# Increased Satisfaction with Care and Lower Costs: Results of a Randomized Trial of In-Home Palliative Care

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**OBJECTIVES:** To determine whether an in-home palliative care intervention for terminally ill patients can improve patient satisfaction, reduce medical care costs, and increase the proportion of patients dying at home.

**DESIGN:** A randomized, controlled trial.

**SETTING:** Two health maintenance organizations in two states.

**PARTICIPANTS:** Homebound, terminally ill patients (N = 298) with a prognosis of approximately 1 year or less to live plus one or more hospital or emergency department visits in the previous 12 months.

**INTERVENTION:** Usual versus in-home palliative care plus usual care delivered by an interdisciplinary team providing pain and symptom relief, patient and family education and training, and an array of medical and social support services.

**MEASUREMENTS:** Measured outcomes were satisfaction with care, use of medical services, site of death, and costs of care.

**RESULTS:** Patients randomized to in-home palliative care reported greater improvement in satisfaction with care at 30 and 90 days after enrollment ($P<.05$) and were more likely to die at home than those receiving usual care ($P<.001$). In addition, in-home palliative care subjects were less likely to visit the emergency department ($P=.01$) or be admitted to the hospital than those receiving usual care ($P<.001$), resulting in significantly lower costs of care for intervention patients ($P=.03$).

**CONCLUSION:** In-home palliative care significantly increased patient satisfaction while reducing use of medical services and costs of medical care at the end of life. This study, although modest in scope, presents strong evidence for reforming end-of-life care. **J Am Geriatr Soc 55: 993–1000, 2007.**

**Key words: palliative care; in-home services; patient satisfaction; end-of-life care**

It has been widely recognized that our current medical care structure is inadequate in meeting the needs of terminally ill patients and reducing the cost of care at the end of life.[1] Despite the existence of hospice as a Medicare benefit for nearly 2 decades, the program remains underused. Approximately 60% of all deaths occur in the hospital,[2] yet most patients express a preference to die at home.[3–6] Although hospice programs aim to provide palliative services in the last 6 months of life, the median length of stay in the program is 22 days, and 35% of patients die within the first 7 days after hospice admission.[7] Hospice patients with a short length of stay often require intensive care to initiate the care plan, resulting in higher per diem costs of care than for patients who receive longer periods of stabilized, low-cost palliative care.[8,9] The low enrollment in hospice services and the short length of time enrolled before death attest to the need for end-of-life care programs that address these access barriers. In addition, recent studies have found that more end-of-life programs are needed to provide alternatives to hospice that do not require forgoing life-sustaining treatment.[10]

Although several studies have reported that end-of-life care programs improve patient outcomes, these studies have significant methodological weaknesses, limiting their generalizability.[11] Specifically, there has been a noticeable lack of comprehensive empirical evidence confirming the clinical benefits and demonstrating the cost effectiveness of these models of care. The absence of rigorous research evaluating the effectiveness of these programs has restricted the ability and motivation of healthcare providers to replicate and adopt these models as standard practice.

The purpose of this study was to test an in-home palliative care model at two sites using a randomized,

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controlled design. Standard care was compared with standard care plus an in-home palliative care program to determine the program's ability to improve patient outcomes and reduce the costs of medical care at the end of life. Specifically, it was hypothesized that the palliative care program would increase patient satisfaction, reduce costs of medical care, and increase the proportion of terminally ill patients dying at home.

## METHODS

This was a randomized, controlled trial conducted at two separate managed care sites to test the replicability and the effectiveness of an In-home Palliative Care (IHPC) program. Specific hypotheses tested for this study were that

- Late-stage patients with chronic obstructive pulmonary disease (COPD), congestive heart failure (CHF), or cancer enrolled in the IHPC program will experience higher satisfaction with care than patients receiving usual and customary care (usual care).
- Medical costs will be lower for end-of-life patients enrolled in the IHPC program than for end-of-life patients receiving usual care.

