Geriatric Care Management for Low-Income Seniors

A Randomized Controlled Trial

Steven R. Counsell, MD
Christopher M. Callahan, MD
Daniel O. Clark, PhD
Wanzhu Tu, PhD
Amna B. Buttar, MD, MS
Timothy E. Stump, MS
Gretchen D. Ricketts, BSW

Context Low-income seniors frequently have multiple chronic medical conditions for which they often fail to receive the recommended standard of care.

Objectives To test the effectiveness of a geriatric care management model on improving the quality of care for low-income seniors in primary care.

Design, Setting, and Patients Controlled clinical trial of 951 adults 65 years or older with an annual income less than 200% of the federal poverty level, whose primary care physicians were randomized from January 2002 through August 2004 to participate in the intervention (474 patients) or usual care (477 patients) in community-based health centers.

Intervention Patients received 2 years of home-based care management by a nurse practitioner and social worker who collaborated with the primary care physician and a geriatrics interdisciplinary team and were guided by 12 care protocols for common geriatric conditions.

Main Outcome Measures The Medical Outcomes 36-Item Short-Form (SF-36) scales and summary measures; instrumental and basic activities of daily living (ADLs); and emergency department (ED) visits not resulting in hospitalization and hospitalizations.

Results Intention-to-treat analysis revealed significant improvements for intervention patients compared with usual care at 24 months in 4 of 8 SF-36 scales: general health (0.2 vs −2.3, $P=.045$), vitality (2.6 vs −2.6, $P<.001$), social functioning (3.0 vs −2.3, $P=.008$), and mental health (3.6 vs −0.3, $P=.001$); and in the Mental Component Summary (2.1 vs −0.3, $P<.001$). No group differences were found for ADLs or death. The cumulative 2-year ED visit rate per 1000 was lower in the intervention group (1445 [n=474] vs 1748 [n=477], $P=.03$) but hospital admission rates per 1000 were not significantly different between groups (700 [n=474] vs 740 [n=477], $P=.66$). In a predefined group at high risk of hospitalization (comprising 112 intervention and 114 usual-care patients), ED visit and hospital admission rates were lower for intervention patients in the second year (848 [n=106] vs 1314 [n=105]; $P=.03$ and 396 [n=106] vs 705 [n=105]; $P=.03$, respectively).

Conclusions Integrated and home-based geriatric care management resulted in improved quality of care and reduced acute care utilization among a high-risk group. Improvements in health-related quality of life were mixed and physical function outcomes did not differ between groups. Future studies are needed to determine whether more specific targeting will improve the program's effectiveness and whether reductions in acute care utilization will offset program costs.

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LOW-INCOME SENIORS REPRESENT a diverse and complex group of older adults who frequently have socioeconomic stressors, low health literacy, chronic medical conditions, and limited access to health care.[1] In addition, this group accounts for a disproportionate share of health care expenditures including high rates of acute care utilization.[2] Older adults in general, and especially the poor, often do not receive the recommended standard of care for preventive services, chronic disease management, and geriatric syndromes.[3-5]

The Geriatric Resources for Assessment and Care of Elders (GRACE) model of primary care was developed specifically to improve the quality of care for low-income seniors. The GRACE model builds on lessons learned from prior efforts to improve the care of older adults through multidimensional assessment. Prior reviews of this literature suggest that time-limited and site-specific geriatric consultation has limited impact on the process and outcomes of care.[6-8] In addition, the inpa-

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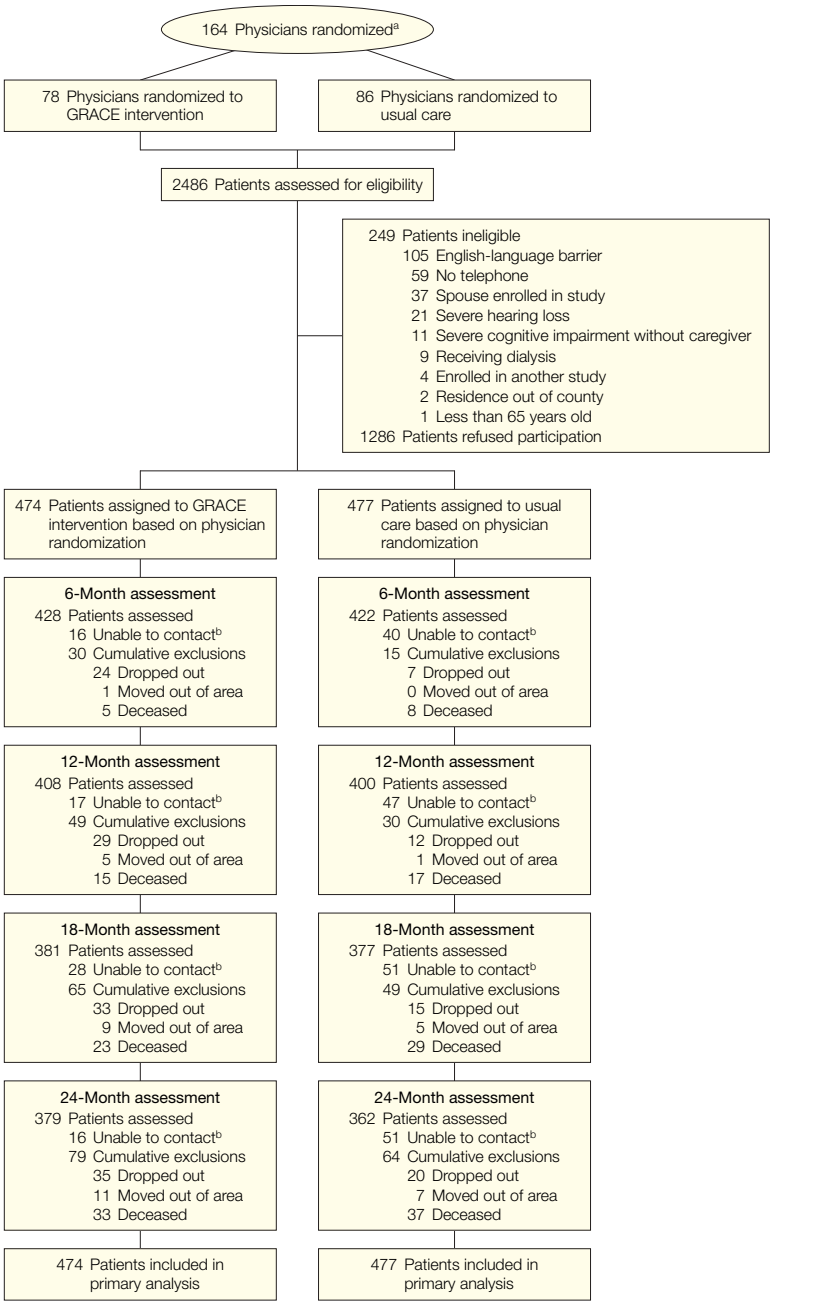
Author Affiliations: Indiana University Center for Aging Research (Drs Counsell, Callahan, Clark, and Tu, Mr Stump, and Ms Ricketts) and Department of Medicine (Drs Counsell, Callahan, Clark, and Tu), Indiana University School of Medicine, Indianapolis; Regenstrief Institute Inc, Indianapolis, Indiana (Drs Counsell, Callahan, Clark, and Tu, Mr Stump, and Ms Ricketts); and Department of Medicine, University of Wisconsin Medical School, Madison (Dr Buttar).
Corresponding Author: Steven R. Counsell, MD, Indiana University School of Medicine, 1001 W 10th St, WOP-M200, Indianapolis, IN 46202 (scounsel@iupui.edu).

