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Association of Claims-Based Quality of Care Measures with Outcomes among Community Dwelling Vulnerable Elders

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Abstract

Background—Few studies examine the link between measured process of care and outcome.

Objective—Evaluate the relationship of claims-based assessment of process of care to subsequent function and survival.

Research Design—Retrospective cohort study using claims from 1999 to assess performance on 41 quality indicators (QIs) from the Assessing Care of Vulnerable Elders (ACOVE) measurement set on functional decline and death in 2000.

Setting—Community dwelling individuals

Subjects—All persons > 75 years old enrolled in Medicare and Medicaid in 19 California counties in 1998 and 1999 who received In Home Supportive Services.

Measures—Quality of care index, Activities of Daily Living (ADL) and Instrumental Activities of Daily Living (IADL) need indices, Mortality

Results—21,310 persons were eligible for a mean of 7.1 QIs; and received 46% of recommended care. The ADL index increased from 8.1 to 11.6 between baseline and follow-up. The IADL index increased from 13.6 to 14.1. Fifteen percent of the cohort died in 2000. After accounting for number of QIs triggered, baseline function and other covariates, better quality was associated with better function at follow-up. Ten percent better quality was associated at follow-up with 0.21 lower ADL need score (95% confidence interval (CI): 0.25 to 0.17), 0.022 lower IADL need score (95% CI: 0.032 to 0.013) and lower odds of death (0.91, 95% CI: 0.89 to 0.93).

Conclusions—Routinely collected data implementing ACOVE measures for community vulnerable elders generate quality scores that are directly related to patient functional and survival

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outcomes. These findings suggest that population-based assessment of care is feasible for vulnerable older persons.

Keywords

Long term care; geriatrics; quality of care; process of care; activities of daily living

INTRODUCTION

There is extensive evaluation of medical care provided to adults in the U.S., yet little measurement focuses on older patients, particularly vulnerable older patients. Despite the existence of measures dedicated to vulnerable older persons,(1) most investigation has been performed on small cohorts using medical records because most measures – and particularly those focused on geriatric conditions – are not available from administrative data.(2) Quality measured from medical record abstraction has been shown to be related to survival,(3, 4) improvement in health related quality of life,(5) and improvement in specific conditions.(6) Among 3,324 community-dwelling elders, better quality of medication prescribing was related to preserved basic self-care function, but not survival.(7) Hospitals that perform better on the ten processes-of-care required to be reported to CMS Hospital Compare have small but statistically lower risk-adjusted mortality rates.(8) However, these findings have not appeared to spur the measurement of care in vulnerable older patients, which is necessary to drive improvement.

Recently, we showed that a portion of the Assessing Care of the Vulnerable Elders (ACOVE) process of care measures could be implemented among older community-dwelling adults who are dually enrolled in Medicare and Medicaid.(9) This methodology, which relies on administrative data, makes it feasible to routinely evaluate quality for a relatively narrow slice of care among large numbers of vulnerable older patients. However, the value of this practical measurement technique – which includes only measures that happen to be available using administrative data – was uncertain, given that the types of measures available may not be those that are most salient for vulnerable older patients.(10)

As payers and providers invest time and energy into quality improvement campaigns, it is imperative to understand whether targeted processes result in improved patient outcomes. To evaluate the relationship of quality of care to subsequent function and survival, we took advantage of data collected by In Home Supportive Services (IHSS) for a portion of the community vulnerable elder sample previously evaluated for quality of care using administrative data measures. We hypothesized that greater quality of care would be associated with better outcomes.

METHODS

Study Sample

We assessed the care of individuals aged 75 years and older who were dually enrolled in Medicare and Medicaid and living in the community in 19 California counties between 1998 and 2000. Individuals were included in the study if they were alive during all of 1999, at

which time process of care was assessed. Patient outcomes were measured during calendar year 2000.

