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The Effects of a Collaborative Model of Primary Care on the Mortality and Hospital Use of Community-Dwelling Older Adults

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Background. This study evaluates the ability of a model of collaborative primary care practice to reduce mortality and hospital use in community-dwelling elderly persons.

Methods. Four rural and four urban clinic sites in east central Illinois were randomized to form treatment and comparison clinics from which patients were enrolled and followed prospectively for 2 years. Patients from the practices of participating physicians were eligible if they were aged 65 and older, were living in the community, and had at least one risk factor as determined prior to the study. Medicare hospital data were obtained from the Health Care Financing Administration. Demographic and health status measures were obtained by telephone interview every 12 months throughout the study.

Results. The treatment group experienced a 49% reduction in all-cause mortality during the second year of the study (odds ratio, 0.51, 95% confidence interval, 0.29–0.91, $p = .02$). There were no significant differences between treatment and comparison patients in percentage of persons hospitalized, hospital length of stay, or Medicare payments. Although measures of health status indicated that the treatment group was significantly sicker at baseline at the end of 1 year, these differences disappeared by the end of 2 years.

Conclusions. The collaborative primary care model evaluated in this study significantly reduced mortality in the second year, without increasing hospital use. These findings suggest that a collaborative primary care team that enhances primary care practice can result in better patient outcomes.

THE rapid growth of the elderly population and the projected expense to our health care system have renewed interest in primary care medicine as a means for improving patient outcomes and controlling growth in costs (1–3). Ideally, primary care practice should allow for a comprehensive, integrated system of care that addresses a wide spectrum of acute and chronic health care needs (4). Practically, the current scope of primary care practice is limited by fiscal incentives that reward disease-oriented, office-based, and episodic care provided primarily by physicians (5). Efforts to develop more broadly based systems of care that go beyond the treatment of illness to include health maintenance and prevention have often been disease specific (6,7), limited in duration (8–10), and, at times, have not actively involved primary care physicians in the study design (11). The limitations of previous studies illustrate the difficulty of evaluating new systems of primary care whose effectiveness relies on longitudinal care provided in the context of the doctor-patient relationship.

We conducted the current 24-month study to evaluate a primary care practice model in which physicians, nurses, and patients worked in collaboration to expand the scope of primary care practice. It was our hypothesis that this collaborative model, which focused on comprehensive assessment and coordinated longitudinal care management, would improve patient outcomes and lower costs.

Methods

Study Setting and Design

This study was conducted at the Carle Clinic Association and Carle Foundation, Urbana, Illinois, between May 1993 and May 1996. A total of 32 family practice (FP) and 19 internal medicine (IM) physicians from eight clinics agreed to participate in this study. These physicians were located in four rural and four urban clinics ranging in size from 4 to 16 physicians. To ensure a balance between rural and urban FP and IM practices, the practices of IM and FP physicians were randomized and then combined to form treatment and comparison groups. This resulted in 19 treatment physicians (10 IM and 9 FP) located in four clinics (two urban, two rural) and 32 comparison physicians (9 IM and 23 FP) located in four (two urban, two rural) clinics.

Study Population

After randomization, participating physicians were provided with patient lists that included information about patient age, gender, and the number of physician visits during the previous year. Physicians selected potential participants if they were aged 65 years or older, were community dwelling, and had any one of the following risk factors: hospitalized in the previous 6 months, lived alone, lacked a caregiver, were taking four or more prescription medications,

had difficulty walking, had limitations in activities of daily living, had difficulties with memory, were incontinent of urine or stool, or experienced multiple illnesses or disabilities requiring special care. Those individuals who were identified as potential study patients were contacted by mail (1286 comparison and 1376 treatment patients). Patients who returned an informed consent and completed a baseline interview between May 1993 and May 1994 were included in the study. A total of 941 individuals met the previously described criteria; 411 in the comparison group (239 FP patients, 172 IM patients) and 530 in the treatment group (239 FP patients, 291 IM patients).

