Impact of a Medication Management System on Nursing Home Admission Rate in a Community-Dwelling Nursing Home–Eligible Medicaid Population

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ABSTRACT

Background: Community-dwelling frail elderly have an increased need for effective medication management to reside in their homes and delay or avoid admission to nursing homes.

Objective: The objective of this study was to examine the impact of a medication management system on nursing home admission within the community-dwelling frail elderly.

Methods: This prospective cohort study compared nursing home admission rates in intervention and control clients of a state Medicaid home and community-based waiver program. Groups were matched on age (±5 years), race, gender, and waiver program start date (±120 days). The medication management service consisted of 2 parts: 1) prescription medicines dispensed from the client's local pharmacy in a calendar card, and 2) a coordinating service by a health educator to address medication-related problems as they arose. The primary dependent variable was admission to a nursing home.

Results: A total of 273 clients agreed to participate, enrolled, and had at least 1 prescription dispensed. The matched control group was composed of 800 other clients. The client sample was 72 years of age, 73% (785/1073) non-white, 75% (804/1073) female, and enrolled in the waiver program approximately 50 months. The 2 groups were similar on all demographic variables examined. Six clients (2.2%) in the intervention group and 40 clients (5.0%) in the control group were admitted to a nursing home at least once during the study period. Logistic regression was used to test the model predicting at least 1 nursing home admission. Control group clients were 2.94 times more likely to be admitted to a nursing home than clients in the intervention group.

Conclusions: The medication management service implemented within this study was effective in reducing nursing home admissions in a group of frail community-dwelling elderly. (*Am J Geriatr Pharmacother*. 2011;9:69–79) © 2011 Published by Elsevier HS Journals, Inc.

Key words: elderly, medication adherence, medication management service, nursing home admission.

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INTRODUCTION

Patients not taking prescribed medicine as directed has been well-documented and is the subject of several excellent reviews.[1–7] The extent of this phenomenon varies greatly and has been observed across a broad range of medical conditions.[8–13] For chronic conditions, it is estimated that only 50% of patients follow medication directions over time.[14–18] This phenomenon has assumed various names, such as medication nonadherence, noncompliance, and lack of persistence. Regardless of its name, the problem can most broadly be considered one in which a patient does not take medicine as prescribed, regardless of reason.

Failure to take medicine as prescribed may result in important consequences to both patients and society. In a retrospective observational study of health care utilization and use of medicines for asthma, patients with the lowest quartile for medication adherence for leukotriene inhibitors experienced 80 emergency department visits and 34 admissions per 1000 patient-years, whereas patients in the highest quartile for adherence experienced 36 emergency department visits and 13 admissions per 1000 patient-years.[19] In another study, the personal impact of medication nonadherence was assessed in 4 chronic diseases in a historical cohort of 137,277 patients. For all 4 conditions examined, the more patients took the medicine as directed, the lower their risk of hospitalization.[20] Societal costs, as measured by productivity losses, were measured in a national cohort of employees with bipolar disease in the United States. Relative to employees who were adherent with their medicines, those assessed as nonadherent had higher indirect costs due to absenteeism, short-term disability, and worker compensation claims.[21] Total cost of nonadherence, including both lost productivity and early mortality, has been estimated at $300 billion.[22] The impact of programs designed to improve patients' medication-taking behavior can be significant. In a review of interventions to improve medication adherence, 19 of 39 interventions were associated with statistical improvements in adherence, whereas 17 were associated with statistical improvements in clinical outcomes.[23]

The frail elderly are particularly susceptible to problems with medication management and adherence. Declining cognition, increasing diagnoses, and associated prescribed medicines make them more likely to experience poor outcomes.[24] For these reasons, emphasis has been placed on improving medication management in this group. A recent review of studies examining the effectiveness of adherence interventions in older patients reported that less than half of the studies employing educational-only strategies found improvement in adherence. However, 4 of the 5 studies with memory aids or cues as part of the intervention, coupled with newer technologies, showed improvement.[25] The authors concluded that the evidence does not support any one intervention as being superior in improving medication adherence in the elderly. However, they also indicated that tailored interventions with consistent contact with health professionals seemed to be more effective than alternatives.

