, but a reduced number of emergency contacts seemed plausible. Only 10 studies were included in the meta-analysis, and most of those were small or had short follow-up. The investigators concluded that high-quality trials with long-term follow-up are warranted to provide definitive evidence for the effect of medication reviews.[21] The aim of our large randomized clinical trial was to determine whether an in-hospital multifaceted pharmacist intervention based on medication review, motivational interview, and follow-up with the patient and the ongoing primary care physician (PCP) can reduce the rate of readmissions.

Key Points

Question Can a multifaceted pharmacist intervention prevent hospital readmissions and emergency department visits?

Findings In a randomized clinical trial of 1467 Danish participants receiving at least 5 medications, a statistically significant reduced rate of readmissions within 30 and 180 days after inclusion was observed in patients randomized to receive an extended pharmacist intervention compared with those who received usual care or a basic pharmacist intervention.

Meaning The proposed multifaceted pharmacist intervention can reduce the number of hospital readmissions and emergency department visits.

Methods

Trial Design and Patients

The randomized clinical multicenter Odense Pharmacist Trial Investigating Medication Interventions at Sector Transfer (OPTIMIST) was conducted among patients at the following 4 different acute admission wards in Denmark: Regional Hospital Viborg, Viborg; Holbæk Hospital, Holbæk; and Odense University Hospital, Odense and Svendborg. A copy of the full study protocol is available in the Supplement. The protocol was approved by the Danish Data Protection Agency. The National Committee on Health Research Ethics found that the study did not require ethical approval according to Danish law. Each patient provided written informed consent.

Patients were eligible if they were 18 years or older, had polypharmacy,[22] defined as use of 5 or more prescribed drugs on a daily basis, spoke and understood Danish, and were new acute admissions. Patients were excluded if they had been included in a similar study, were declared terminally ill, were suicidal, were in custody, were under isolation precautions, or had aphasia or severe dementia. Patients were enrolled from September 1, 2013, through April 23, 2015, and followed up for 6 months (final follow-up was completed on October 31, 2015).

Pharmacist Intervention

Patients were randomized 1:1:1 to a usual care, a basic intervention, or an extended intervention group. Those randomized to usual care received no intervention beyond standard care.

In the basic intervention group, a structured, patient-centered medication review[23] was conducted by a clinical pharmacist once shortly after the patient was admitted, when laboratory data were available and the primary medical admission note was written. The following 3 questions were considered during medication review: Were any diagnoses untreated? Was the goal of treatment reached? Was the treatment in agreement with current national guidelines regarding dose, choice of drug, and time of treatment? We focused on the drugs most commonly implicated in admissions, such as low-dose aspirin, diuretics, anticoagulants, and nonsteroidal anti-inflammatory drugs other than aspirin.[24] Furthermore, all drugs on the medication list were assessed by the indication for treatment, drug dose (considering renal failure, age, etc), adverse drug events, therapeutic duplication, dosage time and interval, drug formulation and strength, interactions, contraindications, precautions, and specific patient characteristics. If drugs were deemed unnecessary, the treatment was proposed to be discontinued. Our participating pharmacists were not authorized to implement changes in the patients' medication after having performed the medication review but documented proposed changes in the electronic patient record and, if possible, communicated with the physician in charge of the patient, who would then follow or reject the advice.

In the extended intervention group, a similar medication review was conducted. In the basic and the extended intervention groups, the time spent on the medication review was a mean (SD) of 26.0 (14.7) minutes. In addition, on discharge of the patient, a medication reconciliation[25,26] was conducted. The pharmacist used a 30-minute structured patient interview with a motivational interview approach,[27-29] including a comprehensive summary of changes in the drug therapy during the hospitalization. The interview included information of changed dose, new medicines, drug discontinuation, drug administration, adverse drug events, adherence, and cost. Motivational interviewing is a coaching method aimed at ensuring adequate patient behavior to prevent health-related events such as adverse drug reactions and other drug-related problems.[27,28]

