

Effectiveness of Team-Managed Home-Based Primary Care

A Randomized Multicenter Trial

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ALTHOUGH HOME-BASED health care has grown prodigiously over the past decade,^{1,2} controversy persists concerning its effectiveness.^{3,4} In part, this controversy reflects the substantial heterogeneity that exists across home-based care programs, users, and outcomes.^{5,6} An early study of a primary care home-based care model for The Department of Veterans Affairs (VA) found significant benefits.⁷⁻⁹ The VA Home-Based Primary Care (HBPC) program differs in important ways from the Medicare home health care benefit. It is financed prospectively at the facility level, enabling clinicians to exercise considerable clinical judgment regarding patient targeting and length of home care stay. Physicians are salaried staff who designate a specific percentage of time to the HBPC program. This feature enables referring physicians to transfer primary care management of patients at discharge to the HBPC physician and medical team who continue to provide primary care man-

Context Although home-based health care has grown over the past decade, its effectiveness remains controversial. A prior trial of Veterans Affairs (VA) Team-Managed Home-Based Primary Care (TM/HBPC) found favorable outcomes, but the replicability of the model and generalizability of the findings are unknown.

Objectives To assess the impact of TM/HBPC on functional status, health-related quality of life (HR-QoL), satisfaction with care, and cost of care.

Design and Setting Multisite randomized controlled trial conducted from October 1994 to September 1998 in 16 VA medical centers with HBPC programs.

Participants A total of 1966 patients with a mean age of 70 years who had 2 or more activities of daily living impairments or a terminal illness, congestive heart failure (CHF), or chronic obstructive pulmonary disease (COPD).

Intervention Home-based primary care (n=981), including a primary care manager, 24-hour contact for patients, prior approval of hospital readmissions, and HBPC team participation in discharge planning, vs customary VA and private sector care (n=985).

Main Outcome Measures Patient functional status, patient and caregiver HR-QoL and satisfaction, caregiver burden, hospital readmissions, and costs over 12 months.

Results Functional status as assessed by the Barthel Index did not differ for terminal ($P=.40$) or nonterminal (those with severe disability or who had CHF or COPD) ($P=.17$) patients by treatment group. Significant improvements were seen in terminal TM/HBPC patients in HR-QoL scales of emotional role function, social function, bodily pain, mental health, vitality, and general health. Team-Managed HBPC nonterminal patients had significant increases of 5 to 10 points in 5 of 6 satisfaction with care scales. The caregivers of terminal patients in the TM/HBPC group improved significantly in HR-QoL measures except for vitality and general health. Caregivers of nonterminal patients improved significantly in QoL measures and reported reduced caregiver burden ($P=.008$). Team-Managed HBPC patients with severe disability experienced a 22% relative decrease (0.7 readmissions/patient for TM/HBPC group vs 0.9 readmissions/patient for control group) in hospital readmissions ($P=.03$) at 6 months that was not sustained at 12 months. Total mean per person costs were 6.8% higher in the TM/HBPC group at 6 months (\$19 190 vs \$17 971) and 12.1% higher at 12 months (\$31 401 vs \$28 008).

Conclusions The TM/HBPC intervention improved most HR-QoL measures among terminally ill patients and satisfaction among non-terminally ill patients. It improved caregiver HR-QoL, satisfaction with care, and caregiver burden and reduced hospital readmissions at 6 months, but it did not substitute for other forms of care. The higher costs of TM/HBPC should be weighed against these benefits.

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agement inside and outside of the hospital until the patients are discharged from the program. Other disciplines encompassed by the home care team can include social workers, dietitians, thera-

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Table 1. Components of the Team-Managed Home-Based Primary Care (HBPC) Intervention and Compliance for 16 Sites

Component	Mean Compliance No. (%)
Target care to high-risk patients	15 (93.8)
Designate primary care manager within team	15 (93.8)
Provide 24-hour contact for patients	11 (68.8)
Prior approval of scheduled hospital readmissions	11 (68.8)
Transfer stable readmitted patients to step-down beds	12 (75.0)
Involve HBPC team in readmission discharge planning	9 (56.2)

pists, pharmacists, and health technicians (paraprofessional aides).

A prior VA study examined HBPC at a single site that targeted hospitalized patients with severe disability (2 or more activities of daily living [ADL] impairments) or terminal illness. This earlier trial of Team-Managed HBPC (TM/HBPC) found improved satisfaction with care among patients and caregivers that was accompanied by a 29% ($P = .03$) reduction in hospital readmission costs.⁷

Although these early findings were promising, a more definitive study using a more clearly delineated model and a larger number of participating hospitals was necessary to assess the impact of the model on an expanded set of patient and caregiver outcomes and on health care costs across the VA system. Specifically, we tested whether the model would improve patient functional status, patient and caregiver health-related quality-of-life (HR-QoL), and satisfaction with care and decrease hospital readmissions. The impact on total health care costs also was assessed.