An outcome of particular interest for the elderly and society is nursing home placement. In 2008, approximately $138 billion was spent on nursing home services, accounting for 6% of national health care expenditure.[26] Studies designed to identify predictors of nursing home placement typically do not assess the impact of medication management.[27,28] In studies where medications are considered, however, a simple count is identified as a predictive factor.[29]

In 1 study, up to 23% of nursing home admissions were reportedly due to elderly patients' ability to self-administer medications.[30] Programs designed to assist the elderly in managing their medicines might reduce nursing home admissions and reduce the impact on society.

The purpose of this study was to examine the impact of a medication management system on nursing home admission within the community-dwelling frail elderly.

MATERIALS AND METHODS

Population

The participants of this prospective cohort study were clients in a state Medicaid home and community-based waiver program—a waiver program for persons eligible for nursing home care, but who prefer to receive their services in the community. Elderly/disabled clients who received their prescriptions from participating pharmacies were contacted by program case managers, who sought their voluntary participation and obtained signed informed consent. These clients formed the intervention group. The control group consisted of clients who did not receive the intervention, and thus received standard care that was provided in their community pharmacies. Control group clients were matched to intervention group clients on age, gender, race, and time in waiver program.

Pharmacies

Selection of participating pharmacies was done through convenience sampling. First, only independently owned community pharmacies were considered

possible participating pharmacies. Chain pharmacies were excluded from the list of potential participating pharmacies for 2 reasons: 1) the corporate organizational structure of chain pharmacies would remove decision-making from local control, and 2) participation involved purchase of a dispensing system that was considered unlikely within a chain environment. Second, the waiver program provided the names of pharmacies and the names of elderly/disabled clients who received prescriptions from the pharmacies. Pharmacies were then ranked according to the number of elderly/disabled clients they served. Pharmacies with the most elderly/disabled clients were asked to participate.

Overview of Intervention

Study clients received an intervention consisting of 2 parts: 1) a calendar card,* in which a client's medicines were dispensed instead of in prescription bottles, and 2) a coordinating service that facilitated communication among clients or caregivers, case managers, and providers to address medication adherence and management issues.

Calendar Card

Each calendar card contained multiple dosage bubbles or blister packs, which can hold up to 6 tablets or capsules for a single administration time. Calendar cards were color-coded, representing different times of the day or night. Each card, therefore, held in its dosage bubbles the medicines that a client would take during a particular time of day. Each card contained medicine for a 30-day supply. To take medicines prescribed for morning administration, for example, the client broke the morning bubble or blister pack, which contained all medicines to be taken at that time. Therefore, clients in the intervention group received their prescription medicines in calendar cards that held all medicines for each dosing time for 1 month. Clients in the control group received their prescription medicines in traditional prescription vials.

Coordinating Service

The coordinating service was designed to improve communication among clients/caregivers, pharmacists, and physicians and to identify and solve many of the practical problems that arise in medication management with this group. A more detailed description of the service is found in the section **Coordinator**.

*The calendar card used was Medicine-On-Time® (Hunt Valley, Maryland 21030).

Summary of Intervention

These 2 components, calendar card and coordinating service, were designed to assist in medication management in the home and to identify and address any medication-related problem quickly. The client's pharmacy prepared the calendar cards each month; a coordinator provided the coordinating service by frequent contact with caregivers, case managers, pharmacists, and physicians, Clients in the control group did not receive this intervention, and thus received standard care (ie, their prescriptions were dispensed in traditional prescription vials, and they did not participate in the coordinating service).

Coordinator

One individual provided the coordinating function throughout the project. The coordinator, a masters-trained health educator, communicated with pharmacists, physicians, case managers, clients, and caregivers regarding clients' prescription medicine. For example, the coordinator would be notified by a participating pharmacy if a client was late in receiving a prescription refill. In that situation, the coordinator would contact the caregiver to notify them of the situation and assist in resolving the problem. Also, the coordinator mailed or faxed a patient profile quarterly to prescribers that described the client's current drug therapy. This list was generated by software used by participating pharmacies. This service provided a written record of medication dispensed from the pharmacy, allowing prescribers to clarify discrepancies between prescribed and dispensed medicines, and gave prescribers a mechanism to communicate back to the pharmacist any adjustments to therapy that had been made. This software also generated order request forms for prescriptions with no remaining refills. Pharmacists faxed or mailed this form to prescribers to facilitate refill processing, thus avoiding interruptions in therapy.