For patients receiving the extended intervention, any drug-related problem not dealt with during hospitalization was mailed or faxed after discharge to the individual patient's PCP. In addition to this process, a summary note containing information of changes in dose, new medicines, and drug therapy discontinuations was sent to the PCP and, if relevant, the nursing home. The PCP, caregiver, and primary care pharmacy were contacted by telephone (approximately 3 workdays after discharge). Follow-up calls with the PCP and nursing home or caregiver were conducted when any change in medication was made during the index hospitalization. The primary pharmacy was called when the clinical pharmacist from the hospital found it necessary, for example, to delete old prescriptions or address problems concerning dose-dispensed medication.

The interview in the follow-up telephone call was also based on principles of motivational interview and was routinely performed twice. The first interview was conducted 1 week after discharge, whereas a second interview was performed 6 months after discharge. If required, additional follow-ups could be arranged. The mean (SD) total pharmacist time spent on all elements in the extended intervention was 114.0 (51.8) minutes.

All interventions were performed by trained clinical pharmacists. During the study, 13 different pharmacists, including 6 of us (L.V.R.-N., M.-L.D., M.L.L., M.L.N., J.P.H., and C.S.E.), were involved in the data collection but not at the same time because of job change, maternity leave, etc. At most times, 2 study pharmacists participated at the same time per hospital. Furthermore, all pharmacists were trained in medication review workshops and had completed a 3-day course in motivational interviewing and subsequent practice sessions before entering the study.

Outcomes

The primary outcomes were the occurrence of readmission within 30 and 180 days and the occurrence of a prespecified composite end point of readmissions and emergency department (ED) visits within 180 days. The secondary outcomes were drug-related readmissions within 30 and 180 days after inclusion and all-cause and drug-related mortality.

The Danish health care system is almost fully tax funded, has universal coverage of citizens, and is based on the principles of free and equal access to health care for all citizens.[30] This process entails an almost universal registry coverage of health care contacts. Information about readmissions, ED visits, and deaths were drawn from the National Patient Register.[31] To evaluate whether a readmission or death should be classified as drug related, an adverse drug reaction or a dose-related therapeutic failure[32] had to be present. For this determination, all readmissions and deaths were manually reviewed by clinical pharmacists who were blinded to study allocation. The pharmacists reviewed all notes from the first 2 days of each readmission plus the discharge summary. If the case was unresolved based on these notes, additional notes were read. Laboratory data could be included in the assessment if necessary. Using a modified version of the Hallas criteria[32] and the World Health Organization criteria,[33] the pharmacist evaluated whether (1) the readmission was potentially drug induced and (2) a possible causal relationship existed All cases classified as a possible or stronger causal relationship were evaluated by a clinical pharmacologist (blinded to study allocation). The clinical pharmacologist would then evaluate the cases using the same method and decide whether the outcome was drug related.

For drug-related mortality, only in-hospital deaths were assessed with respect to causality (ie, drug related or not). Deaths outside the hospital were included as outcomes but did not undergo causality assessment because information from the primary care sector regarding the circumstances of death was usually too sparse. Again, the clinical pharmacist performed the initial assessment based on the criteria of Naranjo et al.[34] Cases found to be probably drug related and probably preventable were forwarded to the clinical pharmacologist for further evaluation (based on the same criteria).

Sample Size

Assuming that the 180-day risk of drug-related readmission is 20%[9,10,12] and with a bilateral significance level at 5% and 80% power, the necessary number of patients in each group was estimated to be 354 to detect an absolute risk reduction of readmissions of 8%. When the risk of dropouts was taken into account, we decided to include 500 patients in each group.