Study Intervention

The specific details of the intervention have been published elsewhere (12,13) and are summarized below. The intervention included the addition of a registered nurse (RN) and a case assistant (CA) to the primary care practice of treatment group physicians. The collaborative team's goal was to enhance existing primary care by providing patient/family assessments conducted in the home or office, flexible home or office visits, and detailed care planning, as well as coordination and procurement of supportive services. The intervention also included routine telephone monitoring to identify changes in condition and adherence to treatment regimes, proactive postillness follow-up, disease education, and wellness promotion.

To promote communication among the physician, RN, CA, and the patient/family, the RN and CA were located in the offices of participating physicians. Communication occurred by telephone, voice mail, written notes and summaries, care-plan letters to patients and families, informal office conversations, and formal meetings in which patient treatment plans were discussed.

Upon enrollment, all treatment patients received an initial in-home assessment conducted by the RN. Protocols guided areas for intervention (e.g., nutrition, medication management, health promotion, prevention) and a team-generated plan of care was developed. The CA provided telephone monitoring and ensured the procurement and provision of supportive services identified by the team. Typically, the RN and CA were able to manage 150 patients and worked with an average of four to five physicians. The longitudinal nature (24 months) of the intervention was an important element in the design of the study since it was likely that any benefits of the intervention would accrue over time.

Data Collection and Measurement Intervals

Data were collected by telephone by trained interviewers who were blinded to the treatment and comparison groups. Baseline data included patient demographics, current health status, and functional status. Demographic data included age, gender, income, education, marital status, living arrangement, and caregiver arrangement. Assessments of health status included cognition (telephone version of the Mini-Mental State Examination [MMSE]) (14), number of prescription medications, and number of comorbid illnesses (heart disease, diabetes, myocardial infarction, stroke, chronic obstructive pulmonary disease, and cancer). Functional status included five subscales of the Health Status Questionnaire (HSQ) (15) and the number of restricted activity bed days. Data were again obtained at 12 and 24 months after enrollment.

Information about hospitalizations were obtained from the Health Care Financing Administration's (HCFA) Medicare part A data. Medicare data included the total number of hospitalizations, total number of hospital bed days, the diagnostic-related group (DRG) assigned to each hospital admission, and the total Medicare payment for each inpatient stay. These data were obtained for 12 months prior to the study and for the entire 24-month study period.

Mortality data were obtained from family members and the patient's medical record. Medicare part A data were used to verify inpatient deaths, and county health department records were used to identify deaths when survival status was unknown.

Statistical Analyses

Baseline comparisons between the treatment and comparison groups were made using Student's *t* test (two-tailed) for normally distributed continuous variables, chi-square tests for categorical variables, and the Wilcoxon rank sum test for nonnormally distributed continuous variables.

The effects of the intervention on mortality, health status, hospital utilization, and reimbursed hospital Medicare payments were evaluated using an intent-to-treat approach. Outcome effects were evaluated for the first and second year and for the entire 24-month study period. Sample size calculations indicated that 410 persons were needed in each group to detect a 25% reduction in hospitalization rates of 40% and a 45% reduction in a 10% annual mortality rate with 80% power, assuming a two-sided significance level of .05.

Logistic regression models, using backward stepwise selection, were used to test for treatment effects on mortality and hospitalization. Linear regression models, with stepwise selection, were used to evaluate the treatment effects on health status, length of stay, and Medicare expenditures. The covariates used in all regression models to control for differences included the following: age, gender, income, education, marital status, living arrangement, MMSE score, absence of a caregiver, number of prescription medications, the presence of comorbid illnesses, primary care physician type, restricted activity bed days, the number of months patients were in the study, clinic site, rural/urban designation of the clinic site, the five subscale measures of the HSQ at baseline, and the baseline value of the outcome variable. The regression models evaluating the amount of hospital use and Medicare payments also included the DRGs grouped into HCFA medical diagnostic categories (MDCs) (16). The regression models evaluating the effectiveness of the intervention on the five HSQ measures included the previously described covariates, but excluded the four HSQ measures not being evaluated, the MDCs, and the time variable.