Case Managers

As a regular part of the Medicaid waiver services provided to clients, each client has a choice of case manager who assists the client with what services and supplies are needed and available through the waiver program. In addition, the case manager assists with locating other resources in the community and in problem solving. Ongoing support is provided by calling or visiting the client monthly. The case manager operates from the community waiver office closest to the client, which is separate from the community Medicaid office. Case managers described the project to potential participants,

obtained informed consent, and were in personal or telephone contact with the client at least once a month throughout the study. This frequency of contact is standard care regardless of whether the client is participating in the study. Case managers received training from the project researchers before implementing the intervention. During the monthly contact, case managers inquired about the health status of the client and determined if the client was having any difficulties with the prescription medication or calendar pack. Case managers entered data on a standardized encounter form. Case managers also were instructed to contact the coordinator to report any medication-related problems that arose during the regularly scheduled monthly contact with clients or whenever a medication problem or issue occured.

Training and Coordination

Considerable effort was made to assure standardization of the intervention. First, all participating pharmacies were trained to use the Medicine-on-Time calendar card system by the group that developed and provided the hardware and software. Second, only 1 coordinator provided the service throughout the study. Third, all case managers were trained to follow the study protocol by the research team. In addition, the coordinator contacted all prescribers, described the study, and informed them of their patients' participation in the study.

Duration of Intervention

Each client enrolled in the program was followed for up to 12 months. Enrollment occurred on a rolling basis, beginning in September 2006 and ending March 2007. Outcomes were assessed until November 2007.

Data Source

The dependent variable, indication of admission to a skilled nursing facility that could include a short-term rehabilitation stay or a long-term placement, was based on skilled nursing home facility (excluding assisted living and community residential care facilities and personal care homes) admission data obtained from the State Office of Research and Statistics (SORS). SORS has legislatively derived authority to collect data and maintain health care databases for all state Medicaid enrollees. Utilization and cost data are sent to SORS by hospitals, state agencies, and insurers. Independent variables were obtained from both SORS and waiver databases.

Study Period

For the purposes of this study, the study period began for each client on the date of first prescription dispensed (index date) using the medication management service calendar pack and ended 30 days past the date of last refill. The "pre-period" was represented by the time from index date back to the individual's entry date into the waiver programs or January 2002, whichever was more recent. The "post-period" was represented by the time from index date forward to 30 days past the date of the last prescription dispensed. The first occurrence of nursing home admission before the index date constituted an outcome event in the pre-period. The first occurrence of nursing home admission after the index date constituted an outcome event in the post-period.

Statistical Analysis

Conditional logistic regression was used to test the hypothesis that nursing home admission was associated with the service intervention. Variables were selected for inclusion in the regression model for 1 of the following reasons: 1) significant association with nursing home admission in bivariate analysis, 2) support within the relevant literature,[31] and 3) experience of senior program managers within the state Medicaid home and community-based waiver program. As a result, the following variables comprised the full model: $\geq$3 drugs, cognitive skills, total activities of daily living, prior nursing home admission, education, residence (rural/urban), emergency disaster priority, cancer, missing limb, renal failure, seizure disorder, hypertension, emphysema, weight loss/gain, vision, not able to shop, and illness-altered diet. The final model was determined using the change-in-estimate method.[32,33] Briefly, each variable was evaluated based on its influence on the estimated group effect. When a variable was deleted, if the change in group effect was within 10% of its estimated value, the variable remained deleted from the model. However, if the deletion resulted in a change >10% of the estimated group effect, the variable was retained in the model. Confounding was controlled in the design (matching) and in the analytic (multivariate regression) phases. All analyses were conducted using SAS version 9.1.3 (SAS Institute Inc, Cary, North Carolina).