The settings for this trial were two group-model, closed-panel, non-profit health maintenance organizations (HMOs) providing integrated healthcare services in Hawaii and Colorado. The Colorado site has more than 500 physicians representing all medical specialties and subspecialties in 16 separate ambulatory medical offices spread across a greater metropolitan area. The HMO contracts with outside providers for emergency department, hospital, home health, and hospice care to serve its 477,000-person membership, which spans the six-county Denver metropolitan area.

The Hawaii site is located on Oahu and serves approximately 224,000 members, with 12 medical offices in Oahu, three in Maui, and three on the Big Island. Three hundred seventeen medical group physicians provide care. In contrast to Colorado, the HMO provides all outpatient and most inpatient care. The Hawaii site operates a 217-bed medical center and also has an internal home health agency, accepting referrals from hospital- and clinic-based medical group physicians. Referrals are processed via a referral center staffed by home care nurses. The Hawaii site does not have an internalized hospice agency and refers patients to outside providers for hospice care only.

Principal investigators in Southern California, where data collection and analysis were conducted, coordinated the study. The institutional review boards of the HMO in Hawaii, Colorado, and the external evaluator approved this study. Participants were enrolled and followed from September 2002 to August 2004. Patients eligible to participate in the study must have had a primary diagnosis of CHF, COPD, or cancer and a life expectancy of 12 months or less, have visited the emergency department or hospital at least once within the previous year; and scored 70% or less on the Palliative Performance Scale.[12,13] The Palliative Performance Scale is a modified Karnofsky scale that ranks the patient's health condition from 0 (death) to 100 (normal). This scale was used to assess the patients' severity of illness. To determine life expectancy, the primary care physician was asked, "Would you be surprised if this patient died in the next year?" This indicator has been used widely to ascertain appropriateness for end-of-life care.[14,15] Patients with physician responses indicating no surprise if the patient died within the next year were included in the study.

Discharge planners, primary care physicians, and other specialty physicians referred potentially eligible terminally ill patients to the study. All patients referred were assessed for study eligibility. For those meeting the initial criteria, the intake clerk contacted the primary care physician to determine the prognosis. Once eligibility was determined, the intake clerk gained informed consent from the patient to participate in the study. The intake clerk then contacted evaluators, who randomly assigned patients to the palliative care intervention or usual care. Group assignment was determined by blocked randomization using a computer-generated random number chart, stratified according to study site. Based on methods established previously,[16] it was determined that, using a significance criterion of .05, a sample size of 300 would be necessary for a statistical power of 0.80, using nondirectional (two-tailed) tests to detect whether the intervention had a significant effect on medical care costs.

### Intervention

Each patient enrolled in the intervention arm received customary and usual standard care within individual health benefit limits in addition to the IHPC program. The IHPC program is an interdisciplinary home-based healthcare program designed to provide treatment with the primary intent of enhancing comfort, managing symptoms, and improving the quality of a patient's life. Modeled after hospice programs in that it offers pain management and other comfort care in the patient's home, the IHPC program features three important modifications, all of them intended to increase access and timely referrals to the program.

- Physicians are not required to give a 6-month prognosis. Recognizing that it is often difficult to estimate life expectancy, referral guidelines were expanded to target patients earlier in their disease process, with an estimated 12-month life expectancy.
- Although the IHPC program emphasizes much-improved pain control and other symptom management, patients do not have to forgo curative care, as they do in hospice programs.
- Patients are assigned a palliative care physician who coordinates care from a variety of healthcare providers, including specialists and the patients' primary care physician, thus preventing the service fragmentation that often occurs in healthcare systems. The structure of the IHPC program allows patients to maintain their primary care provider while also receiving home visits from the palliative care physician.

The IHPC program uses an interdisciplinary team approach, with the core care team consisting of the patient and family plus a physician, nurse, and social worker with expertise in symptom management and biopsychosocial intervention. The core team is responsible for coordinating and managing care across all settings and providing assessment, evaluation, planning, care delivery, follow-up,

monitoring, and continuous reassessment of care. Comprehensive education and discussions focus on identifying goals of care and the expected course of the disease and expected outcomes, as well as the likelihood of success of various treatments and interventions.