Linked Medicare eligibility and claims data, Medicaid eligibility and claims data, and IHSS functional assessments were drawn from the data archive maintained by the California Center for Long Term Care Integration.(11) The archive contains Medicaid data for aged, blind, and disabled persons enrolled between 1996 and 2000 in California's Medicaid program in 19 counties representing half of the state's general population. Medicare eligibility and fee-for-service claims were available for the subset of Medicaid enrollees enrolled in Medicare. Approximately 20% of the dually enrolled elders were receiving IHSS, a program that requires annual functional assessments. In the primary analyses, we examined individuals for whom a baseline (1998) functional assessment was reported, who were alive during all of 1999, and who had a functional assessment or died in 2000.

Measurement of Quality

Eligibility and performance for each quality indicator (QI) was determined based on demographic data and diagnostic (International Classification of Diseases-9th Clinical Modification), procedural (International Classification of Diseases-9th Clinical Modification, Current Procedure Terminology), and medication National Drug Codes reported in the Medicaid and Medicare eligibility files and fee-for-service claims. Medical diagnoses were considered as prevalent conditions if they were present for a patient during the three years (1996–1998) prior to the quality assessment period (1999). Medical diagnoses were considered as incident conditions if they were not present during the three-year look back but did occur during the quality assessment period.

As described previously, we adapted 43 of the 230 explicit process of care quality indicators (QIs) from the ACOVE-2 quality indicator set for community dwelling elders for use with claims.(9) Two QIs were excluded because they almost uniformly were passed (avoidance of prescribing barbituates or meperidine). The 41 QIs implemented for use with secondary data sources cover twelve condition groups (continuity of care, dementia, depression, diabetes, heart failure, hypertension, heart failure, ischemic heart disease, osteoarthritis, osteoporosis, stroke/atrial-fibrillation, and vision care). Each of the twelve conditions has one or more operationalized QIs (see Box 1). A patient may trigger more than one QI per condition. A number of QIs reflect evidence-based recommendations for the management of new onset conditions. QIs that reflect care for new disease tend to be triggered far less often than chronic management QIs.

Each quality indicator contains an “IF” clause that defines the patient who is eligible to receive the care defined by the QI and a “THEN” clause that describes what care is recommended (for example: “If a vulnerable elder has had a myocardial infarction, then he or she should be offered a beta-blocker”). For patients who had a condition that triggered a QI, a performance score of 1 was assigned to the process measure if the data indicated that the patient received the care recommended, otherwise, a score of 0 was assigned

For each patient, we define an overall quality score equivalent to the individual's overall QI pass rate (the number of QIs passed divided by the number of QIs eligible), expressed as a

number between 0 and 1. In sensitivity analyses, we attempted to account for differences in the QIs triggered by each patient by computing the observed quality score of each individual minus the expected score of a hypothetical patient who triggered that set of QIs. This observed-minus-expected score (OE score) takes into account the relative difficulty of passing a QI through the subtraction of the average performance for that QI.(12) Theoretically, values for the OE score could range from -1 to 1, where negative scores would imply worse than expected performance and positive scores better than expected performance. Findings using OE scores were substantially the same as found for simple pass rates and the OE scores.

Outcomes

The two primary outcome measures of interest were change in functioning and mortality. Patient function was measured using the annual 11-item IHSS functional assessment (Box 2). Six of the items are activities of daily living (ADL; bathing, dressing, transferring, mobility inside toileting and feeding), four are instrumental activities of daily living (shopping, food preparation, housekeeping and laundry), and one measures respiratory assistance requirements (respiration) (Appendix Tables 1 and 2). Each of these items is scaled on an ordinal scale from 1 (independent) to 5 (completely dependent), and we rescaled them from 0 to 4. To better understand the relationship of quality of care and function, the six ADL items were combined into an unweighted ADL need index (range 0 to 24). The four IADL items were combined into an unweighted IADL need index (range 0 to 16). Mortality was identified from the Medicare enrollment file. If a patient died during the follow-up period, the ADL and IADL indices were assigned to their maximum scores. Thus, functional decline could be calculated as the difference between the follow-up score (measured if alive or assigned the maximum score if the patient died in 2000) and the baseline score (measured in 1998).