Human Subject Protection and Health Insurance Portability and Accountability Act

This study was approved by the University of South Carolina Institutional Review Board. Data were secured at the research office of the authors. Also, the coordinator was Health Insurance Portability and Accountability

Act trained, and previously served as an instructor on Health Insurance Portability and Accountability Act compliance.

RESULTS

Pharmacies

Twelve pharmacies at 15 locations participated in the study; 1 of the pharmacies operated 4 locations under the same name. Each of these locations served a different patient mix and were considered separately. Pharmacies were geographically distributed throughout the state.

Patients

Of the 283 intervention group clients who received at least 1 dispense of medication via "bubble pack," 273 were successfully matched on year of birth (±5 years), gender (exact), race (exact, white vs non-white), and the waiver program start date (±120 days). Of the 273 intervention group participants included in the analysis, 273 were matched to at least 1 control, 266 were matched to 2 controls, and 261 were matched to 3 controls, for a total of 800 controls. Mean (SD) number of days participants in the intervention group remained in the study was 270 (130); mean (SD) number of days for the control group was 244 (134).

A profile of the intervention and control groups at baseline is presented in **Table I**. Due to matching, age, gender, race, and length of time in the waiver program are similar. On most variables examined, the intervention group and control group were similar. The groups were significantly different with respect to the following variables, with the intervention group having a higher percentage than the control group: presence of hypertension (228 [84%] vs 602 [75%]; <0.01), having an illness that altered diet (157 [58%] vs 382 [48%]; $P < 0.01$), taking ≥3 drugs a day (249 [91%] vs 662 [83%]; $P < 0.01$), and not always being physically able to shop (265 [97%] vs 748 [94%]; $P = 0.03$).

Nursing Home Admission

Of the 273 intervention group participants, 6 (2.2%) were admitted to the nursing home at least once during the study period. Of the 800 control subjects, 40 (5.0%) were admitted to the nursing home at least once during the study period. Logistic regression was used to test the model predicting at least 1 admission to a nursing home (**Table II**). Group membership (intervention or control: odds ratio [OR] 0.340; 95% CI 0.119–0.968) and residence (rural or urban: OR 0.409; 95% CI 0.174–0.963) were predictive of nursing home admission. A client who had the medication management service was 66% less likely to be admitted to a nursing home than clients who did not have the service. Conversely, clients who did not have the medication management service were 2.94 times more likely to have a nursing home admission compared with clients who had the service. Location of residence (urban or rural) was also found to be independently associated with nursing home admission. Controlling for the influence of the intervention, clients who lived in rural areas were 59% less likely to have a nursing home admission during the study period. Conversely, clients living in urban areas were 2.45 times more likely to have a nursing home admission compared with clients living in rural areas.

Table III reports nursing home admission throughout the study. There were no nursing home admissions in the intervention group during the pre-period. During the post-period, the intervention group had 6 clients (2.2%) with at least 1 nursing home admission. Within the control group, there were 6 clients (0.8%) who had a nursing home admission during the pre-period. During the post-period, the control group had 40 clients (5.0%) with at least 1 nursing home admission. The difference (post – pre) in annualized rate of nursing home admission in the intervention group was 3 nursing home admissions per 100 persons. The difference (post – pre) in annualized rate of nursing home admission in the control group was 8 admissions per 100 persons. Participation in the intervention was associated with an avoidance of 5 nursing home admissions per 100 persons.

Services continued for intervention clients as long as they continued to receive their prescriptions from participating pharmacies in the calendar cards. Services, and therefore, study participation, discontinued 30 days after the last prescription was dispensed. Although services were not provided, investigators could assess nursing home activity for some time after the last refill through the SORS database. **Table IV** shows the nursing home rates for clients in both groups at 30 days past date of last prescription (6 [2.2%] vs 40 [5.0%], $P < 0.05$), and at 120 days past date of last prescription. Over the 120 days past date of last refill, during which neither group received prescriptions using the calendar card nor received the coordinating service (ie, level of service was the same), the rate of nursing home admission was similar (5.9% in both groups).

DISCUSSION

The purpose of this study was to assess the effectiveness of a medication adherence and management service in influencing nursing home admission within a Medicaid, nursing home–eligible population. The results indicate

Table I. Intervention and control groups characteristics at baseline.