Upon admission, the team assesses the physical, medical, psychological, social, and spiritual needs of the patient and family. All patients received initial assessments from physicians, nurses, and social workers. Additional team members, including spiritual counselor or chaplain, bereavement coordinator, home health aide, pharmacist, dietitian, volunteer, physical therapist, occupational therapist, and speech therapist, join the core care team in service provision as needed. The team convenes to develop a care plan in accordance with the wishes of the patient and the family. Frequency of subsequent medical visits is based on the individual needs of the patient. Physicians conduct home visits and are available along with nursing services on a 24-hour on-call basis. In addition, advanced care planning is provided that involves patients and their families in making informed decisions and choices about care goals and end-of-life care.

The team provides education, support, and medical care to the patients and their families. Additionally, patients and families are trained in the use of medications, self-management skills, and crisis intervention in the home with the goal of stabilizing the patient and minimizing excessive emergency department visits and acute care admissions. Participants enrolled in the IHPC arm received palliative care until death or transfer to a hospice program. (For more information on this model, see[17,18].)

### Usual Care

Usual care consisted of standard care to meet the needs of the patients and followed Medicare guidelines for home healthcare criteria. These services included various amounts and levels of home health services, acute care services, primary care services, and hospice care. Patients were treated for conditions and symptoms when they presented them to attending physicians. Additionally, they received ongoing home care when they met the Medicare-certified criteria for an acute condition.

### Data Collection

Data were collected from patient interviews and from the HMO service utilization databases at each site. Interviews were conducted via telephone within 48 hours of study enrollment and every 30, 60, 90, and 120 days to gather demographic information and satisfaction with services. Undergraduate- and graduate-level research assistants, blinded to group assignments, were recruited and trained to conduct telephone interviews with the patient or, if the patient was unable to participate, the primary caregiver. Interviews were approximately 20 minutes long. Site of death was obtained from HMO records, death certificates, and family report.

#### *Utilization Data*

Service utilization data for each subject were collected retrospectively from the HMO mainframe database. Medical service use data were collected from the time the patient enrolled in the study until the time of death or the end of the study period. Medical service use data included costs for all standard medical care as well as the costs associated with the palliative care program. Service data included number of emergency department visits, physician office visits, hospital days, skilled nursing facility days, home health and palliative visits, palliative physician home visits, and days on hospice. Service costs were calculated using actual costs for contracted medical services (services provided by non-HMO contracted facilities in Colorado) and proxy cost estimates for all services provided within the HMO. Because services provided within the HMO are not billed separately, it was necessary to use proxy costs. Costs were based on figures from 2002. Hospitalization and emergency department cost estimates were calculated using aggregated data from more than 500,000 HMO patient records and include ancillary services such as laboratory and radiology. Costs of physician office visits included nurse and clerk expenses. Home health and palliative care visits were calculated using average time spent on each visit and multiplying that by the cost for each discipline's reimbursement rate. Proxy costs generated for hospital days and emergency department visits were significantly lower than the actual costs received from contracted providers. A total cost variable was constructed by aggregating costs for physician visits, emergency department visits, hospital days, skilled nursing facility days, and home health or palliative days accumulated from the point of study enrollment until the end of the study period or death.

Enrollment in hospice was gathered retrospectively and was only available from one study site because of difficulty obtaining data from community hospice providers at the second site.

#### *Satisfaction Instrument*

The Reid-Gundlach Satisfaction with Services instrument[19] was used to measure study group member satisfaction, rating overall satisfaction with services, perception of service providers, and likelihood of positive recommendations of services to others. This instrument has been employed in previous studies examining satisfaction with end-of-life care programs.[17,20,21] Satisfaction with care was calculated by adding the score of 12 of the 13 items (one item was a qualitative measure) on the instrument for a total possible score of 48. This method has been employed in previous studies using this instrument.

#### *Severity of Illness*

The Palliative Performance Scale,[12,13] described earlier in this manuscript, was used to measure severity of illness.