tient Acute Care for Elders (ACE) model was shown to be a cost-effective design to improve outcomes in hospitalized older patients by providing a geriatrics interdisciplinary team that integrates and enhances care delivered by the hospital attending physician.[9-12] Building on the ACE model, we designed the GRACE intervention to improve the longitudinal integration of geriatric and primary care services across the continuum of care and thereby improve the likelihood that older adults receive recommended care.[13] Unique features of the GRACE intervention compared with prior studies of home-based integrated geriatric care[14-19] include the following: in-home assessment and care management provided by a nurse practitioner and social worker team; extensive use of specific care protocols for evaluation and management of common geriatric conditions; utilization of an integrated electronic medical record and a Web-based care management tracking tool; and integration with affiliated pharmacy, mental health, home health, and community-based and inpatient geriatric care services.[13]

We conducted a randomized, controlled trial to test the effect of the GRACE intervention on health outcomes of low-income seniors living in the community. We hypothesized that compared with usual care, patients enrolled in the intervention would receive superior quality of care for common geriatric conditions resulting in better health status, greater independence in activities of daily living, and lower acute care services utilization over the 2 years of follow-up.

Figure 1. Patient and Physician Participation in Study



[a] All 236 eligible physicians over the course of the trial were randomized and 164 physicians had a patient enrolled in the study. Because physicians were the unit of randomization, patients already belonged to a randomization group at the time they were assessed for eligibility. However, patients were not assigned to the intervention or usual care group until their baseline interview was completed and primary care physician was confirmed.
[b] Patients who could not be contacted remained in the study and were contacted for subsequent assessments.

METHODS

The study was approved by the Indiana University–Purdue University-Indianapolis institutional review board. All participants or their caregivers provided written informed consent for participation. FIGURE 1 describes the flow of individuals through the study.

Recruitment

Patients were recruited between January 2002 and August 2004 from 6 community-based health centers affiliated with Wishard Health Services, a university-affiliated urban health care system serving medically indigent patients in Indianapolis, Indiana. This primary care practice is staffed by Indiana University School of Medicine faculty and residents and serves

approximately 6000 older adults. Patients visiting their primary care clinician and having the following inclusion criteria were approached by a trained research assistant for further eligibility determination: age 65 years or older, an established patient (defined as at least 1 visit to a primary care clinician at the same site within the past 12 months), and with an income less than 200% of the federal poverty level (defined as qualifying for Indiana Medicaid coverage or being enrolled in the county medical assistance plan). Exclusion criteria included residence in a nursing home or living with a study participant already enrolled in the trial, enrolled in another research study, receiving dialysis, severe hearing loss, English-language barrier, no access to a telephone, or severe cognitive impairment (defined by Short Portable Mental Status Questionnaire score ≤5)[20] and without an available caregiver to consent to participate.

Randomization

To minimize the potential for contamination across groups, physicians were the unit of randomization. All primary care physicians at participating clinics were randomized from within strata formed by teaching status (faculty or resident) and the clinic site. Randomization lists were generated by the study biostatistician (T.E.S.) with the aid of the pseudorandom-number generator Random Number Generator for Discrete data using Alias (RNGDA) method from the FORTRAN/IMSL subroutine library.[21] Physicians, none of whom refused to participate, were not informed of their randomization status but intervention physicians became aware of their status when contacted by the GRACE intervention team personnel about one of their patients. Control physicians did not have access to the intervention. Patients were not informed of their randomization status by the project manager (G.D.R.) until they consented to participate in the clinical trial and completed the baseline interview.

Intervention

The GRACE intervention includes an advanced practice nurse and social worker (GRACE support team) who care for low-income seniors in collaboration with the patient's primary care physician and a geriatrics interdisciplinary team led by a geriatrician. Over the course of the trial, 3 GRACE support teams, assigned to specific practice sites and physicians, were employed by the primary care practice to implement the key components of the GRACE intervention (BOX). Upon enrollment, the GRACE support team met with the patient in the home to conduct an initial comprehensive geriatric assessment. The support team then presented their findings to the larger GRACE interdisciplinary team during the next weekly meeting to develop an individualized care plan, which included activation of GRACE protocols and corresponding team suggestions for evaluating and managing common geriatric conditions. Prepared with this care plan, the GRACE support team met face-to-face with the patient's primary care physician to discuss and modify the plan. Collaborating with the physician and supported by the GRACE interdisciplinary team, the support team then implemented the plan consistent with the patient's goals through face-to-face (usually in the patient's home and occasionally in the office, hospital, or nursing home) and telephone contacts with patients, family members or caregivers, and health care professionals. Each patient received a minimum of 1 in-home follow-up visit to review the care plan, 1 telephone or face-to-face contact per month, and a face-to-face home visit after any emergency department (ED) visit or hospitalization. Otherwise, the number, timing, and content of additional patient contacts occurred as appropriate to implement the care plan. An annual in-home reassessment starts the process over again. A detailed description of the GRACE model has been previously published,[13] and the GRACE protocols are available at http://iucar.iu.edu/research/graceteamsuggestions.pdf.

