Consequences of Preventing Delirium in Hospitalized Older Adults on Nursing Home Costs

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OBJECTIVES: To determine whether costs of long-term nursing home (NH) care for patients who received a multicomponent targeted intervention (MTI) to prevent delirium while hospitalized were less than for those who did not receive the intervention.

DESIGN: Longitudinal follow-up from a randomized trial.

SETTING: Posthospital discharge settings: community-based care and NHs.

PARTICIPANTS: Eight hundred one hospitalized patients aged 70 and older.

MEASUREMENTS: Patients were followed for 1 year after discharge, and measures of NH service use and costs were constructed. Total long-term NH costs were estimated using a two-part regression model and compared across intervention and control groups.

RESULTS: Of the 400 patients in the intervention group and 401 patients in the matched control group, 153 (38%) and 148 (37%), respectively, were admitted to a NH during the year, and 54 (13%) and 51 (13%), respectively, were long-term NH patients. The MTI had no effect on the likelihood of receiving long-term NH care, but of patients receiving long-term NH care, those in the MTI group had significantly lower total costs, shorter length of stay and lower cost per survival day. Adjusted total costs were $50,881 per long-term NH patient in the MTI group and $60,327 in the control group, a savings of 15.7% ($P = .01$).

CONCLUSION: Active methods to prevent delirium are associated with a 15.7% decrease in long-term NH costs. Shorter length of stay of patients receiving long-term NH services was the primary source of these savings. **J Am Geriatr Soc 53:405–409, 2005.**

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Delirium, an acute decline in cognitive functioning and attention, is the most frequent complication of hospitalization in older persons.[1,2] With occurrence rates of 14% to 56% in older hospitalized persons, delirium affects at least 2.4 million persons in the United States annually. It results in considerably increased morbidity, mortality, and healthcare costs.[3,4] Moreover, the aging of the U.S. population implies that the problem of delirium will continue to increase.

The costs associated with delirium are substantial. It has been estimated that annual inpatient costs alone due to delirium and its complications are $4 billion in the United States.[2] Additional nursing home (NH), rehabilitation, and home care costs are incurred beyond the inpatient setting for patients who experience delirium.[5–7] Moreover, NH placement rates are likely to increase as efforts to contain hospital expenditures create pressures to shorten hospital lengths of stay and limit implementation of delirium intervention programs. The focus of this study was on long-term NH care (defined as >100 NH days), because these costs are a large component of healthcare expenditure for long-term chronic illness in older persons in the United States.[8] Studies of NH costs in the United States have found that skilled NH care costs an average of $136 per day (1997 U.S. dollars)[9] or $56,000 per year (1998 U.S. dollars)[10] and that NH costs are increasing.[11]

Previous studies have demonstrated that a multicomponent targeted intervention (MTI) to prevent delirium reduced the risk of delirium by 40% in hospitalized older persons,[3] was cost-effective in the short term from the hospital's perspective,[4] and led to improved long-term outcomes for some high-risk patients.[12] The MTI targets specific delirium risk factors, including cognitive impairment, sleep deprivation, immobility, vision impairment, hearing impairment, and dehydration.

In an effort to demonstrate further cost-effectiveness of the MTI and promote its widespread implementation, the objective of this study was to examine the effect of the MTI

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on long-term NH costs, which represent a major expenditure for our healthcare system. The hypothesis was that the hospital-based MTI might affect subsequent long-term NH care and costs through one of two mechanisms: by reducing the need for any long-term NH care or by reducing costs for patients with a long-term NH stay. It was not anticipated that the intervention would reduce short-term NH care or costs because the intervention protocol included short-term NH placement for patients considered unsafe for discharge (such as delirious patients). Because delirium increases the risk of NH placement, and delirium risk factors are also risk factors for other geriatric syndromes (including functional decline) that might influence NH use,[13] the MTI might reduce the need for long-term NH care. Moreover, because the MTI targets mobility, cognition, and sensory impairment, long-term NH residents who receive the MTI might require less hands-on care than residents who do not receive the MTI and thus generate lower costs.