METHODS

Study Sites

This multisite, randomized, controlled trial was conducted from October 1994 to September 1998 at 16 VA medical centers (VAMCs) that had an HBPC program, an involved home-based care physician, and an interest in testing this new home-based care model. Before the study began, study personnel met for 2 days

to train in implementing the study protocol and the TM/HBPC model. Site investigators continued to meet annually during the course of the study, and telephone calls were held monthly to discuss study protocol and model implementation issues. The trial was reviewed and approved by the Human Rights Committee of the Hines VA Cooperative Studies Program Coordinating Center, Hines, Ill, and by the research and human subjects subcommittees of each participating VAMC.

Eligibility Criteria

Hospitalized patients were eligible if they lived within the 25- to 35-mile catchment area served by their hospital's HBPC program and had 2 or more ADL impairments or a prognosis of terminal illness. Patients who did not meet the latter 2 criteria, but were homebound with a primary diagnosis of congestive heart failure (CHF) or chronic obstructive pulmonary disease (COPD), also were included. Patients referred from outpatient clinics or nursing homes with the same diagnoses were eligible if they had been hospitalized within the past 3 months. Patients with a primary diagnosis of psychiatric illness, alcoholism, substance abuse, or spinal cord injury were excluded. Eligible patients who refused to participate in the study were able to access HBPC but were not included as study participants.

Study Design

Research staff screened all patients admitted to medicine, surgery, and neurology units at each hospital. Written informed consent was obtained from eligible patients and caregivers, baseline data were collected, and patients were stratified prior to randomization by site, diagnosis, and age (younger than 65 years vs 65 years or older). Random assignments to the TM/HBPC group or to customary postdischarge care were made by telephoning the statistical coordinating center. Repeat measures of patient- and caregiver-centered outcomes were obtained at baseline, 1, 6, and 12 months, and health care use and cost data were monitored continuously over 12 months.

Patients were randomized into a treatment group (TM/HBPC intervention) and a control group. Patients were further subdivided into those who were terminally ill (terminal group) and those who were not terminally ill (non-terminal group; defined as those patients with severe disability or who had CHF or COPD) for analysis purposes.

Treatment Group. The TM/HBPC treatment delineated structure and process components of home-based care management that were provided as an overlay to the care routinely provided by HBPC (TABLE 1). It incorporated key features of integrated networks, including systematic screening to identify high-risk patients, an emphasis on continuity of care, and the management of patients across organizational boundaries.¹⁰ Participating sites were asked to provide continuous patient care management with the home-based care physician serving as the primary care physician. Patients continued to receive home care for as long as needed, until maximum patient benefit was achieved, or until a different level of care was required. Sites used clinical judgment to provide visits based on patient condition and need.

Control Group. Patients in the control group could access any VA-sponsored services for which they were eligible with the exception of HBPC, and non-VA postacute services for which they were eligible, such as Medicare home health or hospice care, and were encouraged to speak with their physicians about aftercare needs.

Outcomes

Patient- and Caregiver-Centered. Patient functional status was assessed using the Barthel Index.¹¹ Patient and caregiver HR-QoLs were assessed using the Medical Outcomes Study, short form, 36-item (MOS SF-36) subscales.¹² Subscale items also were aggregated into a Mental Component Scale (MCS) and a Physical Component Scale (PCS), to compare physical and mental health HR-QoL outcomes.¹³ Patient and caregiver satisfaction with the patient's care was assessed using selected Ware Satisfaction with Care scales.¹⁴ Scores were trans-

formed so that each subscale score ranged from 0 (total dissatisfaction) to 100 (total satisfaction). Caregiver burden was assessed using the Montgomery scale, which examines objective and subjective burden.¹⁵

Costs. Veteran Affairs and non-VA health care use and costs were monitored for 12 months. Veterans Affairs hospital, nursing home, outpatient, and TM/HBPC use were abstracted from national data files, and durable medical equipment and pharmacy use were obtained from local hospital computer systems. Private sector use and cost data were obtained from Health Care Financing Administration (HCFA) data tapes for Medicare-reimbursed services and from patient self-reports that were confirmed with providers (eg, hospitals, home health agencies, and nursing homes, in 20% of cases for which HCFA data were not available because patients were younger than 65 years and not eligible for Medicare). Number of readmission days, rates of readmission per patient, proportion of patients readmitted, and total units of service used across all other services were computed to compare use of VA and non-VA services by group.

Veterans Affairs costs were obtained by multiplying use by the cost per unit of use in fiscal year 1996. Unit costs were obtained for each VAMC from the VA Cost Distribution Reports, adjusted to account for any reporting errors in assigning staff to the HBPC program.¹⁶ Mean costs across the VAMCs were calculated and used in the analyses, and a sensitivity analysis was performed to learn whether using site-specific costs changed the results.^{17,18}

Private sector hospital costs were calculated as hospital charges, multiplied by the hospital's cost-to-charge ratio. Other Medicare costs were estimated by Medicare reimbursement to the facility and adjusted, when appropriate, for the Medicare 20% coinsurance rate. For the 20% of patients and for services not covered by Medicare, self-reported use data, confirmed by hospitals, home care, and nursing home providers, were used. Where billing data were not provided,

they were imputed based on available Medicare and billing data at each site. All non-VA costs were adjusted to 1996 costs using the appropriate medical care producer cost inflation index.