Control patients had access to all primary and specialty care services available as part of usual care. At the time of implementation of the GRACE intervention, the following geriatric clinical services existed at Wishard in support of the primary care practice: outpatient geriatric assessment and multispecialty center, inpatient ACE unit and consult service, skilled nursing facility, and physician house calls program. Psychiatric care was available through the health system's community mental health center.

Outcome Measures

Participants completed assessments at baseline and at months 6, 12, 18, and 24 by telephone conducted by interviewers who were blinded to the patient's randomization status and who were not part of the recruitment or intervention process. Race and ethnicity were included because of their potential importance as an independent variable in determining the effectiveness of the GRACE intervention. Patients self-identified their race and ethnicity to interviewers based on the National Institutes of Health predetermined listing of options. Depression severity was measured using the Patient Health Questionnaire-9.[22] Process of care data specific to the implementation of the GRACE model were obtained from the Web-based tracking system specifically developed for this project.

The quality of medical care was assessed using the Assessing Care of Vulnerable Elders (ACOVE) quality indicators developed specifically to evaluate the care of vulnerable elders across the spectrum of care, and including "geriatric syndromes."[23-25] Better performance on ACOVE quality measures is strongly associated with better survival among community-dwelling vulnerable older adults.[26] We chose the ACOVE quality indicators specific to the geriatric conditions targeted by the GRACE intervention and available from the electronic medical record or from patient interviews.

Main outcome measures were: The Medical Outcomes 36-Item Short-

Box. Key Components of the Geriatric Resources for Assessment and Care of Elders Intervention[a]

Initial and annual in-home comprehensive geriatric assessment by a GRACE support team consisting of an advanced practice nurse and social worker

Individualized care plan development annually by GRACE support team with assistance from the GRACE interdisciplinary team involving a geriatrician, pharmacist, physical therapist, mental health social worker, and community-based services liaison

Activation new each year of indicated GRACE protocols and corresponding team suggestions for care related to the 12 targeted geriatric conditions: advance care planning, health maintenance, medication management, difficulty walking/falls, chronic pain, urinary incontinence, depression, hearing loss, visual impairment, malnutrition or weight loss, dementia, and caregiver burden

GRACE support team meeting with patient's primary care physician to review, modify, and prioritize initial and annual care plan protocols and team suggestions

Implementation of care plan and team suggestions by GRACE support team in collaboration with the primary care physician and consistent with the patient's goals

Weekly GRACE interdisciplinary team meetings to review GRACE support team success in implementing care protocols and problem solve barriers to implementation

Ongoing GRACE support team home–based care management (including at least monthly patient contacts) supported by an electronic medical record and Web-based tracking system, and providing coordination and continuity of care among all health care professionals and sites of care

[a]GRACE indicates Geriatric Resources for Assessment and Care of Elders.

Form (SF-36) scales and summary measures; instrumental and basic activities of daily living (ADLs); and ED visits and hospitalizations. Patient health–related quality of life was assessed using the 8 SF-36 scales (physical functioning, role-physical, bodily pain, general health, vitality, social functioning, role-emotional, and mental health)[27] which were aggregated into a Physical Component Summary (PCS) and a Mental Component Summary (MCS).[28] Changes that differ between groups by 2 or more points on a scale of 0 to 100 have been shown to be clinically or socially meaningful.[29] Patient ADL status was assessed using items from the Assets and Health Dynamics of the Oldest-Old (AHEAD) survey.[30] Seven instrumental ADL items and 6 basic ADL items were used with each item scored as 0 points for no, 1 for a little, 2 for a lot of difficulty, or 3 for needing help. Items were summed to create instrumental and basic ADL index scores that ranged from 0 to 21 and 0 to 18, respectively. Days in bed due to illness or injury over the prior 6 months (more than half the day) not counting hospital and nursing home stays were also assessed. Patients' overall satisfaction with the care they received was assessed as excellent, very good, good, fair, or poor. Assuming a 20% rate of attrition, we estimated that a sample size of 500 patients per group would provide 80% power to detect an effect of 0.26 standard deviations in the change of SF-36 scales and ADL from baseline to 24 months at a .05 significance level.[31] The GRACE trial stopped enrolling new patients short of the targeted 1000 due to resource limitations, but the effect size for SF-36 scales were greater than expected; thus, we still had adequate power to show a clinically significant difference.

Emergency department visits, hospital admissions, and hospital days were obtained from a regional health information exchange. This network captures data on resource utilization from all 5 major hospital systems in Indianapolis. When assessing the frequency of ED visits, we did not include those that resulted in hospitalization because these acute care episodes are captured by the hospitalization. Because we did not specifically enroll patients based on their risk of hospitalization, we also calculated the probability of repeated admission (PRA) for each patient based on age, sex, perceived health, availability of an informal caregiver, heart disease, diabetes, physician visits, and hospitalizations.[32] As a preplanned strategy, patients with a PRA score of 0.4 or higher were considered at high risk of hospitalization,[33] and this group was analyzed for differences in acute care utilization similar to the full sample.