Due to the nonnormal distribution of the hospital and Medicare payment data, a Cook's D statistic >1 was used to censure cases from the analysis allowing the parameter estimates (PE) of the linear regression models to be interpreted in their original measurement units. All statistical analyses

were performed using the SPSS software system, version 9.0 (SPSS Inc, Chicago, IL) (17). A p value of .05 indicated statistical significance.

Results

Baseline Characteristics of the Study Population

The baseline characteristics of the 941 patients in the comparison ($n = 411$) and treatment ($n = 530$) groups are shown in Table 1. Overall, patients in the treatment group were older and less well educated and reported a higher prevalence of cormobid illnesses and lower scores on the five measures of the HSQ. The treatment group also had higher hospital use and Medicare expenditures per person during the year prior to the study.

Intervention Intensity and Cost

Each treatment patient had an average of 8.0 intervention contacts (±9.2), totaling 4.8 hours (±5.0) in the first year and 8.4 intervention contacts (±10.2), totaling 4.6 hours (±5.9) in the second year. For both years, patients received a total of 16.1 (±16.1) intervention contacts, including 7.5 (±10.9) home visits, 1.4 (±2.0) office visits, and 7.3 (±6.8) phone calls. On average, each treatment patient had an additional 8.0 self-reported contacts with their primary care physicians over 2 years.

The per member per month cost of the intervention was $38 for the 2-year study period. The average cost of the study intervention was $906 per patient for the combined 2 years. These costs included all personnel, administrative, and overhead expenses.

Mortality

A total of 95 patients (10.1%) died during the study period; 47 (11.4%) in the comparison group and 48 (9.1%) in the treatment group. When the baseline differences between the groups were controlled for in the logistic regression analyses, the risk of death was significantly lower in the treatment group versus the comparison group (odds ratio, 0.51, 95% confidence interval 0.29–0.91, $p = .02$) during the second year of the study (Table 2) and approached significance for the 2-year study period. To assess the benefit of the intervention, we performed a number-needed-to-treat, or NNT, analysis (18) and found that each collaborative team needed to treat approximately 31 patients during the 2-year study period to prevent one death.

Table 1. Characteristics of the Study Population

Characteristic	Comparison Group ($n = 411$)	Treatment Group ($n = 530$)	p Value
Primary care physician type (% IM)	42	55	.000
Demographics			
Mean age, y (SD)	75.4 (6.4)	76.5 (6.7)	.01
Women (%)	75	71	.025
Married (%)	45	42	.43
White (%)	96	97	.93
High school graduate or above (%)	74	65	.000
<$20,000/y household income (%)	58	64	.06
Lives alone (%)	48	49	.76
Health Status			
≥5 prescription medications (%)	32	37	.16
MMSE score ≤17[†] (%)	8	12	.10
Restricted-activity bed days (%)	24	29	.08
Health Conditions			
Heart disease (%)	27	29	.44
Myocardial infarction (%)	14	21	.000
Stroke (%)	10	15	.03
Cancer (%)	9	7	.17
Chronic obstructive pulmonary disease (%)	11	14	.11
Diabetes (%)	20	23	.33
Health Status Questionnaire Scores[‡]			
Mean health perception (*SD*)	62 (23)	59 (24)	.06
Mean physical health (*SD*)	63 (29)	54 (30)	.000
Mean mental health (*SD*)	80 (17)	74 (20)	.000
Mean pain (*SD*)	71 (27)	67 (26)	.04
Mean energy/fatigue (*SD*)	53 (24)	47 (24)	.000
Prior Hospital Use			
Hospitalized (%)	22	28	.02
Mean hospitalizations/person hospitalized (*SD*)	1.6 (.94)	1.5 (.94)	.20
Mean length of stay/person hospitalized (*SD*)	5.7 (3.8)	6.6 (5.3)	.46
Mean Medicare hospital costs/person (*SD*)	$1705 ($4711)	$2149 ($5104)	.01

Notes: IM = internal medicine physician; MMSE = Mini-Mental State Examination.