Other Variables. The Short Portable Mental Status Questionnaire was used to screen for presence of cognitive impairment.¹⁹ The Smith Comorbidity Index was used to assess risk of rehospitalization.²⁰

Implementation of the Model. The TM/HBPC model consisted of 6 components (Table 1). Implementation was assessed through annual surveys of study sites, examination of patient baseline data (Smith Comorbidity Index assessment of patient risk), telephone calls to patients, participant observation by research staff at site TM/HBPC team meetings, and monitoring VA administrative databases. Compliance ranged from 94% for patient targeting and designation of a primary care manager to 56% for involvement in readmission discharge planning.

Statistical Analysis

Success of randomization was determined by comparing the baseline characteristics of the treatment group with the control group using the χ^2 test for categorical variables, *t* test for normally distributed continuous variables, and the Wilcoxon rank-sum test for nonnormally distributed continuous variables.

Patients continued in the study for 1 year unless they died, withdrew, or were lost to follow-up. Patient- and caregiver-centered outcome measures were analyzed using repeated measures analysis of covariance. Patients and caregivers were included in the analyses if they responded to at least 1 of 3 posttests. Covariates included baseline score, diagnostic group, age group, and site. Because patients who were terminally ill had substantially poorer prognoses than patients who were not terminally ill, outcomes for the terminal vs nonterminal patients were modeled and reported separately. Use/cost data were analyzed using Wilcoxon rank-sum tests of readmis-

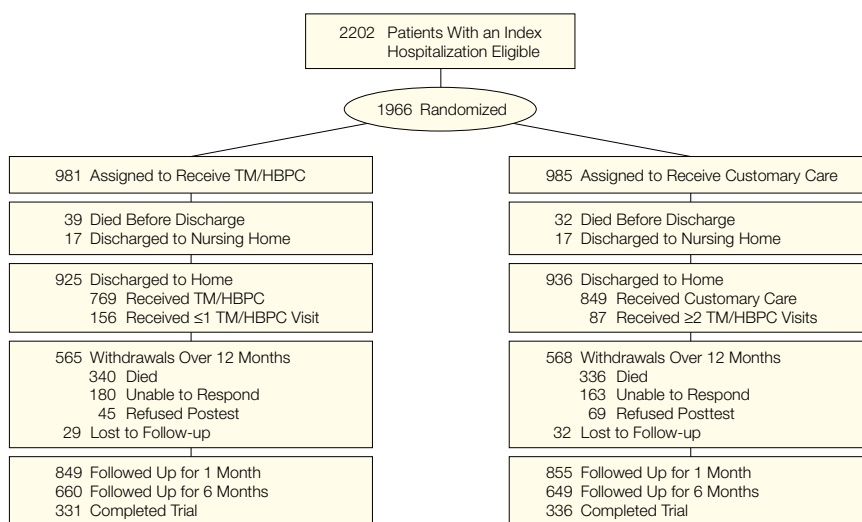
sion rates, use rates, lengths of stay, number of visits, and costs. χ^2 Tests were performed on the proportion of patients who were readmitted. Cost data were analyzed using intent-to-treat and as-treated analyses (ie, patients were grouped by randomization assignment in the first analysis and by the treatment they actually received in the second analysis).

RESULTS

Study Patients

A total of 1966 patients and 1883 caregivers were enrolled and randomized: 981 patients were randomized to the treatment group and 985 were randomized to the control group (FIGURE). Baseline demographic and clinical characteristics of participants showed no significant differences (TABLE 2). More than 90% of patients were male with a mean age of 70 years. A majority were married, approximately 30% were African American, and 30% had incomes less than \$10 000 per year. A majority (75%) of patients had severe disability, 20% were terminally ill, and 5% were homebound with a primary diagnosis of either CHF or COPD. Across all diagnostic groups, 55% had any CHF or COPD (data not shown). Patients had a mean of 3.2 ADL impairments, with the most common impairments being in bathing, dressing, and transferring. About 80% of patients resided with a family caregiver. A majority of patients were at medium-to-high risk of rehospitalization, and 88% had been hospitalized in the 6 months prior to enrollment. Family caregivers were largely female, had a mean age of 62 years, a mean Montgomery scale score for objective burden of 32 and for subjective burden of 25, indicating a moderate amount of burden at baseline.

Baseline values of patient- and caregiver-centered outcomes showed no statistically significant differences between treatment groups for either patients or caregivers (TABLE 3). Patients had very low MOS SF-36 physical function, physical role function, and PCS scores, consistent with their ADL impairments and history of hospital use.

Figure. Clinical Trial Flow Diagram

TM/HBPC indicates Team-Managed Home-Based Primary Care.