Variable	Level	Intervention (n = 273)	Controls (n = 800)	P
Age, mean (SD)	N/A	71.95 (15.17)	71.95 (14.77)	0.99
Race	Non-White	199 (73%)	586 (73%)	0.91
Gender	Female	204 (75%)	600 (75%)	0.93
Education	Less than high school education	144 (53%)	378 (47%)	0.12
No. of months on waiver, mean (SD)	N/A	51 (35.15)	49.19 (33.52)	0.45
Ability to understand others	Understands	176 (64%)	527 (66%)	0.78
	Usually understands	58 (21%)	160 (20%)	
	Sometimes understands	32 (12%)	83 (10%)	
	Rarely/never understands	7 (3%)	28 (4%)	
Cognitive skills	Independent	64 (23%)	185 (23%)	0.35
	Modified independence	79 (29%)	272 (34%)	
	Moderately impaired	79 (29%)	222 (28%)	
	Severely impaired	51 (19%)	121 (15%)	
Long-term memory	Memory OK	182 (67%)	526 (66%)	0.77
	Memory problem	75 (27%)	217 (27%)	
	Unable to rate	16 (6%)	57 (7%)	
ADL–Transfer	Independent	18 (7%)	57 (7%)	0.16
	Supervision	24 (9%)	39 (5%)	
	Limited assistance	22 (8%)	78 (10%)	
	Extensive assistance	174 (64%)	506 (63%)	
	Total dependence	35 (13%)	119 (15%)	
ADL–Locomotion	Independent	6 (2%)	45 (6%)	0.07
	Supervision	4 (1%)	26 (3%)	
	Limited assistance	21 (8%)	60 (8%)	
	Extensive assistance	208 (76%)	560 (70%)	
	Total dependence	34 (12%)	109 (14%)	
ADL–Dressing	Independent	7 (3%)	18 (2%)	0.87
	Supervision	7 (3%)	16 (2%)	
	Limited assistance	33 (12%)	95 (12%)	
	Extensive assistance	187 (68%)	537 (67%)	
	Total dependence	39 (14%)	134 (17%)	
ADL–Eating	Independent	0 (0%)	9 (1%)	0.25
	Supervision	1 (0%)	9 (1%)	
	Limited assistance	16 (6%)	60 (8%)	
	Extensive assistance	230 (84%)	647 (81%)	
	Total dependence	26 (10%)	75 (9%)	
ADL–Toileting	Independent	23 (8%)	35 (4%)	0.08
	Supervision	5 (2%)	17 (2%)	
	Limited assistance	30 (11%)	71 (9%)	
	Extensive assistance	171 (63%)	530 (66%)	
	Total dependence	44 (16%)	147 (18%)	
ADL–Bathing	Independent	3 (1%)	7 (1%)	0.91
	Supervision	1 (0%)	7 (1%)	
	Limited assistance	22 (8%)	59 (7%)	
	Extensive assistance	199 (73%)	580 (73%)	
	Total dependence	48 (18%)	147 (18%)	

Table I (continued).