### Statistical Analysis

Differences between study group sample characteristics were analyzed using two-tailed *t* tests for continuous variables where the distribution was normal. Chi-square tests were used to determine significant differences between discrete variables. Satisfaction with services was analyzed in two ways. First, to determine the clinical meaningfulness of the change in satisfaction according to study group, satisfaction scores were dichotomized as recommended previously[22] and used in other studies,[23] with those with a total score of 37 or above categorized as very satisfied. Next,

logistic regression models were developed for dichotomous satisfaction variables using baseline and 30-, 60-, and 90-day follow-up measures. Linear regression was employed to determine the effect of study group on the number of hospital inpatient days and emergency department days while controlling for length of time enrolled in the study (survival) and demographic variables. Logistical regression was used to determine study group likelihood of dying at home. Kaplan-Meier survival analysis, using the log rank statistic, tested for study group differences in survival time. All study participants were included in the analysis, with those who survived to the end of the study period censored on the last day of the study.

Medical cost data are generally skewed, requiring transformation of the dependent variable for better data fit. As expected, analysis of total medical costs indicated that they were extremely right-skewed; hence, a log transformation of medical costs and Duan's smearing estimate followed linear regression to determine whether transformation of data resulted in a better fit. A comparison of models revealed that, although the log transformation resulted in a normal distribution, the ordinary least squares regression explained a larger amount of the variance (higher coefficient of determination; $R^2$) and had lower error. Further comparison of the residual distributions (the difference between the actual value of the dependent variable and its value as estimated by the equation) revealed a linear relationship between the nontransformed costs. Based on these findings, ordinary least squares regression was used in the final analysis, a decision supported by other studies.[24] Owing to the differences in survival time between study groups, analysis of service use and medical care costs were adjusted for length of time on the program before death or the end of the study period. Analyses were conducted using SPSS 10.1 statistical software package (SPSS Inc., Chicago, IL) and LIMDEP, version 8.0 (Econometric Software, Inc., Plainview, NY).

## RESULTS

From September 2002 through March 2004, 718 patients were referred to the study. Of these, 408 were excluded; 196 did not meet study eligibility criteria, 67 were eligible for and admitted to hospice care, 59 refused, 38 died before enrollment, 26 were part of another research project terminating their eligibility for participation in this study, and 22 moved out of the area or could not be contacted. As a result, 310 terminally ill participants were randomly assigned to usual care (n = 155) or the in-home palliative care program (n = 155). Of these, eight intervention group members died before receiving any palliative care, and five usual care members withdrew from the study, leaving 297 available for analysis (Figure 1).

The sample consisted of almost equal numbers of men (51%) and women (49%), with a mean age ± standard deviation of 74 ± 12.0. Thirty-seven percent belonged to an ethnic minority group; 18% were Asian/Pacific Islanders, 13% Hawaiian, 4% Latino, and 2% other. Fifty-two percent were married, 29% widowed, and 15% single or divorced. Forty-seven percent were referred to the program with a diagnosis of cancer, 33% with CHF, and 21% with COPD. Seventy-six percent lived in their own home or apartment, and 8% lived in the home of a family member;

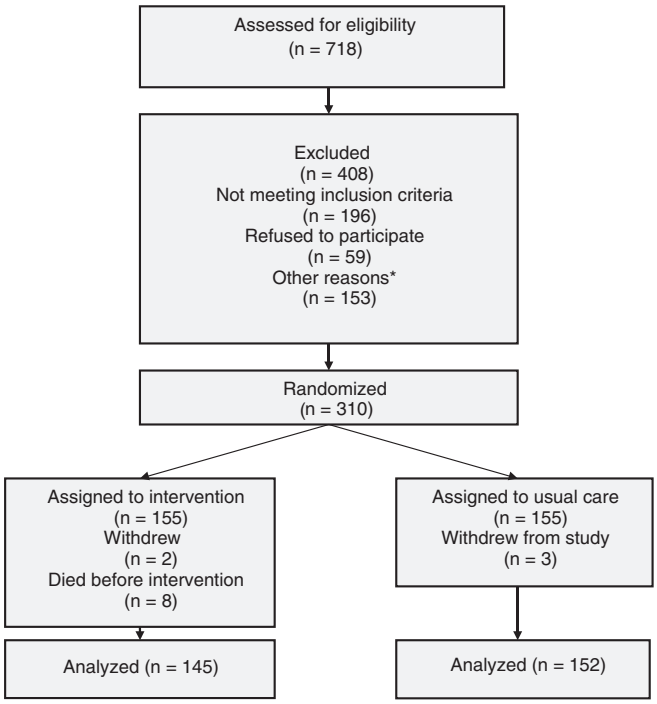


**Figure 1.** Patient flowchart. *Other reasons includes those referred to hospice (n = 67), those who died (n = 38), those who were already in another study (n = 26), and those who moved out of the area or could not be contacted (n = 22).