METHODS

Sample

The sample for the study consisted of 852 patients (426 matched pairs of intervention and control subjects) who were enrolled in a controlled trial of a delirium prevention intervention at an academic medical center between 1995 and 1998. The details of the study have been described previously.[3] Briefly, patients meeting the following criteria were enrolled: consecutive admissions to three nonintensive care general medical units, aged 70 and older, no evidence of delirium at admission, and at intermediate or high risk for delirium based on a previously developed risk model.[14] Patients who could not participate in interviews (e.g., profound dementia, language barrier, profound aphasia, intubation, or respiratory isolation), were in a coma, had a terminal illness, had a hospital stay of 48 hours or less, or who had prior enrollment in the study were excluded. Informed consent for participation and permission to acquire subsequent NH service use and cost data were obtained from the patients, or from a proxy for those with substantial cognitive impairment, according to procedures approved by the institutional review board of the Yale University School of Medicine.

Sources of Data

Data on patient demographic characteristics, comorbidities, and functional status were obtained from primary data collected during the controlled trial. Data on NH use and cost after discharge were obtained from Medicare Part A and B files for these patients. Because Medicare NH coverage is limited to 100 days of care, and information on stays beyond this limit may be inaccurate or missing, the Connecticut Long-Term Care Registry (LTCR) was used to supplement the Medicare files. The LTCR is a longitudinal database containing demographic, health status, and NH length of stay information (dates of all NH admissions and discharges) for all Connecticut nursing facility resident stays.

Deaths were identified using telephone follow-up contacts at 1-, 6-, and 12-month periods, daily obituary review, and the Social Security Death Index. All deaths and dates of death were confirmed using review of medical records, death certificates, or Medicare Enrollment and Claims files.

Measures

Patients in the controlled trial were followed for 1 year after discharge, and measures of total NH service use and cost were calculated. For patients with multiple NH stays, service use and cost were summed across all stays during the year. Costs were calculated using Medicare reimbursed amounts rather than charges, because reimbursed amounts are payments actually received by providers for their services and hence are a better measure of transaction prices than billed charges. Medicare will reimburse only "qualified" NH days. Although Medicare imposes a limit of 100 qualified days for any NH stay, it is possible for patients to have more than 100 qualified NH days during the year if they have more than one NH stay. For patients with unqualified days (days not reimbursed by Medicare), the number of additional days of care for these patients was determined from the Medicare records or LTCR, and costs for these days were imputed using the average daily cost of care associated with the NH in which the patient was admitted.

Analyses

The analysis proceeded in several steps. First, long-term NH patients, defined as patients with more than 100 total days spent in a NH, were identified. Because not all patients had a NH stay, the analysis was divided into two parts. First, logistic regression was used to identify factors influencing the likelihood that a patient would experience a long-term NH stay. Independent variables in the model included whether the patient received the MTI, patient age, whether the patient was married, whether the patient had dementia at baseline, and whether the patient had any impairment in activities of daily living (ADLs) at baseline. Dementia was assessed using the modified Blessed Dementia Rating Scale (mBDRS)[15,16] and the Mini-Mental State Examination (MMSE).[17] Dementia was defined according to a definition used in previous studies as (1) mBDRS score greater than 4 or (2) mBDRS score greater than 2, MMSE score less than 20, and duration of cognitive symptoms of at least 6 months.[18,19] The second part of the analysis consisted of ordinary least squares (OLS) regression models of the log of total NH days and the log of total NH costs during the follow-up period and included the same independent variables as in the logistic regression model. Length of stay and costs were log-transformed to account for their nonnormal distributions.

To correct for the potential bias due to patient deaths, cost per survival day was calculated during the follow-up period in addition to total costs. Cost per survival day refers to costs incurred while the patient was alive during the follow-up period, because not all days survived are necessarily spent in a NH. Because 23% of the sample died during the follow-up period, and patients who die cannot contribute to costs after their death, an analysis of total costs may find that one group has lower costs than another simply because more patients in that group die during the follow-up period.

Fitted values from the logistic and OLS models were then calculated for the intervention and control groups.

Fitted values for the cost and length of stay measures were retransformed to the nonlog scale using an accepted methodology, the "smearing" technique.[20] The residual plots satisfied the assumptions of normality, homoscedasticity, and independence for each of the study outcomes. These fitted values were then compared across the intervention and control groups using *t* tests. All statistical tests were two-tailed, and $P < .05$ was considered statistically significant. All analyses were performed using the SAS statistical program (SAS Institute, Inc., Cary, NC).