[†]Telephone MSE score of ≤17 out of a total score of 24.

[‡]Range 0–100.

Table 2. Logistic Regression Results of the Treatment Effect on Mortality by Study Year

Variables	Year 1 OR (95% CI)	Year 2 OR (95% CI)	2-Year Total OR (95% CI)
Treatment effect (1 = treatment)	1.1 (0.47– 2.5)	0.51* (0.29–0.91)	0.71 (0.44–1.1)
Demographics			
Age	NS	1.1** (1.1–1.2)	1.1** (1.1–1.2)
Women	NS	NS	0.51** (0.31–0.85)
Health Status			
≥5 prescription medications	NS	NS	2.2** (1.3–3.5)
MMSE score ≤17†	3.1* (1.3–7.7)	NS	NS
Restricted-activity bed days	2.3* (1.0–5.3)	NS	2.0** (1.2–3.2)
Health Conditions			
Heart disease	NS	NS	NS
Myocardial infarction	NS	2.4** (1.3–4.3)	NS
Stroke	NS	NS	NS
Cancer	NS	2.6** (1.2–5.6)	NS
Chronic obstructive pulmonary disease	NS	NS	NS
Diabetes	NS	NS	NS
Health Status Questionnaire Scores			
Health perception	NS	NS	NS
Physical health	0.98** (0.96–0.99)	0.98** (0.97–0.99)	0.98** (0.97–0.99)
Mental health	NS	0.98** (0.97–0.99)	NS
Pain	NS	NS	NS
Energy/fatigue	NS	NS	NS
R^2	0.032 (4 *df*)	0.074 (8 *df*)	0.092 (8 *df*)

Notes: All regression models included adjustments for clinic site, rural/urban designation, primary care physician type, marital status, race, education level, household income, and living situation (alone or with others).

OR = odds ratio; CI = confidence interval; MMSE = Mini-Mental State Examination; NS = not significant.

†Telephone MMSE score of ≤17 out of a possible 24.

*$p < .05$; **$p < .01$.

Hospital Use

Eighty-nine comparison patients (21.7%) and 140 treatment patients (26.4%) were hospitalized during the first year of the study; 91 comparison group patients (22.6%) and 128 treatment patients (25.0%) were hospitalized during the second year of the study. A total of 149 comparison group patients (36.3%) and 221 (41.7%) treatment group patients were hospitalized during the entire 24-month study. There were no significant differences in the likelihood of hospitalization between the treatment and comparison groups for the study period (Table 3).

The linear regression models revealed no significant differences in hospital length of stay between the two groups during the study periods. The average length of stay during the first 12 months of the study for the comparison group was 5.0 days(±4.0) versus 6.0 days (±4.0) for the treatment group, 6.1 days (±5.0) for the comparison group versus 5.3 days (±4.0) for the treatment group in the second year of the study, and 6.0 days (±4.0) for the comparison group and 5.4 days (±3.3) for the treatment group for the entire study period.

Health Status

At the end of the first 12 months of the study period, the linear regression analyses indicated that the treatment group had significantly lower HSQ scores in mental health (PE, –2.2; $p < .05$) and energy/fatigue (PE, –3.4; $p < .05$). At the end of the study, there were no significant differences between the two groups.