Randomization and Blinding

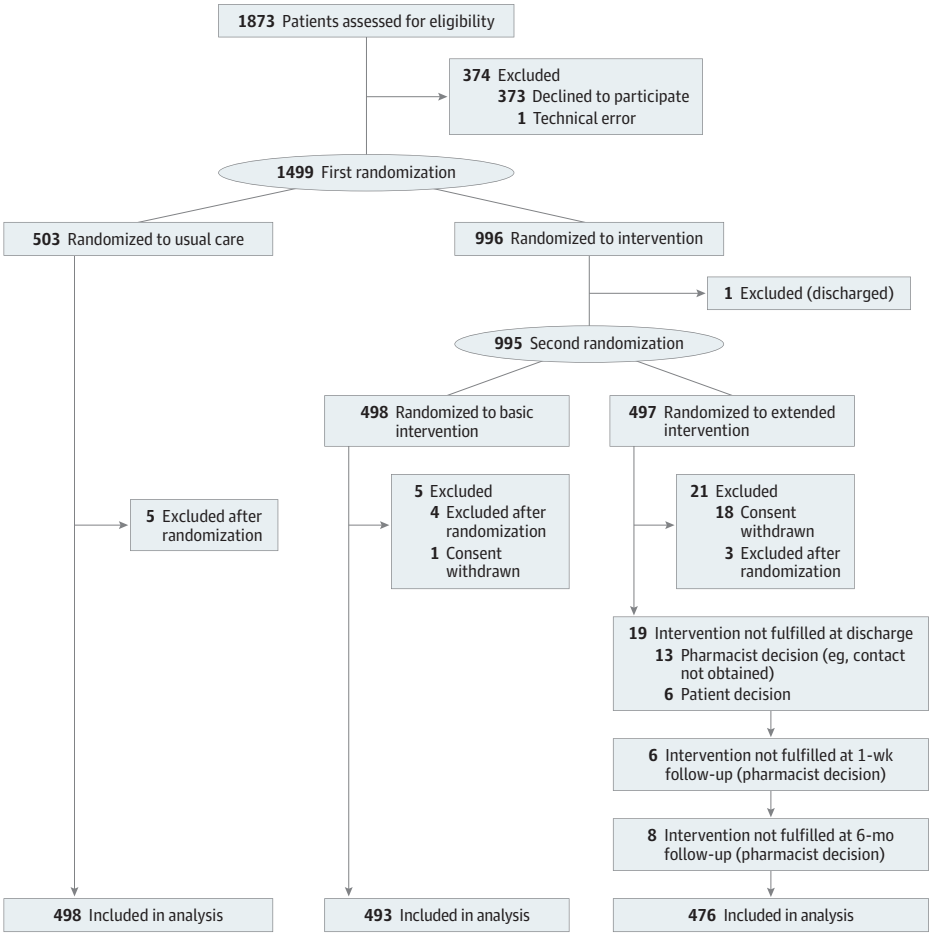
The patients were randomly assigned to the usual care, the basic intervention, or the extended intervention group in a 1:1:1 ratio using block randomization (blocks of 6 and 4) with the sequentially numbered, opaque sealed envelope technique. The patients were enrolled consecutively. The randomization was performed at 2 set points. The first randomization was to the usual care group or an intervention group (1:2), with the patient and the pharmacist blinded to which intervention group until the medication review was conducted. After the medication review, the patients in the intervention groups underwent another randomization to the basic intervention or the extended intervention group. The health care professionals from participating departments and from primary care were not informed about the extent of the intervention.

Statistical Analysis

Data were analyzed according to intention to treat. Patients who withdrew their informed consent were followed up until their withdrawal, unless they specifically allowed longer follow-up.

Data were analyzed using unadjusted Cox proportional hazards regression for the basic and extended interventions compared with usual care. As censoring events, we included death, withdrawal of consent to follow-up, and planned stop of follow-up after 6 months. Hazard ratios (HRs) were reported with 95% CIs. We used the χ^2 test for dichotomous variables and multinomial logic regression for discrete variables. All P values were considered statistically significant at $P < .05$. Analyses were performed using Stata software (version 15.1; StataCorp).