In order to explore the assignment of worst functional status to death, and because some alive-states might be considered worse than being dead, we evaluated two alternative approaches to defining death in these indices. First, analyses were restricted to the 19,166 patients (including some subsequently dying) with both baseline and follow-up function exams. Second, instead of assigning follow-up function for individuals who died to the maximum score, we used a functional assignment used in other analyses that weights the worst function score by the probability of death (predicted by multivariate logistic regression model): $\text{Follow-up function score among those who die} = \text{probability_death} * (\text{maximum} - \text{baseline function score}) + \text{baseline function score}$.(13, 14) Because these sensitivity analyses did not significantly affect the relationship between process and functional outcome, they are not included.

Other independent predictors were included in evaluating patient outcomes. Patient case-mix was assessed through demographic measures (gender, age, and race), comorbidity (Charlson Index (15, 16) based on prevalent diagnoses reported during the three year look back period), and zip code level proxy measures derived from the U.S. Census (rural residence and percent of individuals with incomes below 200% of the federal poverty level) based on patient residence zip code.

Analysis

We examined univariate statistics for patient case-mix and measures of quality. In bivariate comparisons, we examined the association of the summary quality score with mortality and functional decline. For each outcome, we compared tercile groupings of the summary quality score to the outcome, and calculated a Mantel-Hanzel chi-square for trend as well as a correlation coefficient for each comparison. In unadjusted analyses, we employed Kaplan-Meier survival curves to graphically examine survival at follow-up by tercile of quality. In multivariate logistic regression analyses, we assessed the impact of quality of care on function and mortality, accounting for patient demographic measures, proxy SES measures, Charlson Index, number of conditions triggering quality measures, and baseline function (ADL and IADL need index scores).

We performed sensitivity analyses to examine a number of additional issues. We explored the relationship between mortality individual QIs and QI subsets (by condition and type of care). We excluded selected QIs from patients with advanced dementia and poor prognosis using the available data for prevalent diagnosis of dementia and hospice use during the quality assessment period. We identified the primary treating physician at baseline and accounted for provider type, number of visits, and clustering by provider. We explored alternative approaches to scoring function at follow-up by restricting evaluation to live patients and by using the original IHSS functional dependence score, a weighted sum of the 11 items (Appendix Table 3). None of these analyses substantively changed the results; they are not presented in this manuscript. Finally, we explored the impact of quality on mortality in the overall community-dwelling dually enrolled population (including individuals not enrolled in IHSS for whom functional assessments were not available). All analyses were performed using STATA SE Version 10 (College Station, TX). The study design was reviewed and approved by the UCLA Office for the Protection of Research Subjects.

RESULTS

There were a total of 91,597 dually enrolled community-dwelling elders aged 75 years and older in the 19-county sample who were alive during all of 1999. Of these, 25,822 received IHSS, of whom 4,512 were missing either a baseline or follow-up assessment. Thus, the analytic sample is 21,310 persons who had a baseline functional assessment at the end of 1998, and either died or had a follow-up functional assessment in 2000.

The overall study sample was comprised primarily of women with a mean age of 83 years (65% were 80 years or older) (Table 1). Nearly half of the IHSS recipients in the study sample were non-Latino whites (48%), while 14% were non-Latino blacks, 13% Latinos and 19% Asians. Few patients came from rural areas, however more than one-third came from areas where mean income was below 200% of the federal poverty level. The study population had considerable disease and functional burdens. At baseline, the mean ADL need index was 7.1 and the mean IADL need index was 13.6. Mean Charlson Index was 1.6 (range: 0 to 16). IHSS recipients were eligible for quality indicators for a mean of 4.4 ACOVE conditions. Fifteen percent of the study sample died during calendar year 2000.

On average, individuals in the study sample triggered 7.1 QIs (range 1 to 22) with a mean process of care pass rate of 46%. Mean pass rates by quality tercile were 23% (range 0–36%), 46% (37–53%), and 69% (54–100%). Greater quality of care was associated with less functional need at baseline (ADL need index of 7.1 and IADL need index of 13.3 versus 7.9 and 13.9, respectively, for the highest versus lowest tercile of quality), but more baseline comorbid illness as measured by the Charlson Index (2.1 versus 1.3 for highest versus lowest tercile). Patients in the highest tercile triggered more QIs than in the middle and lowest terciles (8.0, 6.8 and 6.0, respectively). The relationship of mortality with pass rates for individual QIs and conditions are displayed in Appendix Tables 4 and 5, respectively.