Implementation of the Model

Data on implementation of the TM/HBPC model (Table 1) show sites succeeded in targeting care to high-risk patients and designating a primary care manager but were less successful providing 24-hour emergency contact for patients, being notified of and preapproving elective hospital readmissions, transferring patients to step-down beds, and working with hospital inpatient staff on discharge planning during readmissions. Quarterly telephone calls to patients by research staff found that approximately 30% of patients in both groups experienced an emergency after hours; however, TM/HBPC patients were significantly more likely to know who to call ($P < .001$) (data not shown).

Seventy-eight percent of patients (769/981) randomized to the TM/HBPC group used HBPC services during the study period (Figure). Six percent ($n = 56$) of treatment and 5% ($n = 49$) of control patients either died during or went to a nursing home immediately following the index hospital admission. In the treatment group, another 156 TM/HBPC patients used 1 visit or less. Of these 156 patients, 22% ($n = 34$) died after discharge but before receiving HBPC, 19% ($n = 30$) were deemed inappropriate for care by HBPC staff, 23% ($n = 36$)

refused TM/HBPC, 11% ($n = 17$) could not be accommodated by HBPC at the time of referral, and 25% ($n = 39$) did not receive HBPC for various other reasons. Of patients assigned to the control group, 9% ($n = 87$) received 2 or more HBPC visits.

During the 12-month study period, 3.0% ($n = 29$) of treatment and 3.2% ($n = 32$) of control patients were lost to follow-up, 4.6% of patients ($n = 45$) in the treatment group vs 7.0% of patients ($n = 69$) in the control group refused to continue to participate, and 34.7% of the patients ($n = 340$) in the treatment group vs 34.1% of patients ($n = 336$) in the control group died ($\chi^2, P = .08$). Use and cost outcomes were obtained for decedents up until the date of death.

Mean length of home care stay for the TM/HBPC group was 5.6 months with a median of 4.5 months. Of treatment group patients, 58% were discharged from TM/HBPC within 6 months. Team-Managed HBPC patients received a mean (SD) of 0.85 (1.5) physician visits, 3 (2.0) nursing visits, and 0.5 (0.6) social work visits per month. Physicians also spent a mean (SD) of 24.3 (25.6) hours per month consulting on primary care management and attending weekly team meetings to review patient care.

Control group patients could access private sector non-VA home health and hospice care if eligible. Approximately 5.9% of control group patients ($n = 59$) used hospice care, with a mean (SD) length of stay of 48.5 (61.4) days, and 49% ($n = 483$) used private sector home health care for a mean (SD) of 102 (106) days and a median of 59 days (2 months). Nursing visits also predominated among Medicare home health care users with 46% of visits provided by skilled nurses, 42% by home health aides, 9% by physical therapists, and 3% by occupational therapists, speech pathologists, and social workers. When control group access to private sector home care was examined by age, patients 65 years and older were significantly more likely to use home-based care (48%) than those younger than 65 years (41%) ($P = .02$), probably as a function of their Medicare eligibility.

Outcomes

Patient Outcomes. Control vs TM/HBPC treatment coefficients from repeated measures analyses of covariance that were performed separately for terminal and nonterminal patients are shown in TABLE 4. Positive coefficients indicate a treatment effect favoring the TM/HBPC group and negative coefficients favor the control group. The coefficients reflect the differences in TM/HBPC group vs control group mean changes in outcomes over time adjusted for baseline values and stratification variables. No difference was observed in functional status (Barthel Index) among terminal or nonterminal patients by treatment group. However, terminal patients in the treatment group improved significantly vs those in the control group in 6 of 8 HR-QoL scales, including emotional role function, social function, bodily pain, mental health, vitality, and general health. For nonterminal patients, no HR-QoL differences were seen by group with the exception of a significant decrease in bodily pain in the control group, and no significant differences were seen by group in PCS or MCS scores. There was no difference in patient satisfaction with

care among terminal patients during 12 months. However, nonterminal patients in the treatment group reported significant increases of 5 to 10 points in 5 of 6 dimensions of satisfaction with care while scores for the control group remained the same or declined slightly.

Caregiver Outcomes. Caregiver outcomes that were derived from the same analyses as those used for patient outcomes are shown in TABLE 5. Positive coefficients indicate a treatment effect favoring the TM/HBPC group, and negative coefficients favor the control group, except for caregiver burden scores in which the opposite is true. Caregiver ratings of functional status (Barthel Index) for terminal patients showed no significant difference by group ($P = .40$) but were significantly higher among caregivers of nonterminal patients in the control group ($P = .001$). All other caregiver outcomes favored the treatment group. Caregivers of terminal patients in the TM/HBPC group showed significant HR-QoL improvements ($P < .05$ overall) compared with the control patients in all but 2 dimensions of the MOS SF-36, the exceptions being vitality and general health. Similar to terminal patients, they showed the greatest amount of improvement (10 points) in emotional role function. Caregivers of nonterminal patients in the TM/HBPC group also improved significantly in 6 MOS SF-36 dimensions (range, $P < .001$ to $P = .004$) compared with the control group, with the most pronounced effects occurring in social functioning, general health, and physical function ($P < .001$). The only dimensions that did not improve significantly were physical and emotional role functioning ($P = .07$ and $P = .20$, respectively). No significant differences were seen between groups on PCS and MCS scores for caregivers of terminal patients ($P = .12$ and $P = .06$, respectively), but significant benefits were seen in both scores for TM/HBPC caregivers of nonterminal patients ($P = .01$). Caregivers of the TM/HBPC group of terminal and nonterminal patients showed significant gains (on average 7-8 points in the terminal group [range, $P < .001$ to $P = .005$] and 3.80-9.5 points in the non-