Figure 1. CONSORT Flow Diagram



Patients invited to participate in the Odense Pharmacist Trial Investigating Medication Interventions at Sector Transfer (OPTIMIST) underwent randomization to usual care vs intervention; those randomized to intervention underwent a second randomization to the basic intervention vs the extended intervention.

Results

We invited 1873 patients into the study, and 1499 (80.0%) accepted (**Figure 1**). A total of 503 patients were randomized to usual care; 498, to the basic intervention; and 497, to the extended intervention, with 1 patient excluded owing to incorrect assessment of exclusion criteria. After randomization, 12 were excluded because of an administrative mistake that caused double inclusion, and 19 withdrew their informed consent, prohibiting their inclusion in the primary analysis. Consequently, 1467 patients entered the primary analysis.

Baseline characteristics of the included patients are presented in **Table 1**. The median age of the patients was 72 years (interquartile range, 63-80 years); 679 (46.3%) were men and 788 (53.7%) were women. All patients from the extended intervention group had a follow-up call. In addition, 262 in this group had a call to their PCP and, if required, their caregiver.

The analysis of the primary outcomes is shown in **Table 2** and illustrated in **Figure 2**. The extended intervention had a statistically significant effect on the number of patients who experienced a readmission within 30 days after inclusion (HR, 0.62; 95% CI, 0.46-0.84) or within 180 days after inclusion (HR, 0.75; 95% CI, 0.62-0.90) and the number of patients who had a composite of readmissions or ED visits within 180 days after inclusion (HR, 0.77; 95% CI, 0.64-0.93).

We observed a nonsignificant decrease in the number of drug-related readmissions within 30 days (HR, 0.65; 95% CI, 0.39-1.09) or within 180 days (HR, 0.80; 95% CI, 0.59-1.08), drug-related deaths within 180 days (HR, 0.83; 95% CI, 0.22-3.11), and ED visits (HR, 0.74; 95% CI, 0.38-1.44). The basic intervention showed HRs below 1.00 for all end points; however, none of them reached statistical significance (Table 2). The numbers needed to treat were consistently lower for the extended intervention than for the basic intervention except for drug-related death within 180 days. The numbers needed to treat for the main composite end point were 12 for the extended intervention and 65 for the basic intervention. The numbers needed to treat for readmissions within 180 days were 11 for the extended intervention and 65 for the basic intervention; for readmissions with 30 days, 12 for the extended intervention and 41 for the basic intervention ($P < .05$ for all comparisons).

Subgroup analyses are shown in **Table 3**. In brief, the lowest HRs for extensive intervention were seen among men, among the youngest patients, and among those taking