Medicare Payments

The average inpatient Medicare reimbursement during the first year of the study for the comparison group was $1813 (±$5041) versus $2218 (±$5166) for the treatment group. The average inpatient Medicare reimbursement during the second year of the study for the comparison group was $2058 (±$5056) versus $2264 (±$5500) for the treatment group, and $3826 (±$7289) for the comparison group and $4452 (±$7706) for the treatment group for the entire study period. For those patients who had an inpatient hospitalization, the median Medicare reimbursement during the first year was $5057 for the comparison group and $6139 for the treatment group. During the second year, the median inpatient reimbursement was $6039 for the comparison group and $6265 for the treatment group. Results of the linear regression models revealed no significant differences between the two groups during the evaluation study periods.

DISCUSSION

This study evaluated the impact of a collaborative primary care team on the health status and hospital use of community-dwelling elderly persons living in east central Illinois. The most significant finding was the reduced risk for mortality in the treatment group during the second study year. Although differences in mortality during the 2-year study period only approached significance, the risk of death in the treatment group was 49% lower in Year 2 when compared with that of the comparison group. Coincident with the lower mortality rate was a disappearance of prior health

Table 3. Logistic Regression Results Showing Treatment Effects for any Hospitalization by Study Year

Variables	Year 1 OR (95% CI)	Year 2 OR (95% CI)	2-Year Total OR (95% CI)
Treatment effect (1 = treatment)	1.1 (0.77–1.5)	1.0 (0.73–1.4)	1.1 (0.82–1.5)
Demographics			
Age, y	NS	NS	NS
Women	0.67* (0.47–0.96)	NS	0.76* (0.54–0.99)
Health Status			
≥5 prescription medications	2.3** (1.6–3.2)	NS	NS
MMSE score ≤17†	NS	NS	NS
Restricted-activity bed days	NS	NS	NS
Health Conditions			
Heart disease	1.6* (1.1–2.2)	NS	NS
Myocardial infarction	NS	NS	NS
Stroke	NS	NS	NS
Cancer	NS	NS	NS
Chronic obstructive pulmonary disease	NS	NS	NS
Diabetes	NS	NS	NS
Health Status Questionnaire Scores			
Health perception	NS	0.99** (0.98–0.99)	NS
Physical health	.99* (0.98–1.0)	NS	0.99* (0.98–0.99)
Mental health	NS	NS	1.1* (0.97–0.99)
Pain	NS	NS	NS
Energy/fatigue	NS	1.1* (1.0–1.2)	NS
Any hospitalization prior to study entry	NS	1.8** (1.3–2.6)	NS
R^2	.106 (10 *df*)	.051 (6 *df*)	.051 (7 *df*)

Notes: All regression models included adjustments for clinic site, rural/urban designation, medical diagnostic categories, months in the study, primary care physician type, marital status, race, education level, household income, and living situation (alone or with others).

OR = odds ratio; CI = confidence interval; MMSE = Mini-Mental State Examination; NS = not significant.

†Telephone Mini Mental State Exam score of ≤17 or out of a possible 24.

*$p < .05$; **$p < .01$.

status differences between the two study groups. The HSQ measures showed significantly poorer health in the treatment group at baseline and at Year 1, but this difference disappeared by the end of the study.

There are two possible explanations why the reduced mortality occurred during the second year of the study. First, the benefits of enhanced primary care evaluated in this study require time to develop. The potential benefits of improved patient self-management, health promotion, and education are not immediate and must accumulate over time with repetition and familiarity. The clinical effectiveness of home visits and telephone monitoring likely also increase over time as patients became more familiar and accepting of these activities.

Second, the collaborative primary care practices were likely better developed and more effective during the later months of the study. It requires time to introduce new clinical programs into busy office practices, build professional relationships, establish lines of communication, and implement a team approach to primary care. These factors are highlighted by a significant increase in both patient and physician satisfaction that occurred during the second year of the study (data available from the authors).

Although one effect of the intervention seems to have been to improve the survival of what initially had been a sicker patient population, lowered mortality was not accompanied by increases in hospital use. There were no significant reductions or increases in the use of hospital care during the study for the treatment group. There were also no differences in rates of hospitalization, hospital length of stay, or Medicare payments during any year of the study. Although the costs of the intervention were quite modest ($906 per patient for both years), these costs were not offset by measurable reductions in hospital use.