Variable	Level	Intervention (n = 273)	Controls (n = 800)	*P*
Bowel incontinence	Continent	155 (57%)	444 (56%)	0.35
	Usually continent	37 (14%)	84 (11%)	
	Occasionally incontinent	21 (8%)	70 (9%)	
	Frequently incontinent	25 (9%)	66 (8%)	
	Incontinent	35 (13%)	136 (17%)	
Bladder incontinence	Continent	69 (25%)	210 (26%)	0.68
	Usually continent	23 (8%)	53 (7%)	
	Occasionally incontinent	34 (12%)	98 (12%)	
	Frequently incontinent	100 (37%)	276 (35%)	
	Incontinent	47 (17%)	163 (20%)	
Emergency priority	Yes	12 (4%)	27 (3%)	0.44
Congestive heart failure	Yes	57 (21%)	177 (22%)	0.67
Hypertension	Yes	288 (84%)	602 (75%)	<0.01
Myocardial infarction	Yes	30 (11%)	82 (10%)	0.73
Peripheral vascular disease	Yes	55 (20%)	121 (15%)	0.05
Alzheimer's disease	Yes	22 (8%)	78 (10%)	0.41
Other dementias	Yes	24 (9%)	106 (13%)	0.05
Cerebrovascular accident	Yes	83 (30%)	266 (33%)	0.39
Parkinson's disease	Yes	9 (3%)	17 (2%)	0.28
Anemia	Yes	45 (16%)	128 (16%)	0.85
Arthritis	Yes	183 (67%)	512 (64%)	0.37
Cancer	Yes	30 (11%)	77 (10%)	0.52
Diabetes	Yes	128 (47%)	365 (46%)	0.72
Missing limb	Yes	19 (7%)	64 (8%)	0.58
Renal failure	Yes	24 (9%)	59 (7%)	0.45
Seizure disorder	Yes	29 (11%)	86 (11%)	0.95
Depression	Yes	45 (16%)	174 (22%)	0.06
Emphysema	Yes	60 (22%)	162 (20%)	0.54
Pneumonia	Yes	10 (4%)	35 (4%)	0.61
Diet supplement	Yes	22 (8%)	86 (11%)	0.20
25% Food uneaten at meals	Yes	8 (3%)	30 (4%)	0.53
Weight loss/gain	Yes	88 (32%)	244 (31%)	0.59
Illness-altered diet	Yes	157 (58%)	382 (48%)	<0.01
≥3 drugs	Yes	249 (91%)	662 (83%)	<0.01
Eats alone most times	Yes	73 (27%)	200 (25%)	0.57
Not able to cook	Yes	253 (93%)	729 (91%)	0.43
Not able to feed self	Yes	15 (5%)	66 (8%)	0.14
Gain weight	Yes	27 (10%)	72 (9%)	0.66
Loss weight	Yes	29 (11%)	90 (11%)	0.78
Not enough money to buy food	Yes	18 (7%)	50 (6%)	0.84
Not able to shop	Yes	265 (97%)	748 (94%)	0.03

ADL = activities of daily living.
P values derived from *t* test for continuous level data, and χ^2 for categorical data.

Table II. Odds of nursing home admission.

		Odds Ratio Estimates	
Variable	Comparison	Adjusted Odds Ratio	95% Wald CIs
Group	Intervention/control	0.340	0.119–0.968
Residence	Rural/urban	0.409	0.174–0.963
Renal failure	Yes/no	2.281	0.583–8.920
Seizure	Yes/no	2.547	0.471–13.774
Hypertension	Yes/no	0.408	0.145–1.152
Emphysema	Yes/no	0.397	0.112–1.407
Vision	Impaired/adequate	2.240	0.988–5.078
Not able to shop	Not able/able	3.448	0.994–11.960

The intervention group had lower odds of being admitted to the nursing home within 30 days after receiving their last dispense of drugs via the intervention compared with the controls. Those in the control group were 2.94 times more likely to be admitted to a nursing home. This final model had the lowest Akaike Information Criterion value, demonstrating that the model was the best fit of models tested.[34]

that clients who had the service, composed of a calendar card dosage administration system coupled with a coordinating service, experienced a significantly lower rate of nursing home admission than similar clients who did not have the service. Furthermore, when the intervention was no longer applied, the nursing home rate for the intervention group rose to a level similar to the rate in the control group.

A study that examined predictors of nursing home admission used number of prescriptions as a measure of general morbidity.[29] The authors reported that number of prescriptions was a predictor of nursing home admission. Although the number of prescriptions has been used as a proxy for this broader measure, an alternative interpretation is possible. In the referenced study, participants with more prescriptions perhaps had more difficulty managing their medication than those with fewer prescriptions. This interpretation can be seen as consistent with our findings, in which the intervention was designed specifically to assist in medication management. The intervention group received assistance in the form of a calendar card and coordinating service. Those who received this assistance had a lower rate of institutionalization in nursing homes than those who did not receive this assistance.

Much of the focus of intervention studies designed to reduce nursing home admission has been on the caregiver of frail or medically compromised patients. A meta-analysis was conducted assessing the effectiveness of home visitation in preventing or delaying admission to a nursing home.[35] The authors reported that the reduction in admission rate was modest and nonsignificant. However, subgroup analysis indicated

Table III. Standardized nursing home utilization.