Table 1. Patient Characteristics at Baseline

Characteristic	Study Group[a]			P Value
	Usual Care (n = 498)	Basic Intervention (n = 493)	Extended Intervention (n = 476)	
Sex, No. (%)				
Male	220 (44.2)	245 (49.7)	214 (45.0)	.17
Female	278 (55.8)	248 (50.2)	262 (55.0)	.17
Age, median (IQR), y	73 (65-80)	72 (63-80)	71 (63-79)	.25
No. of medications by admission, median (IQR)	9 (7-12)	10 (7-13)	10 (7-12)	.39
No. of medications by discharge, median (IQR)	10 (8-13)	11 (8-14)	11 (8-14)	.36
Cumulative No. of hospital admissions since 2000, median (IQR)	9 (5-15)	8 (5-15)	8 (5-13)	.10
Cumulative No. of days of hospital stay since 2000, median (IQR)	47 (25-96)	46 (24-89)	45 (22-85)	.05
Risk factors, No. (%)				
High level of alcohol consumption[b]	31 (6.2)	41 (8.3)	51 (10.7)	.03
Smoker[c]	124 (24.9)	133 (27.0)	117 (24.6)	.65
BMI >30	122 (24.5)	151 (30.6)	124 (26.1)	.09
Medication administering status, No. (%)				
Self-administered	444 (89.2)	439 (89.0)	417 (87.6)	.70
Unit dose drug dispensing	20 (4.0)	26 (5.3)	21 (4.4)	.63
Help from nurse for medication management	96 (19.3)	85 (17.2)	101 (21.2)	.29
Hospital ward, No. (%)				
Acute care	218 (43.8)	216 (43.8)	220 (46.2)	.68
Department of geriatric medicine	79 (15.9)	75 (15.2)	49 (10.3)	.02
Department of endocrinology	44 (8.8)	51 (10.3)	51 (10.7)	.58
Department of gastroenterology	54 (10.8)	53 (10.8)	59 (12.4)	.66
Department of rheumatology	12 (2.4)	20 (4.1)	12 (2.5)	.24
Department of respiratory medicine	78 (15.7)	69 (14.0)	74 (15.5)	.72
Department of infectious diseases	13 (2.6)	9 (1.8)	11 (2.3)	.70
Medical history, No. (%)				
Heart failure	88 (17.7)	88 (17.8)	86 (18.1)	.99
Diabetes	134 (26.9)	143 (29.0)	148 (31.1)	.35
Hypertension	278 (55.8)	263 (53.3)	275 (57.8)	.38
Arythmia	152 (30.5)	149 (30.2)	131 (27.5)	.53
Malignant diseases	93 (18.7)	75 (15.2)	90 (18.9)	.24
Cerebral vascular lesion	127 (25.5)	100 (20.3)	90 (18.9)	.03
Myocardial infarction	51 (10.2)	67 (13.6)	44 (9.2)	.08
Pulmonary diseases	176 (35.3)	187 (37.9)	158 (33.2)	.30
Dementia	8 (1.6)	7 (1.4)	6 (1.3)	.90
Charlson comorbidity index, median (IQR)[d]	2 (1-4)	2 (1-4)	2 (1-4)	.85

Abbreviations: BMI, body mass index (calculated as weight in kilograms divided by height in meters squared); IQR, interquartile range.

[a] Percentages have been rounded and may not total 100.

[b] Indicates more than 14 U/wk for women and more than 21 U/wk for men. A unit of alcohol consumed indicates 330 mL of beer or 20 mL of liquor.

[c] Excludes those who quit smoking more than 6 months earlier.

[d] Scores range from 1 to 4, with higher scores indicating more comorbidities.

the highest number of different drugs. The HR point estimate was below unity (1.00) for all subgroups in the extended intervention.

The pharmacists proposed 946 interventions directed to hospital physicians. Of these, 449 (47.5%) involved a risk for drug-related readmission, according to the reference for risk-related drugs.[24] Seventy-five of 183 interventions directed to primary care (41.0%) concerned such risk-related drugs. The implementation rate of the pharmaceutical interventions suggested during medication review was 61% at the hospital and 66% in primary care, respectively.

Discussion

In this randomized clinical trial, we established that a multifaceted pharmaceutical intervention based on medication review, motivational interview, and postdischarge follow-up for hospitalized patients with polypharmacy can reduce the short- and long-term rates of readmissions. The observed comparable effect on non-drug-related and drug-related readmissions seems counterintuitive. However, we believe that our intervention, if it is effective against, for example,