RESULTS

Of the 400 patients in the intervention group and 401 patients in the control group with available follow-up data, 153 (38.3%) and 148 (36.9%), respectively, were admitted to a NH during the year, and 54 (13.5%) and 51 (12.7%), respectively, were long-term NH patients. There were no differences in rates of short-term NH service use between the two groups (data not shown). Baseline characteristics for the study sample are illustrated in Table 1. Differences in baseline characteristics between the intervention and control groups were relatively small and were not statistically significant.

Results from the logistic regression model demonstrate that the MTI did not significantly influence the likelihood of having a long-term NH stay. Patients who had dementia, were not married, or had ADL impairments were more likely to have a long-term NH stay.

Characteristics of patients with long-term NH stays are presented in Table 2. Although a significantly greater proportion of patients in the control group had any ADL impairment, there were no other significant differences between the two groups in baseline characteristics; the difference in baseline ADLs was controlled for in all subsequent multivariable models (see below). Patients in the intervention group had significantly fewer long-term NH days and significantly lower total costs over the 1-year follow-up period.

The OLS regression results for the log of total long-term NH costs, days, and cost per survival day for these patients, controlling for all covariates, are presented in Table 3. The estimated coefficient on the intervention group dummy variable was negative and statistically significant in each model, indicating that, net of the effects of the other independent variables, patients in the intervention group had lower total costs, total days of care, and cost per survival day than patients in the control group. Patients with dementia had significantly higher total days of care and cost per survival day, and patients who were married had significantly lower total costs, total days of care, and cost per survival day.

Fitted values from the two-part model are presented in Table 4. The difference between the intervention and control groups in the probability of having a long-term NH stay was small and not statistically significant. Of patients receiving long-term NH care, patients in the intervention group had significantly lower total costs ($9,446 less, $P = .01$), total days of care (41 fewer days, $P = .04$), and cost per survival day ($26.64 less, $P = .01$).

The difference in the proportion of patients in the intervention and control groups for whom imputed costs were used was not statistically significant. Costs for some of the NH days were imputed for 24 of the 51 (47.1%) long-term NH patients in the MTI group and for 28 of the 54 (51.9%) long-term NH patients in the control group ($P = .62$). Cost differences described above persisted when the analyses were performed after excluding days for which Medicare did not reimburse costs (data not shown).

DISCUSSION

This study investigated the effects of an intervention to prevent delirium in hospitalized older patients on long-term NH care and costs. The hypothesis was that the hospital-based intervention might have an effect on subsequent long-term NH costs by reducing the need for long-term NH placement or by reducing daily NH costs. The results indicated that, although the MTI did not significantly affect the likelihood of patients receiving long-term NH care, the costs for long-term NH patients were significantly lower for patients in the intervention group—including total costs and costs per survival day. These lower costs were primarily due to fewer days of long-term NH placement.

Previous studies have demonstrated that the MTI is cost-effective in preventing delirium in hospitalized older

Table 1. Sample Characteristics

Measure	Intervention Group (n = 400)*	Control Group (n = 401)†	*P*-value‡
	n (%)		
Baseline			
Married	153 (38)	136 (34)	.20
Demented	53 (13)	48 (12)	.59
Any impairment in activities of daily living	139 (35)	141 (35)	.90
Follow-up period			
Any nursing home stay	153 (38)	148 (37)	.70
Long-term nursing home stay	51 (13)	54 (13)	.76
Death during follow-up	97 (24)	89 (22)	.49

Mean age ± standard deviation = * 79.6 ± 6.0, † 80.0 ± 6.2; $P = .48$.
‡ *P*-values correspond to chi-square tests for dichotomous variables and to Wilcoxon tests for continuous variables.

Table 2. Characteristics of Patients with Long-Term Nursing Home (LTNH) Stays

Measure	Intervention Group (n = 51)	Control Group (n = 54)	*P*-value*
Baseline			
Age, mean ± SD	81.5 ± 6.9	81.9 ± 6.6	.68
Dementia, n (%)	22 (43)	21 (39)	.66
Married, n (%)	8 (16)	10 (19)	.70
Any impairment in activities of daily living, n (%)	26 (51)	40 (74)	.01
Follow-up period			
Died during follow-up, n (%)	12 (24)	9 (17)	.38
Days survived during follow-up, mean ± SD	341.6 ± 51.1	343.3 ± 58.9	.46
Total LTNH days, mean ± SD	241 ± 98	280 ± 93	.05
Total LTNH costs, $ mean ± SD	51,198 ± 22,176	60,882 ± 21,157	.02

* *P*-values correspond to chi-square tests for dichotomous variables and to Wilcoxon tests for continuous variables.
SD = standard deviation.

patients in the short term[4] and leads to improvements in health and functioning measures 6 months after discharge in some subgroups.[12] The current study demonstrated that the intervention has longer-term benefits as well.