Higher quality of care was consistently related to better outcomes. In unadjusted comparisons between quality score and patient outcomes, higher quality score terciles were strongly related to greater function at follow-up and lower mortality (Table 1). The Kaplan-Meier Survival Curve demonstrates that greater quality was associated with improved survival during the follow-up year (Figure 1). Mortality at follow-up was 12% in the patients with the highest tercile of quality versus 18% in those in the lowest tercile of quality ($P < 0.01$).

In the multivariate regression model accounting for baseline function (Table 2), patient demographics, and proxy SES measures (by patient zip code), higher quality scores predicted better ADL and IADL need index scores at follow-up. Examining the ADL need index at follow-up, compared to the lowest tercile of quality, the highest tercile of quality (Beta = -1.35 ; 95% Confidence Interval [CI]: -1.57 to -1.13) and the middle tercile of quality (Beta = -0.56 ; 95% CI: -0.78 to -0.34) were associated with lower follow-up ADL need index scores (Table 2). A difference of 1 in the ADL need index is equivalent to a single level change, for example going from ambulating independently with reminders to needing physical assistance for stairs (see Appendix Table 2). Differences were much smaller for the IADL need index at follow-up; versus patients in the lowest tercile of quality, patient in the highest tercile of quality had an adjusted difference of -0.12 (95% CI: -0.18 to -0.07) in the follow-up IADL need index. For both ADLs and IADLs, greater number of conditions, older age, and higher Charlson Index were associated with greater functional needs at follow-up, while non-white individuals had lower functional needs at follow-up (Table 2). Follow-up ADL need increases 0.62 (95% CI: 0.56 to 0.69) for each additional condition, 0.16 for each year of age (95% CI: 0.15 to 0.18), and 0.29 (95% CI: 0.24 to 0.36) for each unit increase in the Charlson Index.

Findings from multivariate logistic regression predicting death were consistent with functional status at follow-up; compared to the lowest tercile, the highest tercile of quality (OR = 0.57; 95% CI: 0.52 to 0.63) and the intermediate tercile of quality (OR = 0.84; 95% CI: 0.76 to 0.92) were associated with lower mortality during the follow-up period (Table 2). Odds of death increased for each additional condition (OR 1.25; 95% CI: 1.22 to 1.29), each year of age (OR: 1.07; 95% CI: 1.06 to 1.07), and for each unit increase in the Charlson Index (OR 1.12; 95% CI: 1.09 to 1.14). Thus, relatively modest differences in illness are associated with much greater differences in outcome than can be attributed to differences in measured quality. For example, an increase in the number of conditions by two is associated

with a level of functional decline and odds of death that are similar in magnitude to the differences in outcome between the highest and lowest terciles of quality.

Consistent with the analyses categorizing quality by tercile, better performance on a continuous measure of quality is significantly related to improved function and survival at follow-up (Table 3). After accounting for covariates, higher quality was associated with lower ADL need index (Beta: -2.12 ; 95% CI: -2.52 to -1.72) and IADL need index (Beta: -0.22 ; 95% CI: -0.32 to -0.13) at follow-up. Using the inter-tercile mean difference in quality (0.46), the expected ADL index difference at follow-up would be 0.98, slightly less than estimated in the categorical model. Similarly, the inter-tercile difference in the mortality model yields an odds ratio of death of 0.65, similar to that derived using the tercile categories. A ten percent difference in quality is associated with an odds ratio of death of 0.91 and a decrement in ADL need index of 0.21 at follow-up.

In the sensitivity analysis involving all of the 91,597 individuals in the community-dwelling dually enrolled sample, multivariate regression accounting for patient demographics and proxy SES measures yields results for the relationship between quality and survival that are substantially similar to those for the dually enrolled population receiving IHSS (Table 3). Using a continuous measure of quality, the risk-adjusted odds ratio is 0.41 (95% CI 0.37 to 0.46). Use of the OE score yields similar results (data not shown).