74% resided with a family member, primarily a spouse or a child, and 26% lived alone. Thirty-three percent reported having an annual income of $20,000 or less. Participants came from an array of educational backgrounds; approximately 22% did not complete high school, 41% were high school graduates, and 36% had some college or postgraduate education (Table 1).

Overall, the majority of the sample demographics were consistent at both study sites, although there was some variation. Sixty-three percent of participants in Hawaii were minorities, compared with 10% in Colorado. This difference in ethnic distribution is reflective of the larger demographics within each of the states. Eighty-two percent of participants in Hawaii were living with a family member, compared with 72% in Colorado. Finally, 27% of participants in Colorado suffered from COPD, versus 15% of participants in Hawaii. There were no significant differences between sites in age, education, marital status, income, or housing status (Table 1).

During the course of the study, 75% (n = 225) of the participants died. There were no significant differences between study groups in terms of the portion of patients dying during the study period, although differential survival periods after enrollment in the study were found using independent-sample *t* tests, with those enrolled in the intervention surviving an average of 196 ± 164 days and those in usual care surviving an average of 242 ± 200 days ($P = .03$). Results of the Kaplan-Meier survival analysis did not show significant differences in survival time between study groups (log rank test = 2.98; $P = .08$), although subsequent analysis controlled for survival days due to the strong trend toward differences and its potential effect on use of medical services and costs of medical care.

**Table 1. Baseline Characteristics**

| Characteristic | Colorado (n = 147) | Hawaii (n = 150) | Usual Care (n = 152) | Intervention (n = 145) | Total (N = 297) |
|---|---|---|---|---|---|
| Female, n (%) | 71 (48) | 74 (49) | 81 (53) | 65 (45) | 146 (49) |
| Age, mean ± SD | 74.1 ± 10.8 | 74.3 ± 13.1 | 73.7 ± 13.0 | 73.9 ± 11.1 | 73.8 ± 12.1 |
| Racial minority, n (%) | 14 (10)* | 95 (63)* | 53 (35) | 56 (39) | 109 (37) |
| Married, n (%) | 83 (58) | 72 (51) | 73 (48) | 82 (57) | 155 (52) |
| Primary diagnosis, n (%) | | | | | |
| Cancer | 65 (44) | 73 (48) | 74 (49) | 64 (44) | 138 (47) |
| Congestive heart failure | 42 (29) | 55 (37) | 52 (34) | 45 (31) | 97 (33) |
| Chronic obstructive pulmonary disease | 40 (27)* | 22 (15)* | 26 (17) | 36 (25) | 62 (21) |
| Education, mean ± SD | 12.0 ± 2.1 | 11.6 ± 2.5 | 11.9 ± 2.2 | 11.8 ± 2.4 | 11.9 ± 2.3 |
| Lives with family member, n (%) | 103 (72)* | 116 (82)* | 105 (69) | 114 (79) | 219 (74) |
| Lives in own house/apartment, n (%) | 113 (77) | 114 (76) | 113 (74) | 114 (79) | 227 (76) |
| Annual income <$20,000, n (%) | 46 (45) | 53 (45) | 53 (35) | 46 (32) | 99 (33) |
| Palliative Performance Scale score, mean ± SD | 62.5 ± 11.5 | 54.2 ± 11.9 | 58.5 ± 12.0 | 57.8 ± 13.1 | 58.2 ± 12.5 |
| Satisfaction, mean ± SD | 39.4 ± 6.0 | 40.9 ± 5.3 | 39.3 ± 6.2 | 40.8 ± 5.2* | 40.1 ± 5.7* |

*$P < .05$.
SD = standard deviation.