This intervention had many components designed to enhance primary care services and, for this reason, it is difficult to identify specific components that resulted in lowered mortality. Although the benefits of home visits and telephone monitoring are well known, we know of few studies in which both of these methodologies have been combined with the health promotion and prevention activities of this collaborative primary care model. The reduced mortality is unlikely the result of improved prescribing practices or better physician management of specific diseases. No effort was made to implement disease management protocols or to enhance knowledge of geriatric medicine.

The collaborative practice model evaluated in this study has many features that distinguish it from usual primary care. First, the model requires that the physician and RN actively collaborate to manage the care of a well-defined panel of high-risk patients. This is unlike typical office practice in which the responsibilities of the RN are often diffused among many patients, less collaborative, and more acute care oriented. Second, the collaborative practice model promotes shared decision making between the patient, physician, and RN. This shared decision making al-

lowed for congruent planning and monitoring, which encouraged patients to adhere to health maintenance and treatment regiments. Third, the model relied upon a standardized set of protocols and guidelines, which defined comprehensive practice to include health maintenance and promotion. Fourth, the model allowed for maximum flexibility to manage patients outside of Medicare guidelines, which often restrict not only what can be provided, but how much can be provided, regardless of need. This flexibility was essential for health monitoring and maintenance.

This study had several limitations. First, the patient assignment did not follow a randomized, clinical trial design, which was not feasible in the participating primary care practices. We were concerned that the development of collaborative teams would alter the care provided to all patients in the intervention practices regardless of treatment group assignment. Our decision to randomize practices to ensure a balanced urban/rural mix created a disparity between the two patient populations. Treatment patients were more likely to be the patient of an IM physician, possibly explaining why they were in poorer health. Accordingly, all analyses were performed adjusting for these baseline differences between study groups, but all adjustments were limited to the variables available in the database. The extent to which we were able to adequately adjust for baseline differences between groups is unknown.

A second limitation of our study was our inability to compare overall costs of care for the treatment and comparison groups. After almost a 2-year delay in obtaining Medicare data from the HCFA, we had to restrict analyses to part A data to avoid prohibitive costs and additional delay. An unanswered question is whether the RN and CA contacts occurred in addition to usual physician office visits or acted as a substitute for physician visits. We also were unable to determine the intervention's effect on home health care, nursing home care, and other elements of health care use.

A third limitation of the study was that we were limited in the analyses to only those variables that had been collected as part of the original study. We included those variables that in previous studies have been shown to be predictors of the dependent variables, either hospitalization or mortality. Because this was an outpatient population, we did not have access to inpatient records that would have allowed us to calculate indices for severity of illness (Acute Physiology and Chronic Health Evaluation [APACHE]) (19) or comorbidity (20).

Finally, the results of this study may not be generalizable to other patient populations residing in different geographical areas and served by models of primary care with different payment mechanisms. The patients enrolled in this study were from both urban and rural areas and were selected using broadly defined medical and/or psychosocial criteria. Further study is needed to validate the results of this study and to identify those patients most likely to benefit from a more comprehensive approach to primary care.

The fundamental question raised by this study concerns the feasibility of collaborative primary care practice in the current health care environment. The typical primary care practitioner does not have the resources or, under fee-for-service reimbursement, the fiscal incentives to implement collaborative practice, regardless of the potential benefits to patients. Although the costs of this model are born by providers, the potential savings from any reduced hospitalization accrue to the Medicare program. At present, only managed care organizations who are at financial risk in the Medicare program have both the financial incentives and the organizational resources to develop integrated primary care systems such as the one evaluated in this study. This study suggests that there remain untapped efficiencies to be gained when a more comprehensive approach to primary care is applied to elderly patients. The reduction in mortality suggests that our current, limited system of primary care may be potentially detrimental to the health of our patients.

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