DISCUSSION

This study shows that a set of 41 QIs adapted from the ACOVE measurement set that can be implemented using routinely collected administrative data yields quality of care measures for vulnerable older persons living in the community that are directly related to the outcomes of these persons over the following year. While the process–outcome link has been demonstrated previously for the relationship between a broader set of ACOVE medical record-based measures and survival,(3) this expands the set of outcomes to include functional status. Persons who received higher quality medical care in 1999 sustained smaller declines in function during 2000. Furthermore this study shows that a smaller set of measures that can be collected using administrative data demonstrate the link between quality of care and vulnerable older persons' outcomes. While the effects are modest, the follow-up period is short and the findings are stable across choices of model predictors and patient subsets.

These findings suggest that quality measurement can be undertaken for large samples of vulnerable older persons. These measures can be used to identify patient groups in need of improved care and conditions that require additional attention. The mechanism of measurement also makes serial measurement feasible to monitor the effect of interventions or the impact on patient care due to structural health care changes. It should be noted that the set of measures implemented here are those that are available using Medicare and Medicaid claims, meaning that many aspects of care particularly relevant to vulnerable older persons (e.g., falls, incontinence, screening) cannot be measured.(1, 17) Efforts to enhance collection of the data elements to evaluate these conditions by expanding the penetration of electronic health records (EHR) are needed. Nevertheless, the existence of ready-to-implement

measures to claims data with a relationship to outcomes means that monitoring quality of care for large populations does not need to wait for implementation of EHRs, and can be used now to monitor changes in the structure of care delivery such as the adoption of the medical home. Functional assessment, such as that routinely collected by the IHSS program, highlight the potential for enriching routinely collected data with meaningful additional outcome measures.

Relatively few studies demonstrate a link between process-of-care quality and outcomes, and this is particularly uncommon in the ambulatory setting. In the original ACOVE cohort, it was possible to show that higher quality of care was related to decreased mortality during a three year follow-up period after the baseline quality measurement.(3) In that study, the overall quality of care measure reflected a comprehensive assessment of quality, using 160 quality indicators to assess mortality among 372 vulnerable elders. On average, each individual triggered 21 quality indicators. Kahn et al. examined the impact of 120 quality of care measures on health status among 963 managed care patients.(5) In this latter study, higher quality was associated with improved health status after an instrumental variable approach accounted for unmeasured patient severity. Both studies had advantages that at present are unavailable to the routine measurement of quality in real world circumstances: access to comprehensive medical information, including chart abstraction to measure a large number of quality indicators. The current study adds to the armamentarium available to measure quality of care among vulnerable elders by demonstrating a relationship between care and outcomes with a relatively limited set of quality measures using routinely collected administrative data.

The current exploration demonstrates a rather modest impact of improved quality on function at follow-up, with a stronger relationship to mortality at follow-up. The magnitude of the relationship between quality and function at follow-up may be explained in part by the existing functional impairment of the IHSS population itself, which is a requirement for enrollment. Thus, there is a ceiling effect, especially noticeable in the IADL function change. In addition, it is not unreasonable to expect that medical interventions will have greater impact on survival rather than function. Improvement in the assessment of patient health states (function, health, quality of life) and routinely collected data that can be used to assess quality of care and studying vulnerable, but less functionally impaired elderly populations may yield greater magnitude quality-outcome effects.

This is a retrospective study using administrative data. Eligibility for QIs and processes of care delivered may be under-reported or over-reported by the administrative data. Results may not generalize to other regions or to patients not enrolled in both Medicaid and Medicare. The ACOVE QIs used here were designed to reflect care practices during year 2000. The modest impact of quality on outcome may be due to imperfect measurement of processes of care, limited measurement of quality, short follow-up, healthy survivor effect (participants survived the one-year assessment period), and significant overall illness of the cohort (reducing between-patient differences). Exclusion criteria for selected clinical characteristics (e.g., advanced dementia and poor prognosis) could not be determined from these data. To the extent that quality of care measures identifiable from administrative data

are limited to tests and medications, many types of care important to older patient outcomes go under-evaluated.