### Baseline Measures

There were no significant differences between study groups in baseline measures other than satisfaction. Satisfaction with services was measured at baseline after study assignment. Those randomized to intervention demonstrated significantly higher satisfaction with services at baseline than those assigned to usual care ($P = .03$). Member awareness of the results of randomization may have influenced the higher level of satisfaction at baseline in those in the palliative care group.

### *Satisfaction with Care*

Analysis of satisfaction data included satisfaction at baseline (n = 277) and 30 days (n = 216), 60 days (n = 168), and 90 days (n = 149) after study enrollment. Significant reduction in sample size at 120 days (n = 136) resulted in the exclusion of this data in analyses. There was no significant difference in the portion of participants according to study group reporting to be very satisfied at baseline or at 60 days after enrollment (odds ratio (OR) = 1.79; 95% confidence interval (CI) = 0.65–4.96; $P = .26$), although rates of satisfaction increased in the intervention group at 30 days (OR = 3.37, 95% CI = 1.42–8.10; $P = .006$) and 90 days (OR = 3.37, 95% CI = 0.65–4.96; $P = .03$) after enrollment, with 93% of those enrolled in the palliative care group very satisfied with care at 90 days after enrollment, compared with 81% of usual care patients (Figure 2).

### *Service Use*

Bivariate analysis revealed significant differences between groups in terms of service use. Twenty percent of palliative care members went to the emergency department, compared with 33% of usual care members ($P = .01$; Cramer's $V = .15$). Similarly, 36% of those receiving palliative care were hospitalized, compared with 59% of those enrolled in usual care ($P < .001$; Cramer's $V = .23$). Number of days in the study was significantly different according to study group, as well. Those enrolled in the IHPC group remained in the study for 196 days on average, whereas those in the usual care group were in the study an average of 242 days. Because of these differences, additional analysis was conducted after controlling for length of time on the program

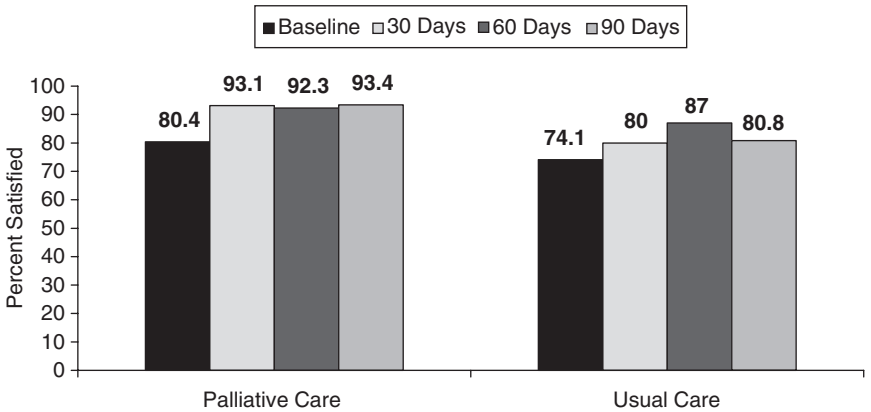


**Figure 2.** Percentage very satisfied at enrollment (n = 277), 30 days (n = 216), 60 days (n = 168), and 90 days postenrollment (n = 149) according to study group.

**Table 2. Predictors of Medical Costs After Study Enrollment (N = 297)**

| Variable | Mean Cost | 95% Confidence Interval | *P*-Value | $R^2$ |
|---|---|---|---|---|
| Age | −312 | (−547 to −761.02) | .01 | .002 |
| Days enrolled | 42 | (27–57) | .001 | .125 |
| Health status | −2,323 | (−5,524–878) | .15 | .130 |
| Congestive heart failure (vs cancer) | 5,255 | (−1,297–11,808) | .12 | .138 |
| Chronic obstructive pulmonary disease (vs cancer) | 3,294 | (−3,648–10,237) | .35 | .138 |
| Palliative (vs usual care) | −7,552 | (−12,730 to −2,374) | .004 | .160 |

*Note*: Dependent variable, total medical costs.
Mean costs are measured in dollars.