Statistical Analysis

Between-group comparisons were made by using *t* tests for continuous variables and χ^2 tests for categorical variables. For SF-36 and ADL outcomes, we used mixed-effects regression models to assess the intervention effect on the change between the baseline and 24-month measurements in an intention-to-treat fashion.[34] These models were hierarchical in nature as they incorporated random patient effects within each physician and random physician effect within each clinic in a nested structure.[35] The magnitudes and time patterns of missing data were examined by the treatment groups and then compared across the groups. Missing outcomes during the follow-up period were imputed using the last-observation-carried-forward method. To assess the robustness of the analytical results under alternative imputation methods, we repeated analyses on all primary outcomes using a multiple regression imputation method.[36] Results did not differ between the 2 imputation methods; thus, we report results based on the last-observation-carried-forward method. Acute care services utilization was characterized by ED visits and hospitalizations. We analyzed the counts of ED visits and hospital admissions by using log-linear regression models. To

accommodate unequal durations of follow-up due to early dropout, we incorporated the logarithmic duration of follow-up time into the log-linear model as an offset parameter. Regression parameters and standard errors were obtained from the model. The incidence rate ratios for the treatment effect were obtained for both ED visits and hospital admissions by exponentiating the regression parameter estimates. For the convenience of interpretation, we reported annual rate of visits and admissions per 1000 participants. Rates of deaths were analyzed using χ^2 tests, and time from enrollment to death was examined using Kaplan-Meier estimates of the survival function and compared using the Wilcoxon test. SAS software version 9.1 (SAS Institute Inc, Cary, North Carolina) was used in all analyses. Tests were considered significant at $P < .05$.

RESULTS

Sample Characteristics

Baseline characteristics of the 951 individuals randomized to intervention or usual care appear in TABLE 1. These patients were cared for by 164 different primary care physicians (78 in the intervention group and 86 in the usual care group). Similar proportions of physicians between intervention vs usual care groups were women (42% vs 36%; $P = .41$), specialized in internal medicine (72% vs 73%; $P = .83$) as opposed to internal medicine/pediatrics, and practiced in the primary care center (49% vs 50%; $P = .87$) as opposed to 1 of the 5 smaller community-based health centers. Enrolled patients per physician ranged from 1 to 49 (median, 3) for intervention physicians and 1 to 63 (median, 2) for physicians who provided usual care. Approximately 80% of intervention patients were seen by faculty physicians compared with 75% of usual care patients ($P = .07$). Reflecting the targeted patient population, three-quarters of the study patients were women, more than half were black, and all were socioeconomically disadvantaged. The majority of patients in both intervention and usual

Table 1. Baseline Characteristics of Study Participants[a]

Characteristic	No. (%) Intervention Group (n = 474)	No. (%) Usual Care Group (n = 477)	*P* Value
Age, mean (SD), y	71.8 (5.6)	71.6 (5.8)	.56
Women	358 (75.5)	365 (76.5)	.72
Black	272 (57.6)	292 (62.4)	.14
Living alone	219 (46.3)	225 (47.4)	.74
Education <12 y	296 (62.5)	285 (60.0)	.44
Household income <$10 000 annually	303 (73.4)	301 (71.5)	.55
County medical assistance	394 (83.7)	420 (89.0)	.02
Medicaid recipient	169 (37.1)	157 (34.1)	.33
Perceived health (fair or poor)	247 (52.6)	242 (51.1)	.65
SF-36 PCS, mean (SD)	35.8 (10.8)	36.5 (11.2)	.39
SF-36 MCS, mean (SD)	51.0 (10.2)	51.7 (10.4)	.36
Instrumental ADL, mean (SD)	2.7 (4.2)	2.5 (3.9)	.69
Median (range)	0 (0-21)	0 (0-18)	
Basic ADL, mean (SD)	1.6 (3.1)	1.3 (2.6)	.15
Median (range)	0 (0-18)	0 (0-16)	
Satisfaction with care (very good or excellent)	305 (64.6)	291 (61.3)	.29
Comorbid conditions			
Hypertension	383 (81.1)	390 (82.3)	.65
Angina pectoris or coronary artery disease	61 (13.1)	51 (11.0)	.33
Congestive heart failure	58 (12.5)	68 (14.4)	.38
Heart attack	81 (17.3)	75 (15.9)	.57
Stroke	85 (18.1)	68 (14.4)	.13
Chronic lung disease	111 (23.6)	106 (22.5)	.67
Arthritis of hip or knee	261 (55.4)	245 (51.6)	.24
Diabetes mellitus	158 (33.5)	168 (35.4)	.54
Cancer (other than skin)	66 (13.9)	59 (12.5)	.50
Geriatric conditions			
Difficulty walking 1 block (limited a little/a lot)	177 (37.7)	168 (35.7)	.52
Fall in past 6 mo	105 (22.2)	103 (21.7)	.85
Pain (moderate/severe/very severe)	231 (48.9)	224 (47.1)	.56
Urinary incontinence	150 (31.7)	131 (27.5)	.15
Depressed or sad	125 (26.4)	119 (25.0)	.60
Depression (PHQ-9 score ≥10)	54 (11.7)	53 (11.4)	.87
Vision problems	59 (12.5)	58 (12.2)	.87
Hearing difficulty	216 (45.6)	201 (42.1)	.29
Dementia (SPMSQ score ≤5)	4 (0.8)	4 (0.8)	.99
Caregiver who helps at home	116 (24.5)	115 (24.1)	.88
Health services utilization			
Physician or clinic visits in past 6 mo			
Mean (SD)	2.7 (2.9)	2.8 (4.2)	.61
Median (range)	2 (0-25)	2 (0-60)	
ED visits in past 6 mo			
Mean (SD)	0.6 (1.1)	0.6 (1.2)	.72
Median (range)	0 (0-7)	0 (0-10)	
Hospitalizations in past 6 mo			
Mean (SD)	0.2 (0.5)	0.2 (0.6)	.98
Median (range)	0 (0-5)	0 (0-6)	
Hospital days in past 6 mo			
Mean (SD)	0.7 (3.4)	0.9 (5.2)	.50
Median (range)	0 (0-60)	0 (0-77)	
PRA score, mean (SD)	0.3 (0.1)	0.3 (0.1)	.58
PRA score ≥0.4	112 (23.6)	114 (23.9)	.92

Abbreviations: ADL, activities of daily living; ED, emergency department; MCS, Mental Component Summary; PCS, Physical Component Summary; PHQ-9, Patient Health Questionnaire-9; PRA, probability of repeated admission; SF-36, Medical Outcomes 36-Item Short-Form; SPMSQ, Short Portable Mental Status Questionnaire.