terminal group [$P < .001$]) in satisfaction with patient care compared with the control group, with the exception of personal satisfaction among caregivers of the terminal patients in the TM/HBPC group ($P = .10$). Finally, TM/HBPC caregivers of nonterminal patients reported a significant decline in objective burden compared with controls ($P = .008$).

VA Hospital Readmissions

The impact on VA hospital readmissions (TABLE 6) for all patients by treatment group and by disease stratum shows a 7.9% ($P = .07$) relative reduction in proportion of TM/HBPC group patients admitted in the first 6 months,

with most of the reduction occurring among those with severe disability; however, this reduction was not sustained at 12 months. Similarly, an 11% ($P = .06$) relative reduction in mean number of TM/HBPC group readmissions was seen at 6 months but was not sustained at 12 months. This relative reduction was 22% ($P = .03$) in the subset with severe disability. Finally, no significant group differences were seen in number of rehospitalization days at 6 or 12 months.

Cost of Care

Veterans Affairs health care, private sector care, and total costs for treatment and

Table 2. Baseline Characteristics of Patients and Caregivers by Study Group*

Characteristic	TM/HBPC Group (n = 981)	Control Group (n = 985)	P Value
Patients			
Age, mean (SD), y	70.4 (10.3)	70.4 (10.3)	.95
Education, % <12 y	44.0	43.7	.92
Marital status, % married	58.7	60.6	.12
Race, %			
White, non-Hispanic	62.8	64.2	.83
Black, non-Hispanic	29.7	28.3	
Other	7.5	7.5	
Income <\$10 000, %	30.0	32.8	.37
Male, %	96.5	96.2	.73
Length of index admission, mean (SD), d	31.3 (45.9)	30.1 (49.2)	.07
From randomization to discharge, mean (SD), d	13.6 (38.3)	12.1 (36.0)	.52
Reside with caregiver, %	80.7	83.5	.11
Hospitalized in prior 6 months, %	88.7	88.8	.83
Disease group, %			
Terminally ill	20.7	20.1	.56
Not terminally ill			
Severely disabled	75.1	74.4	
CHF	1.4	1.6	
COPD	2.8	3.9	
SPMSQ, mean (SD), score	7.0 (3.6)	7.1 (3.6)	.50
Katz ADL, mean (SD), impairments	3.2 (1.8)	3.2 (1.8)	.68
Smith Comorbidity Index, % of patients			
Low	6.7	7.0	.17
Medium	59.7	55.5	
High	33.6	37.5	
Caregivers			
Female, %	83.3	83.6	.85
Age, mean (SD), y	61.6 (14.6)	62.2 (15.0)	.18
Caregiver burden, mean (SD), points†			
Objective	31.9 (5.2)	31.7 (5.2)	.54
Subjective	25.1 (8.7)	24.9 (8.3)	.99

*There were no significant baseline differences between groups. TM/HBPC indicates Team-Managed Home-Based Primary Care; CHF, congestive heart failure; COPD, chronic obstructive pulmonary disease; SPMQ, Short Portable Mental Status Questionnaire; and ADL, activities of daily living.
†Caregiver burden was assessed using the Montgomery scale.

control groups (all disease strata combined) were compared at 6 and 12 months. At 6 months, VA hospital re-admission costs for the TM/HBPC group were lower, but home-based care and nursing home care costs were significantly higher than the control group costs (data not shown). Despite significantly lower private sector costs, total

Table 3. Baseline Values of Patient- and Caregiver-Centered Outcomes by Study Group*