(survival), age, and severity of illness. Linear regression revealed that enrollment in the IHPC reduced hospital days by 4.36 ($P < .001$; $R^2 = 0.14$) and emergency department visits by 0.35 ($P = .02$; $R^2 = 0.04$) after adjusting for survival, age, and severity of illness.

Although enrollment in hospice was not a specific aim of this project, rates of enrollment were reviewed. Hospice data were available from one of the study sites, with analysis of differences between the portions enrolled in hospice (25% of intervention vs 36% of usual care, $P = .15$) and days in hospice ($t = .52$; $P = .60$) before death revealing no significant differences between study groups.

### *Costs of Care*

Significant differences between palliative and usual care members in cost of care ($t = -3.63$, $P < .001$) were noted. Owing to differences in time enrolled in the study, a linear regression was conducted to determine the portion of costs explained by study group, controlling for days on service (survival), age, severity of illness (measured using the Palliative Performance Scale), and primary disease. Days enrolled was significantly correlated with age and severity of illness, although the associations between these variables were weak ($r = 0.22$ and 0.20, respectively). Three variables were significant in the regression model: age (although the effect size was small), days enrolled (survival), and enrollment in the IHPC program (Table 2). This analysis revealed that overall costs of care for those enrolled in the IHPC program were 33% less than those receiving standard care ($P = .03$; 95% CI = −$12,411 to −$780; $R^2 = 0.16$). The adjusted mean cost for patients enrolled in the palliative care group was $12,670 ± $12,523, compared with $20,222 ± $30,026 for usual care. Figure 3 represents the average cost of care per member per day according to study group. The average cost per day incurred by palliative care recipients ($95.30) was significantly lower than that of usual care group members ($212.80) ($t = -2.417$; $P = .02$).

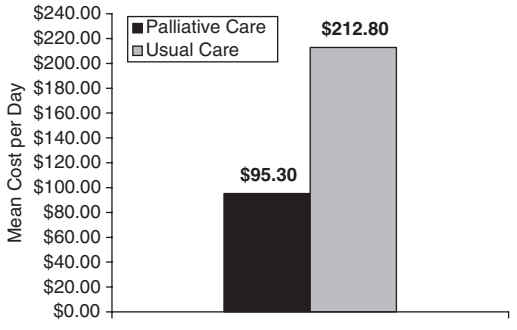


**Figure 3.** Average adjusted cost of care per day according to study group (n = 297).

### *Site of Death*

During the course of the study, 75% of study members included in the final analysis died. For 98% of these persons, site of death data were available. Seventy-one percent of IHPC participants died at home, compared with 51% of those receiving usual care ($P < .001$). Bivariate logistic analysis confirmed that patients enrolled in the IHPC program were significantly more likely to die at home and less likely to die in an acute care facility. Furthermore, after controlling for age, survival time, and medical conditions, IHPC participants were 2.2 times as likely to die at home as those receiving usual care (OR = 2.20, 95% CI = 1.3–3.7; $R^2 = 0.27$, $P < .001$).

## DISCUSSION

This study examining the effect of the IHPC revealed several positive findings. The IHPC intervention improved patient satisfaction at 30 and 90 days after enrollment, improved the likelihood of dying at home, and significantly reduced the cost of care overall and by average cost per day. First, providing an interdisciplinary palliative care team within the home of terminally ill homebound patients earlier in the disease trajectory has a positive effect on patient satisfaction with medical care in addition to influencing costs of care at the end of life. Recent studies have found that, although costs of care vary from state to state and from hospital to hospital, they remain high in the last 2 years of life.[25] In addition, previous studies focusing on costs of care in the last year of life found that average per-member costs have remained constant over the past decade, representing approximately 25% of all Medicare expenditures.[26] Moreover, a recent study examining costs of care in the last 2 years of life estimated average costs to be approximately $58,000.[25] This finding suggests that end-of-life care programs should not be limited to the last 6 months of survival, because costs associated with end-of-life care are likely to accrue over the last 2 years of life. This study supports findings from a previous study of this model[17] that found significantly lower costs for palliative care than for standard care.

There was a strong trend toward shorter survival for those in the palliative care group (196 days vs 242 days) after study enrollment. The differential in survival period after study enrollment may be attributed to several factors.