[a] Seven instrumental ADL items and 6 basic ADL items were used with each item scored as 0 for no, 1 for a little, 2 for a lot of difficulty, or 3 needs help. Items were summed to create instrumental and basic ADL index scores that ranged from 0 to 21 and 0 to 18, respectively.

care groups were independent in instrumental (64% vs 62%; *P*=.45) and basic ADLs (83% vs 87%; *P*=.11). Most patients had multiple comorbid and geriatric conditions and high rates of acute care services utilization. Nearly 1 in 4 study participants were at high risk of hospitalization as defined by having a PRA score of 0.4 or higher (112 in the intervention group and 114 in the usual care group).

Table 2. Process of Care in Patients Receiving the Geriatric Resources for Assessment and Care of Elders Intervention[a]

	Year 1 (n = 447)	Year 2 (n = 409)
Initial team conference within 30 d, %	83	
Initial team conference, mean (range), d	25 (4-162)	
GRACE protocols activated per patient, mean (range)	5 (2-10)	5 (2-11)
Activation of GRACE protocols, %		
Advanced care planning	100	100
Health maintenance	100	100
Medication management	97	95
Difficulty walking or falls	55	50
Chronic pain	47	48
Urinary incontinence	41	37
Depression	38	41
Visual impairment	22	19
Hearing impairment	21	19
Malnutrition and weight loss	11	8
Dementia	10	10
Caregiver burden	4	4
Team suggestions activated per patient, mean (range)	63 (33-131)	34 (7-84)
Adherence to team suggestions	81	79
GRACE support team patient contacts, mean (range)[b]		
Face-to-face	7 (1-39)	6 (1-33)
Telephone	12 (0-44)	11 (0-58)
Total	18 (1-65)	17 (1-90)
GRACE support team continuity of care contacts, mean (range)		
Primary care physician	3 (0-14)	2 (0-14)
Other clinician	5 (0-101)	4 (0-101)
Total	8 (0-115)	6 (0-115)

Abbreviation: GRACE, Geriatric Resources for Assessment and Care of Elders.

[a] Numbers in Year 1 (n = 447) represent GRACE intervention patients who had an initial clinical assessment and complete Year-1 records in the Web-based tracking system; and numbers in Year 2 (n = 409) represent GRACE intervention patients who had an annual clinical assessment and complete Year-2 records in the Web-based tracking system.

[b] Face-to-face patient contacts usually occurred in the patient's home but also on occasion in the office, hospital, or nursing home. Numbers do not sum due to rounding.

Process of Care in Patients Receiving the GRACE Intervention

TABLE 2 outlines the process of care and implementation of the key components of the GRACE intervention for the patients enrolled in the intervention group who had an initial clinical assessment by the GRACE support team with completed tracking in year 1 (n=447) and an annual assessment with completed tracking in year 2 (n=409). The number of patients is lower in year 2 due to deaths, participants moving out of the area, and study dropouts. The numbers of patients cared for by the GRACE team shown in Table 2 will not necessarily correlate with the numbers of patients contacted by research interviewers in Figure 1. Intervention patients received a mean of 18 (range, 1-65) and 17 (range, 1-90) contacts in year 1 and year 2, respectively, with one-third being face-to-face (usually in the patient's home) and two-thirds by telephone.

Quality of Medical Care

Adherence to ACOVE quality indicators for geriatric conditions and processes of care targeted by the GRACE intervention is compared between intervention and usual care groups in TABLE 3. Patients in the intervention group with geriatric syndromes were more likely than patients in usual care to have documentation in the electronic medical record or report that their condition was recognized or diagnosed, that they received specialty consultation, and that they were provided with appropriate information or treatment. The intervention group also had documented in the electronic medical record or reported better adherence to quality indicators for preventive care, continuity of care, medication use, and end-of-life care.

Patient Outcomes

The SF-36 and ADL outcomes are shown in TABLE 4. The coefficients reflect the differences between intervention and usual care groups in their 2-year mean changes. Patients in the intervention group improved significantly compared with the control group in 4 of the 8 SF-36 scales (general health, vitality, social functioning, and mental health) and in the Mental Component Summary score. No differences were observed in 2-year mean changes in ADL status. Analysis of change scores categorized as better, same, or worse confirmed these results. Needing more help at 24 months compared with baseline in instrumental (21% vs 24%; *P*=.25) and basic ADLs (12% vs 13%; *P*=.64) also did not differ significantly between intervention and usual care groups. At 24 months, 66% of intervention patients rated their overall satisfaction with care as very good or excellent compared with 63% of those receiving usual care (*P*=.31). Mortality at 24 months (33 intervention patients [7.0%] vs 37 usual care patients [7.8%]; *P*=.64) and time to death were similar between groups.

Acute Care Services Utilization

We first examined differences in rates among the entire study population and then among those at high-risk of hospitalization as defined by their probability of repeated admission.[32,33] FIGURE 2 shows ED visits (not associated with hospital admission) and hospital admissions for intervention and usual care over the 24-month trial period. The cumulative 2-year ED visit rate per 1000 was lower in the intervention group (1445 [n=474] vs 1748 [n=477]; *P*=.03). Emergency department visits per 1000 were similar between groups in year 1 (823 [n=474] vs 937 [n=477]; *P*=.22) but significantly lower in the intervention group in year 2 (643 [n=459] vs 841 [n=460]; *P*=.01). Cumulative 2-year rates per 1000 did not differ between groups for hospital admissions (700 [n=474] vs 740 [n=477]; *P*=.66) or hospital days (3759 [n=474] vs 4069 [n=477];

P=.66). Hospital admissions and hospital days per 1000 in intervention compared with usual care patients were not significantly different in year 1 (384 [n=474] vs 358 [n=477] admissions per 1000; *P*=.66 and 2076 [n=474] vs 1983 [n=477] hospital days per 1000; *P*=.85) or year 2 (325 [n=459] vs 396 [n=460] admissions per 1000; *P*=.22 and 1739 [n=459] vs 2163 [n=460] hospital days per 1000; *P*=.37). There were no significant differences between groups in the proportion of hospitalized patients readmitted within 30 days of their first hospital discharge (26% [n=206] vs 32% [n=200]; *P*=.24).