Table 2. Outcomes in the Intention-to-Treat Analysis

Outcome	Study Group, No. (%)			HR (95% CI)	
	Usual Care (n = 498)	Basic Intervention (n = 493)	Extended Intervention (n = 476)	Basic Intervention vs Usual Care	Extended Intervention vs Usual Care
Composite end point[a]	243 (48.8)	233 (47.3)	193 (40.5)	0.94 (0.79-1.13)	0.77 (0.64-0.93)
Readmission within 180 d after inclusion	243 (48.8)	233 (47.3)	189 (39.7)	0.95 (0.79-1.13)	0.75 (0.62-0.90)
Readmission within 30 d after inclusion	111 (22.3)	98 (19.9)	68 (14.3)	0.89 (0.68-1.17)	0.62 (0.46-0.84)
ED visit	21 (4.2)	19 (3.9)	15 (3.2)	0.91 (0.49-1.69)	0.74 (0.38-1.44)
Died within 180 d after inclusion	50 (10.0)	42 (8.5)	54 (11.3)	0.84 (0.53-1.32)	1.05 (0.68-1.63)
Drug-related readmission within 180 d after inclusion	96 (19.3)	95 (19.3)	75 (15.8)	0.99 (0.75-1.32)	0.80 (0.59-1.08)
Drug-related readmission within 30 d after inclusion	38 (7.6)	34 (6.9)	24 (5.0)	0.90 (0.56-1.42)	0.65 (0.39-1.09)
Drug-related death within 180 d after inclusion	6 (1.2)	3 (0.6)	5 (1.1)	0.60 (0.14-2.52)	0.83 (0.22-3.11)

Abbreviations: ED, emergency department; HR, hazard ratio.

[a] Indicates readmission or ED visit within 180 days of inclusion.

Table 3. Primary Composite End Point in Intention-to-Treat Analysis

Variable	Patient Group, No. (%)			HR (95% CI)	
	Usual Care (n = 503)	Basic Intervention (n = 498)	Extented Intervention (n = 497)	Basic Intervention vs Usual Care	Extended Intervention vs Usual Care
Men	116/220 (52.7)	111/245 (45.3)	81/214 (37.9)	0.79 (0.61-1.03)	0.64 (0.48-0.84)
Women	127/278 (45.7)	122/248 (49.2)	112/262 (42.7)	1.10 (0.86-1.41)	0.90 (0.69-1.15)
Age <65 y	55/121 (45.5)	73/141 (51.8)	45/130 (34.6)	1.22 (0.86-1.73)	0.70 (0.47-1.03)
Age ≥65 y	188/377 (49.9)	160/352 (45.5)	148/346 (42.8)	0.86 (0.70-1.06)	0.80 (0.64-0.99)
≤8 Drugs at admission	80/194 (41.2)	69/180 (38.3)	58/180 (32.2)	0.91 (0.66-1.26)	0.71 (0.51-1.00)
>8 Drugs at admission	189/351 (53.8)	178/353 (50.4)	152/353 (43.1)	0.90 (0.73-1.10)	0.73 (0.59-0.90)
Charlson comorbidity index ≥3[a]	124/293 (42.3)	119/278 (42.8)	106/284 (37.3)	0.99 (0.77-1.27)	0.84 (0.65-1.09)
Charlson comorbidity index 0-2[a]	119/205 (58.0)	114/215 (53.0)	87/192 (45.3)	0.87 (0.67-1.12)	0.69 (0.52-0.91)

Abbreviation: HR, hazard ratio.

[a] Scores range from 1 to 4, with higher scores indicating more comorbidities.

nonadherence, to a large extent could prevent readmissions that are not obviously drug related. If a patient is readmitted because of nonadherence, this will typically manifest itself as a worsening of his or her underlying disease. Unless the patient confesses to being nonadherent, the readmission is unlikely to be recognized as drug related.