Long-term NH cost savings due to the MTI are considerable. Adjusted total annual long-term NH costs were $9,446 lower per patient on average for patients receiving the intervention than for patients in the control group ($50,881 vs $60,327; $P = .01$). Considering that 1.56 million people aged 65 and older lived in NHs during 2000 in the United States,[8] that approximately 25% of NH residents were admitted from a hospital setting,[21] and that 34.9% of NH patients in the sample were long-term NH residents, the MTI could lead to substantial cost savings if the results were extrapolated to the national level.

Wide generalizations about these results have not been made. The study sample and many of the data on symptoms and functioning were collected from a single-site controlled trial. Nonetheless, patients enrolled in the study were drawn from a large sample representative of older patients admitted to an acute care hospital. Also, cost data were collected from Medicare, which limits the number of qualified NH days to 100 days per patient. Costs associated with days beyond the 100-day limit were imputed using the average costs associated with the individual NH. To the extent that average daily costs might increase or decrease with longer lengths of stay, the cost estimates may be over- or underestimated. However, there is no reason to suspect any systematic bias in the rates of over- or underestimation between intervention and control groups. The proportion of patients for whom imputed costs were used was similar across the two groups, and the cost differences remained when the analysis was repeated without using the imputed costs. In addition, the data are right-censored, meaning that, because some patients were still in the NH at the end of the follow-up period, it is possible that a patient who spent more than 100 days in a NH would be classified as a short-term NH patient if their stay began more than 265 days after discharge. However, more than 75% of long-term nursing patients in the study sample were admitted to the NH within 2 months of discharge, and there were no differences in the distribution of date of NH admission across the MTI and control groups. When short-term NH patients who were still in the NH at the end of the follow-up period were followed past 1 year using Medicare data, only three additional long-term NH patients were identified.

Table 3. Ordinary Least Square Regression Results of Patients Receiving Long-Term Nursing Home (LTNH) Care

	Log of Total LTNH Costs			Log of Total LTNH Days			Log of LTNH Costs per Survival Day		
Independent Variable	Estimate	± SE	*P*-value	Estimate	± SE	*P*-value	Estimate	± SE	*P*-value
Intercept	10.153	± 0.513	<.001	4.933	± 0.495	<.001	4.367	± 0.465	<.001
Received multicomponent targeted intervention	−0.222	± 0.085	.01	−0.189	± 0.082	.02	−0.235	± 0.074	.002
Age	0.010	± 0.006	.12	0.008	± 0.006	.21	0.009	± 0.006	.11
Dementia	0.148	± 0.094	.12	0.175	± 0.091	.06	0.249	± 0.087	.005
Married	−0.320	± 0.110	.005	−0.310	± 0.106	.004	−0.203	± 0.096	.04
Any impairment in activities of daily living (baseline)	−0.014	± 0.023	.55	−0.009	± 0.022	.68	−0.022	± 0.020	.29
R^2	.166			.160			.215		
Adjusted R^2	.124			.117			.175		

SE = standard error; R^2 = coefficient of determination.

Table 4. Fitted Values of the Probability of Having a Long-Term Nursing Home (LTNH) Stay, LTNH Costs, and Length of Stay*

Measure	Intervention Group	Control Group	Difference*	*P*-value†
Probability of LTNH stay	0.1275	0.1347	−0.0072	.92
Total costs per patient, $‡	50,881	60,327	−9,446	.01
Length of stay, days‡	220.2	261.2	−41.0	.04
Cost per survival day, $‡	148.83	175.47	−26.64	.01

* Multicomponent targeted intervention minus control.
† *P*-value for probability of LTNH stay based on logistic regression results. *P*-values for length of stay and cost per survival day are based on t tests comparing the retransformed fitted values.
‡ Of LTNH patients.

Finally, the perspective of the study is that of the healthcare system; thus, any benefits to patients receiving the MTI due to improved functioning or better quality of life are not captured in the present study.

This study shows that efforts to prevent delirium extend beyond the hospital stay. Research is currently underway to combine these long-term NH findings with other areas of care to more fully evaluate the long-term cost impact of the delirium intervention strategy.

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