	Patient			Caregiver		
	TM/HBPC Group (n = 981)	Control Group (n = 985)	P Value	TM/HBPC Group (n = 937)	Control Group (n = 946)	P Value
Patient Barthel Index rating	73.9 (20.0)	75.4 (19.3)	.19	62.3 (27.0)	64.2 (25.5)	.25
HR-QoL (MOS SF-36) score						
Physical function	20.3 (22.6)	20.1 (22.3)	.85	74.4 (28.0)	74.7 (28.4)	.84
Role function-physical	14.4 (30.4)	12.5 (27.8)	.45	69.0 (42.6)	69.8 (41.8)	.69
Role function-emotional	57.2 (45.5)	56.7 (45.1)	.78	70.2 (41.1)	71.8 (39.9)	.50
Social function	45.5 (32.3)	43.6 (31.4)	.28	76.8 (29.7)	76.9 (28.9)	.70
Bodily pain	45.9 (32.2)	43.2 (30.6)	.18	70.9 (30.1)	72.7 (29.4)	.20
Mental health	63.4 (22.4)	63.5 (23.1)	.97	70.7 (21.8)	70.5 (21.2)	.59
Vitality	33.0 (22.5)	31.4 (23.1)	.11	54.1 (25.4)	54.1 (25.4)	.87
General health	39.5 (21.3)	38.0 (21.9)	.12	64.7 (23.9)	65.8 (23.2)	.32
PCS	25.7 (8.7)	24.9 (8.3)	.12	46.5 (12.4)	46.8 (12.4)	.45
MCS	46.3 (12.5)	46.1 (12.4)	.58	47.6 (12.1)	47.5 (12.6)	.75
Satisfaction with patient's care†						
Access	55.6 (18.4)	56.4 (18.9)	.59	57.2 (18.8)	57.7 (18.7)	.64
Technical quality	60.0 (21.4)	61.7 (21.8)	.08	61.7 (21.6)	61.9 (22.4)	.96
Communication	53.9 (23.3)	55.8 (23.0)	.13	58.1 (22.6)	57.6 (23.5)	.51
Interpersonal	61.5 (21.5)	63.2 (21.9)	.17	65.4 (21.2)	65.7 (22.0)	.64
Outcomes	62.2 (22.9)	64.6 (23.1)	.07	64.1 (23.0)	65.5 (24.0)	.16
Personal satisfaction	64.7 (13.2)	65.0 (12.9)	.58	67.2 (12.7)	67.5 (13.0)	.57

*Values are expressed as mean (SD). TM/HBPC indicates Team-Managed Home-Based Primary Care; HR-QoL, health-related quality of life; MOS SF-36, Medical Outcomes Study, short-form, 36 items; PCS, Physical Component Scale; and MCS, Mental Component Scale.

†Assessed using Selected Ware Satisfaction with Care scales.

Table 4. Impact of Treatment on Patient Outcomes by Terminal and Nonterminal Patient Status*

	Terminal Group (n = 188)		Nonterminal Group (n = 906)	
	Treatment Effect Coefficients, HBPC Minus Control (SE)	P Value for Treatment	Treatment Effect Coefficients, HBPC Minus Control (SE)	P Value for Treatment
Patient Barthel Index	-2.5 (2.3)	.40	-0.1 (1.2)	.17
Patient HR-QoL (MOS SF 36) score				
Physical function	-0.1 (3.5)	.88	-0.1 (1.5)	.75
Role function-physical	2.4 (5.4)	.55	-1.9 (2.6)	.44
Role function-emotional	12.7 (6.3)	<.001	1.8 (2.8)	.42
Social function	0.6 (4.6)	.03	3.2 (2.0)	.39
Bodily pain	2.4 (3.9)	.02	-2.0 (2.0)	.006†
Mental health	3.0 (2.7)	.008	0.3 (1.3)	.86
Vitality	1.8 (3.0)	.05	1.6 (1.4)	.45
General health	0.9 (2.8)	.03	-0.2 (1.2)	.94
PCS	-0.5 (1.2)	.71	-0.4 (0.5)	.49
MCS	1.4 (1.7)	.41	1.0 (0.7)	.15
Patient satisfaction with care‡				
Access	10.9 (2.6)	.44	5.3 (1.1)	<.001
Technical quality	11.8 (2.9)	.79	6.3 (1.3)	<.001
Communication	8.7 (3.1)	.74	8.5 (1.4)	.005
Interpersonal	9.2 (2.9)	.41	6.3 (1.3)	.001
Outcomes	7.5 (3.0)	.76	7.1 (1.4)	.02
Personal satisfaction	6.4 (1.6)	.96	2.2 (0.8)	.39

*Values shown are coefficients and P values for treatment effect in repeated measures analyses of covariance adjusted for baseline score, disease group, age, and site. The terminal group were patients who had a prognosis of terminal illness. The nonterminal group were patients who had at least 2 activities of daily living impairments or had congestive heart failure or chronic obstructive pulmonary disease. Patients in the terminal and nonterminal groups were those who completed baseline and at least 1 of 3 posttests. See Table 3 for Expansion of abbreviations.

†The only outcome to show a significant difference in favor of the control group.

‡Assessed using selected Ware Satisfaction with Care scales.

TM/HBPC costs were 6.8% higher than the total control group costs. At 12 months (TABLE 7), HBPC ($P < .001$) and nursing home ($P = .02$) costs were significantly higher for the TM/HBPC group than the control group, and only outpatient costs were significantly lower in the TM/HBPC group compared with the control group ($P = .02$). As a result, total VA costs were 18.1% higher in the TM/HBPC group ($P < .001$). This increase was partially offset by a 9% reduction in the TM/HBPC group for private sector or non-VA costs ($P < .001$). However, total costs of VA and private sector care combined were 12.1% higher for the TM/HBPC group ($P = .005$). This \$3000 difference was approximately equal to the cost of the TM/HBPC intervention and amounted to a mean add-on of \$282 per client per month. Sensitivity analyses substituting facility-specific costs vs those averaged across facilities for VA costs and using Medicare charges as opposed to reimburse-

ment produced the same findings, as did an as treated analysis.