A meta-analysis[21] from 2016 concluded that medication review does not reduce mortality or hospital readmissions. This conclusion is at odds for several possible reasons, at least with respect to the extended intervention. First, our study is larger than previous studies. The meta-analysis was based on 10 studies with 3575 patients altogether, whereas our study alone included 1499 patients. Second, our study has one of the most intensive interventions in the extensive intervention group. Third, our follow-up is longer than in most other trials.[21,35,36] Fourth, our extended intervention was multifaceted, using elements of a motivational interview among other things. The motivational interview technique is nonjudgmental and may more often result in answers that are honest and useful.[27,28] Single interventions, however intensive, are unlikely to affect, for example, adherence.[20] Finally, with respect to the basic intervention, our results are in agreement with those of the existing literature, essentially showing no clear effect of medication review in itself.[17]

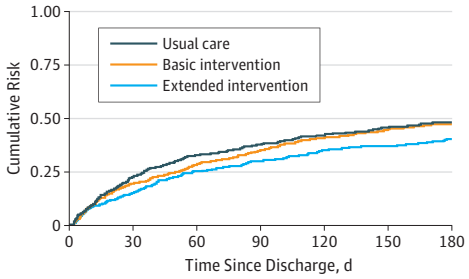
Strengths and Limitations

Among the principal strengths of our study is its fairly large size, thus enabling us to measure the effect in subgroups defined by age, sex, and level of polypharmacy. Another strength is the use of 2 levels of intervention. This allowed us to establish a larger effect with more intensive interventions, which is a strong indicator of a true intervention effect. We had a low level of patients who declined participation (374 [20.0%]), which implies a high degree of generalizability and an intervention that is acceptable for patients. The end points are objective except the drug-related hospital contacts and deaths, for which the relation to drug use entails an element of subjectivity. The acceptance rate for the proposed changes was 61% in secondary care and 66% in primary care, thus indicating a high level of acceptability compared with similar studies.[13]

Some potential weaknesses and limitations need to be considered. The study could not be entirely blinded because, for

example, the intervening pharmacist and the patient would know the result of the allocation. We used a blinded randomization procedure[37,38] and also blinded those who ascertained drug-related admissions. In addition, the pharmacist who performed the medication review was unaware of whether the patient would be assigned to the basic or the extensive intervention, thereby avoiding different levels of diligence being put into the medication review. Another potential problem is that of intervention carryover between assignment groups.[39] Some of the staff at participating wards could have learned elements of the intervention and applied it to some of the patients in the usual care group. This would have the effect of diminishing the contrast between the usual care and intervention groups, thereby underestimating the true effect of our intervention. We had more dropouts in the extensive intervention group than in the usual care or the basic intervention group. Our patients had a high burden of morbidity, and some in the extensive intervention group were frustrated by the additional health care contacts and withdrew their informed consent. A similar problem has been reported by others.[40] To account for this, we have analyzed the data based on intention to treat; unfortunately, 18 patients in the extensive intervention group also withdrew their consent for us to follow up based on intention to treat. Because the proportion is low (3.6%), we believe this to be of minor significance. Another limitation is that, because of the requirements for informed consent, patients with severe dementia and delirium were underrepresented in our study population. Dementia is prevalent among the patients in our age group,[41] and how well our intervention would work with a cognitively impaired population is unknown.

Figure 2. Cumulative Risk of the Primary Composite End Point



No. at risk							
Usual care	498	405	344	317	292	273	258
Basic intervention	493	409	360	330	292	275	262
Extended intervention	476	413	361	336	315	300	288

The primary composite end point included readmission or an emergency department visit within 180 days of study inclusion. The usual care and intervention groups are described in the Pharmacist Intervention subsection of the Methods section.

Conclusions

This study shows that hospital pharmacists may play an important role in preventing hospital readmissions. If our findings are taken at face value, what are the barriers for implementing this intervention on a larger scale? First, the intervention has to be cost-effective. A formal health economics analysis based on our data is pending. Second a possible barrier may exist in the lack of properly trained clinical pharmacists. For example, the motivational interview technique requires some training and expertise not universally available.[27] Furthermore, political or other barriers toward allocating a large budget for such interventions may exist. Future studies might be able to more accurately identify those at high risk of drug-related problems, allowing for a more focused intervention.[42] Finally, given the ambiguous results from other interventions studies, seeing our findings verified in other settings would be desirable.

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