Emergency department visit and hospital admission rates for the 112 intervention and 114 usual care patients classified at baseline as being at high risk of hospitalization (PRA score, ≥0.4) are also shown in Figure 2. In year 1, hospital admissions and hospital days per 1000 were similar between intervention and control patients in this high-risk group (705 [n=112] vs 798 [n=114] admissions per 1000; *P*=.60 and 3938 [n=112] vs 4544 [n=114] hospital days per 1000; *P*=.68). In year 2, however, hospital admission rates were significantly lower in the intervention group (396 [n=106] vs 705 [n=105]; *P*=.03) but the difference in hospital days did not reach statistical significance (2152 [n=106] vs 3943 [n=105]; *P*=.13). Similarly, ED visits were significantly lower in the intervention group in year 2 (848 [n=106] vs 1314 [n=105]; *P*=.03) but not in year 1 (1098 [n=112] vs 1149 [n=114]; *P*=.79).

COMMENT

This, to our knowledge, is the largest randomized clinical trial of a geriatrics system-level and home-based intervention specifically designed to improve health care for community-dwelling low-income seniors. In designing the study, we made a specific effort to monitor the process of care and to measure a broad array of outcomes important for older adults and for health system planners. These outcomes include not only function and health-related quality of life measures, for example, but also high-cost utilization patterns. The primary care practice in the current study serves a mixed-race population of seniors who are poor, have multiple comorbid conditions, and whose care is often fragmented across providers and sites of care. These patient groups have been understudied in previous trials and represent a complex and high-cost population that might especially benefit from improved

Table 3. Quality of Medical Care in Year 1 of Clinical Trial

Geriatric Conditions	No./Total (%)		*P* Value
	Intervention	Usual Care	
Difficulty walking or falls			
New diagnosis of difficulty walking or gait abnormality documented in those reporting fall(s) and not having diagnosis at baseline	28/95 (29)	7/97 (7)	<.001
Newly visited geriatric assessment center or physical or occupational therapy in those reporting fall(s) at baseline	30/77 (39)	15/74 (20)	.01
Newly received falls information in those reporting fall(s) at baseline and no past information	23/76 (30)	5/83 (6)	<.001
Urinary incontinence			
New diagnosis of urinary incontinence documented in those reporting urinary incontinence and not having diagnosis at baseline	54/116 (47)	8/104 (8)	<.001
Newly visited geriatric assessment or continence care center in those reporting urinary incontinence at baseline	33/139 (24)	12/121 (10)	.003
Newly received urinary incontinence information in those reporting urinary incontinence at baseline and no past information	45/100 (45)	18/95 (19)	<.001
Depression			
New diagnosis of depression documented in those with PHQ-9 score ≥10 and not having diagnosis at baseline	19/25 (76)	7/33 (21)	<.001
Newly visited geriatric assessment center or mental health clinic in those with PHQ-9 score ≥10 at baseline	22/46 (48)	5/45 (11)	<.001
New antidepressant prescribed or newly reported being seen by psychologist, counselor, or psychiatrist in those with PHQ-9 score ≥10 and without antidepressant or prior counseling at baseline	18/26 (69)	6/28 (21)	<.001
Sensory impairment			
Newly visited ophthalmology or eye clinic in those reporting visual difficulty at baseline	14/42 (33)	10/44 (23)	.27
Newly visited audiology or ears, nose, and throat clinic in those reporting hearing loss at baseline	37/203 (18)	11/190 (6)	<.001
General Health Care			
Preventive care			
Newly reported having an influenza shot	83/171 (49)	57/162 (35)	.01
Reported at 12 mo having an influenza shot in the past year	298/405 (74)	264/395 (67)	.04
Pneumococcal vaccination received in those on record as not having previously had pneumococcal vaccination	19/108 (18)	16/149 (11)	.11
Continuity of care			
Newly identified a primary care physician	43/53 (81)	36/57 (63)	.04
Follow-up primary care visit occurred within 6 weeks of first hospital discharge in those having ≥1 hospitalization	80/96 (83)	49/91 (54)	<.001
Medication use			
Newly reported having a medication list	161/277 (58)	105/275 (38)	<.001
Not prescribed a medication with strong anticholinergic effects in months 6-12	415/474 (88)	395/477 (83)	.04
End-of-life care			
Newly reported having a health care representative or living will	154/348 (44)	61/359 (17)	<.001

Abbreviation: PHQ-9, Patient Health Questionnaire-9.

coordination and integration of their health care. We found that patients enrolled in the GRACE intervention, compared with usual care, received better quality of care and had significant improvements in health-related quality of life measures. We found no significant differences in traditional measures of geriatric functional status. Intervention patients experienced a reduction in ED visits over 2 years. In addition, intervention patients experienced a reduction in hospital admissions in the second year among the group at high risk of repeat hospitalization.

We developed the GRACE outpatient intervention based on experience with its inpatient predecessor, the ACE model.[10,12,37] The approach in both models is to complement and support the role of the primary physician by helping to identify common but frequently unrecognized geriatric conditions and providing resources that aid in evaluating and treating these patients. Through close collaboration with primary care and hospital clinicians, respectively, the limited resources of specially trained geriatricians and geriatrics interdisciplinary teams can be leveraged for greatest impact on patient outcomes. Unlike previous trials that have focused primarily on providing in-home comprehensive geriatric assessment and follow-up independent of and in parallel with primary care providers,[38,39] the GRACE intervention is fully integrated within the primary care practice. GRACE support teams were employed by the primary care practice and assigned to work with specific sites and physicians. In addition, GRACE protocols and roles of the GRACE nurse practitioner and social worker were developed in collaboration with opinion leaders from the primary care practice.

The quality of medical care provided to vulnerable community-dwelling older patients falls short of acceptable levels for a wide variety of conditions, particularly for conditions uniquely important to geriatric patients.[5] Quality of medical care for these geriatric conditions as measured by the ACOVE quality indicators has been shown to correlate with mortality.[26] Using ACOVE quality measures developed specifically to cover the most important conditions of vulnerable elders, we found that the GRACE intervention compared with usual care substantially improved the quality of medical care for the geriatric conditions and general health processes targeted. Improved rates of diagnosis of geriatric conditions in intervention patients, however, may in part be explained by better documentation in the electronic medical record by their physicians and GRACE support team advanced practice nurses.