First, although the Palliative Performance Scale was used to measure severity of illness, the two groups may have had several differences in disease severity and range of medical conditions that were not collected as part of this study. In addition, the data do not take into account personal preferences for care at the time of study enrollment and changes in these preferences throughout the course of the study. Moreover, the palliative care intervention contains strong components, such as patient education, ongoing conversations about care preferences, and care plans, that are developed to ensure adherence to patient preferences and directives, all of which may influence patient survival time. Several studies have found that older patients would choose pain and symptom relief and comfort care over aggressive treatment to extend life.[27,28] Thus, the intervention components that focused on delineating and following patient care preferences also may have affected survival time. This notion was supported in a chart review of a sample of 90 study participants that found that IHPC patients had fewer 911 calls and fewer life-sustaining interventions conducted in the emergency department or intensive care unit.

Although enrollment in hospice was not a stated goal of this program, a retrospective examination of enrollment rates in participants of one study site was conducted that found no significant difference in the rate of hospice enrollment between groups. This may be attributed to the fact that the focus was on implementing the in-home palliative care program rather than facilitating transfer to hospice and to the structure of the in-home palliative care program. Enrollment in hospice would entail changing care providers from those employed at the managed care organization to a care team in a free-standing outside (non-managed care) organization.

Satisfaction with care improved significantly for those enrolled in the intervention arm of this study at 30 days and remained high, with more than 90% reporting being very satisfied with their medical care. At 30 and 90 days, individuals in the palliative study group were three times as likely to report high levels of satisfaction. This may be attributable to several factors. As suggested above, the palliative care model itself may be more conducive to the needs and preferences of the patients. One study[29] found that the most important elements in end-of-life care identified by seriously ill patients and their families related to trust in the treating physician, avoidance of unwanted life support, effective communication, continuity of care, and life completion, all of which are core components of the IHPC program. Another positive finding from the current study was the ability to enroll diverse participants and retain them in the intervention arm. Satisfaction appeared to be high in this diverse population.

This study was limited in several respects. The adequate sample of individual minority groups limited further analysis of ethnic variation. This area merits additional investigation and attention given the IHPC program's apparent success in enrolling a wide range of ethnic groups. This study was conducted within closed-system managed care settings; as a result, it may be less generalizable to all healthcare settings, and the relative cost savings may not be realized across other settings. Additionally, the use of proxy costs of care calculated from aggregated patient records further limits the ability to generalize findings across settings. It also did not extend to an examination of the effect of the individual model components (such as 24-hour call center and physician home visits) on patient outcomes; this element is a critical next step in determining what aspects of the model are associated with key outcomes. Relying on death at home as a measurement of patient preferences for site of death also presented a limitation. Although a better measurement would have been death in the patient's preferred locale, these data were not collected as part of this study. Finally, this study was limited in the lack of accurate hospice data available at one of the sites.

This is one of the first rigorous studies to examine the effectiveness of an in-home, community-based, palliative care program for terminally ill individuals. It provides strong clinical and financial evidence supporting the provision of palliative care in the home of terminally ill patients with cancer, COPD, and CHF with a life expectancy of approximately 1 year. It also suggests major policy implications for reforming end-of-life care. Evidence provided here and in a previous study[17] supports the need for fundamental changes in the design of our healthcare system by adjusting our current hospice benefit to better meet the needs of patients or developing a new, "pre-hospice" palliative care benefit that provides a bridge between standard medical care and hospice care.

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**Author Contributions:** Richard Brumley was the principal investigator on the study and was responsible for the design and supervision of the study intervention. Susan Enguidanos was the co-investigator on the project and was responsible for the study design, overall study implementation, data collection, analysis, and preparation of the manuscript. Paula Jamison was the project manager and data coordinator on the study and assisted in the preparation of the manuscript. Nora Morgenstern, Sherry Saito, Rae Seitz, and Jan McIlwaine were co-investigators and were responsible for intervention implementation at the local sites, including participant eligibility screening and enrollment in the study. Kristine Hillary provided clinical training and oversight on the palliative care intervention.

Jorge Gonzalez supervised day-to-day data collection among study participants and oversaw data entry and data preparation for analysis.

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