COMMENT

This multisite randomized trial found no difference in patient functional status outcomes; however, terminally ill patients demonstrated significant improvements in HR-QoL, including a 13-point gain in emotional role functioning compared with controls, and nonterminal patients reported significantly higher satisfaction with care (ranging from a 5-point gain for access to a 9-point gain for communication) across 5 of 6 satisfaction subscales.

This is the first home-based care effectiveness study, to our knowledge, to assess impact on caregiver HR-QoL, caregiver satisfaction with the patient's care, and caregiver burden. Consistent benefits in the treatment group were observed in these outcomes. Although a significant improvement was seen in caregiver ratings of functional

status of nonterminal control group patients, it was very small (point change of 0.1 in a 100-point scale), and all other caregiver outcomes favored the TM/HBPC group. These outcomes included significant HR-QoL benefits for caregivers in the TM/HBPC group of both types of patients, including a 10-point increase in emotional role functioning among caregivers of terminally ill patients. Caregivers in the TM/HBPC group of both types of patients also reported systematic increases in satisfaction with their family member's care, ranging from 7 to 10 points. Finally, we believe that this is one of the first home-based care studies to demonstrate a significant benefit of treatment on objective caregiver burden among caregivers of nonterminal patients.

These patient and caregiver benefits were accompanied by an 8% reduction in proportion of patients with hospital readmissions and a 22% reduction in

Table 5. Impact of Treatment on Caregiver Outcomes by Terminal and Nonterminal Patient Status*

	Terminal Group (n = 289)		Nonterminal Group (n = 1317)	
	Treatment Effect Coefficients, HBPC Minus Control (SE)	P Value for Treatment	Treatment Effect Coefficients, HBPC Minus Control (SE)	P Value for Treatment
Caregiver rating of patient, Barthel Index rating	3.9 (2.4)	.40	-0.1 (1.2)	.001†
Caregiver HR-QoL (MOS SF-36) score				
Physical function	5.4 (2.0)	.001	3.0 (1.1)	<.001
Role function-physical	6.4 (4.2)	.04	4.0 (2.1)	.07
Role function-emotional	9.6 (4.7)	<.001	4.3 (2.1)	.20
Social function	2.4 (2.9)	.005	3.8 (1.4)	<.001
Bodily pain	5.4 (2.7)	.004	2.1 (1.4)	.004
Mental health	4.3 (2.1)	.03	1.7 (1.0)	.001
Vitality	5.9 (2.4)	.12	2.3 (1.1)	<.001
General health	2.7 (1.9)	.95	3.1 (0.9)	<.001
PCS	1.5 (1.0)	.12	1.1 (0.4)	.01
MCS	2.1 (1.1)	.06	1.3 (0.5)	.01
Caregiver satisfaction with patient's care‡				
Access	8.0 (2.3)	<.001	7.3 (1.0)	<.001
Technical quality	8.4 (2.4)	<.001	8.9 (1.1)	<.001
Communication	8.3 (2.5)	.005	9.5 (1.2)	<.001
Interpersonal	7.7 (2.5)	<.001	9.4 (1.1)	<.001
Outcomes	7.9 (2.5)	<.001	8.7 (1.2)	<.001
Personal satisfaction	1.1 (1.4)	.10	3.8 (0.7)	<.001
Caregiver burden§				
Objective	-0.6 (0.6)	.82	-0.7 (0.3)	.008
Subjective	-0.8 (0.8)	.10	-0.6 (0.4)	.47

*Values shown are coefficients and *P* values for treatment effect in repeated measures analyses of covariance adjusted for baseline score, disease group, age, and site. The number of caregivers for the terminal and nonterminal groups were for caregivers who participated in at least 1 posttest. See Table 3 for expansion of abbreviations.

†The only outcome to show a significant difference favoring the control group.

‡Assessed using selected Ware Satisfaction with Care scales.

§Assessed using the Montgomery Scale.

Table 6. Effect of Treatment on Veterans Affairs Hospital Readmission and Length of Stay by Disease Group*

Variable	Months 1-6			Months 1-12		
	TM/HBPC Group (n = 981)	Control Group (n = 985)	P Value	TM/HBPC Group (n = 981)	Control Group (n = 985)	P Value
Proportion readmitted, %						
All patients	49.2	53.4	.07	61.2	63.3	.35
Terminally ill	51.7	52.5	.92	56.2	56.1	>.99
Nonterminal						
Severely disabled	47.4	52.0	.08	61.5	63.6	.42
CHF	71.4	75.0	>.99	78.6	87.5	.64
COPD	70.4	73.4	.79	81.5	84.2	>.99
No. of readmissions, mean (SD)						
All patients	0.8 (1.2)	0.9 (1.3)	.06	1.3 (1.6)	1.3 (1.7)	.28
Terminal	1.0 (1.3)	1.0 (1.4)	.87	1.1 (1.4)	1.2 (1.8)	.93
Nonterminal						
Severely disabled	0.7 (1.0)	0.9 (1.2)	.03	1.2 (1.5)	1.3 (1.6)	.30
CHF	2.2 (2.6)	1.6 (1.5)	.68	3.6 (4.7)	2.0 (1.6)	.51
COPD	1.5 (1.6)	1.3 (1.3)	.95	2.4 (2.4)	2.5 (2.0)	.70
Rehospitalization for all patients, mean (SD), d	9.3 (18.3)	9.5 (17.5)	.16	14.7 (27.6)	13.3 (22.8)	.95