Consistent with other recent multifaceted interventions, the GRACE intervention did not lead to improved measures of physical health. Also, improvements in the SF-36 scales were inconsistent and of sufficiently low magnitude to question their clinical significance. The current study is the first home-based intervention, however, to report improvements in SF-36 scales in nonterminally ill older adults. A previous trial of the Veterans Affairs Team-Managed Home-Based Primary Care reported significant improvements in terminally ill patients at 12 months in 6 of the 8 SF-36 scales (all scales except physical functioning and role-physical), but no differences favoring the intervention in nonterminal patients with severe disability.[16] A previously reported outpatient comprehensive geriatric assessment coupled with strategies for high rates of adherence to care recommendations reported a positive effect in older patients with geriatric conditions after 15 months on SF-36 scales of physical functioning, vitality, social functioning, and the Physical Component Summary.[31] In a multicenter VA study, frail hospitalized

Table 4. Baseline Values and Impact of Treatment on Patient Outcomes by Study Group[a]

	Baseline and 2-Year Mean (SD) Changes				Treatment Effect Coefficients Intervention Minus Control, Mean (SD)	*P* Value[b]
	Intervention		Usual Care			
SF-36 scales						
Physical functioning	54.2 (26.7)	–5.3 (23.0)	55.7 (27.7)	–6.8 (22.7)	1.5 (22.9)	.32
Role-physical	44.4 (39.3)	1.9 (39.9)	46.4 (39.8)	–2.7 (38.0)	4.7 (38.9)	.07
Bodily pain	56.4 (26.1)	0.1 (25.7)	56.4 (26.3)	0.8 (24.8)	–0.7 (25.3)	.67
General health	50.3 (20.9)	0.2 (19.4)	52.3 (20.9)	–2.3 (19.0)	2.5 (19.2)	.045
Vitality	47.5 (23.9)	2.6 (21.7)	50.6 (24.9)	–2.6 (20.0)	5.1 (20.8)	<.001
Social functioning	72.9 (27.3)	3.0 (30.4)	73.7 (27.0)	–2.3 (30.5)	5.3 (30.4)	.008
Role-emotional	75.8 (35.9)	–0.5 (41.5)	75.6 (36.7)	–2.6 (45.3)	2.1 (43.5)	.46
Mental health	72.1 (20.1)	3.6 (18.5)	73.6 (19.8)	–0.3 (18.2)	3.9 (18.3)	.001
SF-36 PCS	35.8 (10.8)	–1.1 (8.9)	36.5 (11.2)	–1.6 (8.8)	0.5 (8.8)	.38
SF-36 MCS	51.0 (10.2)	2.1 (10.2)	51.7 (10.4)	–0.3 (10.8)	2.4 (10.5)	<.001
Instrumental ADL	2.7 (4.2)	0.4 (3.3)	2.5 (3.9)	0.6 (3.6)	–0.2 (3.5)	.77
Basic ADL	1.6 (3.1)	0.2 (2.7)	1.3 (2.6)	0.4 (2.7)	–0.2 (2.7)	.37
Days in bed	4.7 (22.1)	–1.7 (23.8)	3.5 (18.7)	–0.5 (22.5)	–1.2 (23.2)	.54

Abbreviations: ADL, activities of daily living; MCS, Mental Component Summary; PCS, Physical Component Summary; SF-36, Medical Outcomes 36-Item Short Form.
[a] Higher SF-36 scores represent better health while higher ADL scores represent greater difficulty or dependence.
[b] Values shown are *P* values for treatment effect.

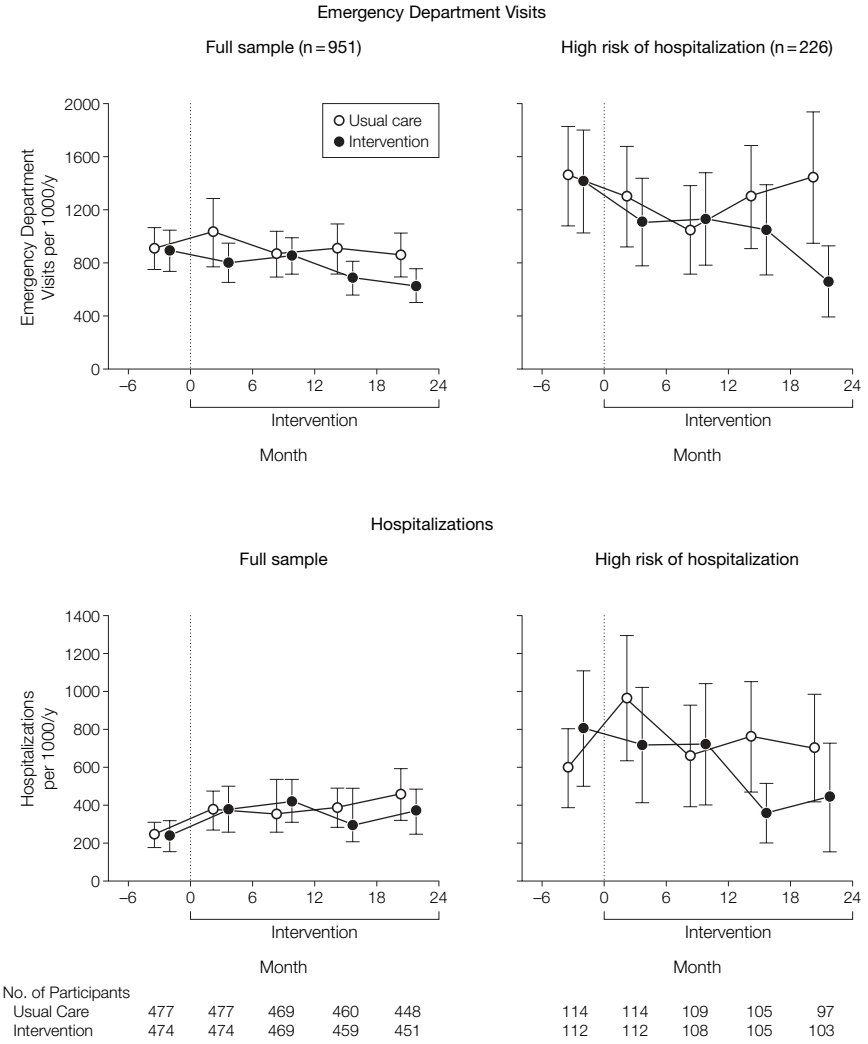
older patients discharged to receive outpatient geriatric evaluation and management were found at 12 months to have improvements from discharge in the SF-36 mental health scale only.[40] The clinical significance of change scores of SF-36 scales may be difficult to interpret.[41,42] However, the magnitude of the differences found in the GRACE trial ranged from 5% to 10% and were similar to those reported in the 3 studies described above.