	Intervention (n = 273)		Control (n = 800)	
	Pre	Post	Pre	Post
Nursing Home				
No. people with at least 1 utilization (%)	0 (0.0)	6 (2.2)	6 (0.75)	40 (5.0)
Total visits	0	6	6	40
Days observed	1186	270	1168	244
Total visits Annualized*	0	8	2	60
Annualized rate†	0	0.029	0.002	0.075
Rate per 100‡	0	3	0	8
Difference§		3/100 person		8/100 person
Impact of service‖		5/100 avoided		

*Total visits annualized = (total visits/days observed) × 365.
†Annualized rate = total visits annualized/N.
‡Rate per 100 = (annualized rate) × 100.
§Difference = (post rate per 100) – (pre rate per 100).
‖Impact of service = (intervention difference) – (control difference).

Table IV. Nursing home admission at different end points.

	Intervention (N = 273) N (%)	Control (N = 800) N (%)
30 d past last prescription	6 (2.2)*	40 (5.0)
120 d past last prescription	16 (5.9)	47 (5.9)

*$P < 0.05$ vs control.

that interventions were successful only if based on multidimensional assessment, included multiple in-home visits, and targeted those at low risk of death, and if participants were relatively young. Our study elaborated upon these results in several ways. Though age was not an independent factor associated with nursing home placement, the effect of the intervention was greatest in clients <80 years of age. This was consistent with the observation that dementia and incontinence exert greater influence on nursing home placement at advancing ages. Also, the intervention did not increase the number of home visits provided to clients. Where our study differed was in the type and intensity of intervention. The present study introduced a simple intervention in the form of a calendar card to address a frequently identified problem for community-based elderly, namely, medication management. The coordinator provided a service in which she had contact with multiple personnel involved in the provision of care, but managed the contact entirely through telephone, fax, and mail. This difference in targeted versus broad-based intervention might explain the difference in conclusion regarding the effectiveness in reducing nursing home admissions. Future work might elaborate on the discussion of targeted versus broad-based interventions, intensity of intervention, and value of a coordinated medication management systems for the frail elderly.

The nature of the intervention prevented an assessment that could separate the effect of the calendar card from the coordinating service. The purpose of the study, agreed to by the funding agency and academic researchers, was to assess the effectiveness of the intervention as a whole, not its component parts. Further, each client, regardless of group, received the services of the case manager as part of the regular benefit provided to all community long-term care waiver clients. In this way, the case manager was not considered part of the intervention unique to only one group.

The study has several limitations. Sampling of both participants and pharmacies was not random, and randomization of the service intervention was not feasible. Consequently, results may be attributable to factors other than the intervention. Research comparing randomized versus nonrandomized studies has shown that the use of matching in nonrandomized studies, as done in this study, can produce study groups with similar distributions of baseline covariates, a strength of traditional randomized studies.[36,37] Clients were not randomly selected within pharmacies because of the clear danger of contamination between clients. Pharmacies were not randomly selected for practical reasons. Participation required the purchase and use of equipment to dispense medicines in the calendar card. Pharmacies needed a sufficient number of waiver clients already in their patient mix to make the project economically feasible. Only pharmacies with sufficient numbers of clients could participate. Chain pharmacies were not included. Corporate approval would have been unlikely for only selected pharmacies within a region. In addition, local control within independently owned pharmacies implied a greater likelihood for accurate and consistent application of the intervention within each pharmacy. The exclusion of chain pharmacies decreases the generalizability of the study. However, the accurate and consistent application of the intervention increased the study's internal validity. Finally, Medicare Part D was implemented during the study, which prevented an accurate assessment of medication adherence within the control group. Although this prevented assessing association between medication adherence and nursing home admission, it did not prevent an assessment of the overall medication management service and nursing home admission.

CONCLUSIONS

This study found that the pharmacy-based calendar card dispensing system and coordinating service, which was designed to facilitate medication adherence, can reduce medication management issues, address problems as they arise, and reduce nursing home admissions of community dwelling, nursing home–eligible patients.

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