*TM/HBPC indicates Team-Managed Home-Based Primary Care; CHF, congestive heart failure; and COPD, chronic obstructive pulmonary disease.

Table 7. Effect of the Intervention on Costs of Care*

Source	Months 1-12, Mean (SD), \$		
	TM/HBPC Group (n = 981)	Control Group (n = 985)	Wilcoxon P Value
VA Utilization			
Inpatient	13 100 (21 439)	12 923 (20 414)	.64
HBPC	3617 (3845)	283 (1447)	<.001
Outpatient	3787 (5617)	4129 (5552)	.02
Nursing home	2472 (8426)	2056 (7859)	.02
Other†	2638 (4456)	2296 (3968)	<.001
VA Cost Total	25 614 (27 339)	21 687 (25 709)	<.001
Non-VA use costs			
Inpatient	2051 (9853)	1703 (6463)	.13
Home-based care	1192 (4595)	2308 (5514)	<.001
Hospice	96 (1034)	291 (1860)	<.001
Outpatient	239 (1663)	256 (1375)	.10
Medicare part B	452 (1630)	387 (1129)	.07
SNF	1460 (8593)	1085 (7671)	.32
Other‡	297 (2115)	291 (1645)	.65
Non-VA Cost Total	5787 (17 172)	6321 (13 210)	<.001
Total	31 401 (32 624)	28 008 (30 613)	.005

*TM/HBPC indicates Team-Managed Home-Based Primary Care; VA, Veterans Affairs; and SNF, skilled nursing facilities.

†Includes emergency department, pharmacy, durable medical equipment, contract nursing home, and adult day health care.

‡Includes emergency department, case management, emergency response, adult day health care, residential care, and homemaker/chore.

number of hospital readmissions among the patients with severe disability in the TM/HBPC group at 6 months that were not sustained at 12 months, and no reduction in number of days or cost of bed days was seen at either time period. As a result, patient and caregiver benefits were accompanied by a 6.8% increase in

total costs of care at 6 months and a 12.1% increase at 12 months.

The cost findings may reflect site difficulties implementing this complex model. This trial took place over 4 years at 16 hospitals across the United States when a considerable amount of change was occurring in the VA health care sys-

tem. During this time, several facilities closed their step-down units because of declining lengths of stay and several physicians and home care staff who were on board at the inception of the study moved on to other positions and were replaced by staff who may not have been as well versed in the model. More time devoted to ongoing site training and/or monitoring, simplification of the model, or some type of use/cost feedback might have improved cost outcomes.

Although roughly half of the control group patients in this study received private sector (mainly Medicare) home health care, neither they nor their caregivers showed the same HR-QoL and satisfaction benefits. Thus, this hospital-based primary care home care model appears to promote better patient and caregiver outcomes. We believe that greater perceived continuity and coordination of care that is possible within a vertically integrated care system is responsible for these outcomes. However, given a multiple component intervention, it is impossible to attribute the improvement to a single factor.

The findings of improved PCS and MCS scores and reduced burden among caregivers of patients with severe disability are noteworthy. These patients constitute an open-ended commitment for family caregivers. Recent find-

ings indicate that such caregiving is not without cost. The national economic value of informal caregiving is estimated to have been \$196 billion in 1997, compared with national expenditures that same year of \$32 billion for formal home health care and \$83 billion for nursing home care.²¹ Caregiver burden has been shown to be associated with poor mental and physical HR-QoL,²² and spousal caregivers who experience emotional strain have been shown to be 63% more likely to die within 4 years than noncaregivers,²³ indicating that caregiver outcomes must be considered in assessing home-care effectiveness.

Findings from this VA study may not be generalizable to the private sector. However, primary care management of the increasingly complex types of patients cared for at home is an important issue in both the VA and the private sectors. Although previous critiques of the home-based care literature have charged that programs must target "high risk" patients to achieve cost effectiveness,^{4,24,25} critics only now are beginning to recognize a concomitant need to develop the capacity to clinically and cost-effectively manage these patients' conditions at home. Recent single-site private sector home care trials that have both targeted high-risk patients and used either disease-specific care management protocols or advance practice nurses to manage the transitional care of patients have documented impressive 6-month cost savings.²⁶⁻²⁸ The comparative benefits of these new models, their impact on family caregivers, their replicability, and the generalizability of their results are unknown and constitute a pressing area for future home-based care research.

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