Reasons the GRACE model was not more effective in moving clinical outcomes might include an ineffective targeting strategy for patients at risk of decline. The mean 2-year decline in SF-36 scales was only 2.4 in the usual care group. In addition, usual care patients received components of the GRACE intervention when referred to one of the geriatric specialty services. Comparing intervention and usual care groups, 2.1% of the intervention and 1.5% of the usual care patients ($P=.45$) were seen by the physician house-calls program, 4% of each group were seen in the outpatient geriatric assessment center, and 18% of intervention patients vs 11% of usual care patients ($P=.003$) were seen by the inpatient ACE consult service during the study period.

Although the GRACE intervention included multidimensional geriatric assessment and multiple follow-up home visits, we found no evidence that the intervention improves ADL status or prevents ADL decline as some programs have demonstrated.[15,38,39] We did not specifically target older adults with ADL impairment for participation in this trial. Indeed, most of the enrolled patients were independent in instrumental and basic ADLs at baseline and remained so at 2 years. Compared with previous studies demonstrating prevention of ADL decline, our study population was younger, poorer, less educated, and more independent in ADLs. In addition, the current trial was only 2 years in duration. A longer intervention period or more intensive intervention may be necessary to alter ADL outcomes. These measures may also have been insensitive to important improvements in ADLs among this cohort of older adults. A more intensive program may be needed to prevent ADL decline, such as in-home physical therapy that focuses primarily on improving underlying impairments in physical abilities.[43]

Many studies of outpatient geriatric assessment and of community and home-based care management have failed to demonstrate lower acute care utilization rates.[16-19,38,40,44,45] Prior successful studies and the current trial, however, provide evidence that ED visits and hospital utilization can be reduced through a geriatrics interdisciplinary team that provides ongoing care management (usually including home visitation) in support of and integrated with the primary care physician.[15,46-49] There may be a "period of engagement" before utilization rates decline.[47,49] We found that the GRACE support team needed time to develop trusting and working relationships with both the patient and primary care phy-

Figure 2. Acute Care Utilization Rates at Baseline and During 2-Year Follow-up by Study Group



Error bars represent the associated 95% confidence interval. Emergency department visit rates do not include those associated with hospital admission.

sician. This may help explain why differences in acute care utilization became more apparent in the second year of the GRACE intervention.

This study has several limitations that deserve specific mention. The results of this trial may not be generalizable to different groups of older persons (eg, those of higher socioeconomic status and those living in rural communities) or different clinic settings. Physicians and the intervention team and patients were unblinded to the participant's intervention status given the nature of the intervention, but the research assistants conducting the independent outcome assessments were blinded. Because we did not design the study to include a control group that received only sham contacts, we cannot assess whether the power of the intervention is simply due to social contacts. The accuracy of the regional health information exchange database is unknown but any inaccuracies should be equal in the intervention and control groups. We used multiple primary outcomes measures consistent with our original hypotheses regarding the impact of the intervention and consistent with best practices in geriatric health services research.[50] This comprehensive approach to outcome assessment results in multiple hypothesis testing. Although the current study was not adequately powered to accommodate adjustments for multiple outcomes, we repeated the analysis considering all 14 main outcome measures using the conservative Bonferroni correction.[51] The results remained significant for SF-36 scales of vitality ($P=.006$), mental health ($P=.03$), and the Mental Component Summary ($P=.008$), but not for ED visits ($P=.42$).

The current study site was also a site for successful collaborative care models in primary care for improving depression and dementia.[52,53] The findings from the GRACE intervention builds on these more focused disease management approaches to address the entirety of the older patient's health status including important and disabling geriatric conditions.[54] We found the GRACE model of primary care to be feasible in a public health system serving low-income seniors and effective in improving quality of care. Improved recognition and treatment of depression in the GRACE trial, for example, contributes to better mental health status found in the intervention group. Similarly, other quality improvements may have mediated positive effects on health status that in turn lowered acute care services utilization. It is upon the foundation of the GRACE model that specific geriatric condition and disease management protocols can be efficiently applied to the care of older patients and integrated within primary care.

Future studies should compare potential cost savings from less acute care utilization with program costs to determine feasibility. Under current fee-for-service Medicare, most of the services provided by the GRACE intervention are not reimbursed. Medicare managed care, however, presents a financial vehicle under which the GRACE intervention could currently be supported. In a managed care environment, the costs of the GRACE model potentially would at least in part be offset by prevention of high-cost acute care utilization, more appropriate risk adjustment due to improved recognition and documentation of medical conditions, and improvements in performance on quality indicators. The GRACE intervention might also be financed through recently proposed methods of reimbursement such as "comprehensive payment for comprehensive care" that is needs or risk adjusted and performance based, or the advanced medical home model.[55,56] We hope the GRACE model will prove to be a practical health system innovation that will contribute to improved geriatric care and outcomes while reducing high-cost acute care utilization in low-income seniors.

Author Contributions: Drs Counsell and Callahan had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Counsell, Callahan, Clark, Buttar.
Acquisition of data: Counsell, Callahan, Buttar, Ricketts.
Analysis and interpretation of data: Counsell, Callahan, Clark, Tu, Buttar, Stump, Ricketts.
Drafting of the manuscript: Counsell, Callahan, Tu, Ricketts.
Critical revision of the manuscript for important intellectual content: Counsell, Callahan, Clark, Tu, Buttar, Stump, Ricketts.
Statistical analysis: Callahan, Tu, Stump.
Obtained funding: Counsell, Callahan, Buttar.
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Study supervision: Counsell, Callahan, Buttar, Ricketts.
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