Conclusions

The routine measurement of quality of care in vulnerable populations is an important step toward improving care delivery. We show that measuring quality of care for a vulnerable community-based population using a subset of a comprehensive quality measurement set is feasible and that measurement has a demonstrable relationship with meaningful patient outcomes. This set of measures should be applied in other samples and the measurement set should be expanded as data elements integral to care for older patients become increasingly available in electronic health records.

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Text Box 1 – Example Assessing Care of Vulnerable Elders quality indicators implemented using administrative data

Condition	Example Quality Indicator
Continuity of care	IF VE discharged from hospital, THEN follow-up within 6 wks
Dementia	IF VE with dementia has new depression, THEN treat the depression
Depression	IF VE is treated with new antidepressants, THEN TCAs, MAOIs, benzodiazepines, and stimulants should not be 1st or 2nd line therapy
Diabetes	IF VE has diabetes, THEN hemoglobin A _{1c} should be measured at least every 12 months.
Heart failure	IF VE has newly diagnosed heart failure, THEN chest x-ray, ECG, CBC, serum sodium/potassium/creatinine, and TSH should be checked within 1 month of diagnosis (or 3 months prior to diagnosis)
Hypertension	IF VE has hypertension and renal disease with serum creatinine > 1.5 mg% or proteinuria (> 1gm protein/24 hrs), THEN an ACE inhibitor medication should be offered
Ischemic heart disease	IF VE is hospitalized for acute myocardial infarction, THEN should be offered assessment of LVEF within 3 days after hospital discharge
Medication use	IF VE is prescribed thiazide or loop diuretic, THEN electrolytes checked within 1 week of initiation and yearly thereafter
Osteoarthritis	IF VE is older than 75 years of age and is treated with warfarin or has a history of peptic ulcer disease or gastrointestinal bleeding, AND is treated with NSAIDs, THEN should be offered misoprostol or a PPI
Osteoporosis	IF a female VE is newly diagnosed with osteoporosis, THEN the patient should be offered bisphosphonates (or HRT) within 3 months of diagnosis
Stroke and Atrial fibrillation	IF VE has atrial fibrillation then offer anticoagulation or antiplatelet treatment
Vision	IF VE undergoes cataract surgery, THEN follow-up ocular exam should occur within 3 months.

VE = vulnerable elder, TCA = tricyclic antidepressant medication, MAOI = Monoamine oxidase inhibitor medication, ECG = electrocardiogram, CBC = complete blood count, LVEF = left ventricular ejection fraction, NSAID = non-steroidal anti-inflammatory drug, PPI = proton pump inhibitor medication, HRT = hormone replacement therapy.

Text Box 2 – In-home Supportive Services Function Limitation Assessments

Function Assessment	Type
Housework	IADL
Laundry	IADL
Shopping and errands	IADL
Meal preparation and clean up	IADL
Mobility inside/Ambulation	ADL
Bathing and grooming	ADL
Dressing	ADL
Bowel, bladder and menstrual	ADL
Repositioning	ADL
Eating	ADL
Respiration	Other

ADL = Activity of daily living, IADL = Instrumental activity of daily living

Figure 1.
Survival by Quality Score Tercile (N=21,310)

Patient Demographics – Dual Enrollees receiving In-Home Supportive Services in 19 Counties in California in 1999–2000

Table 1

	IHSS Enrollees			Quality of Care Tercile		
	Included	Excluded	P ¹	Tercile 1	Tercile 2	Tercile 3
N	21,310	4,512		7,167	6,928	7,215
Male (%)	22	21	< 0.01	24	22	21
Race (%)			< 0.01			
White	48	49		44	48	51
Black	14	16		13	15	14
Latino	13	13		12	13	14
Asian	19	17		23	18	15
Other/Unknown	6	5		7	6	5
Age (mean, years)	83	83	< 0.01	84	83	82
Census Measures						
% Non-English speakers	13	12	< 0.01	13	13	13
% < 200% federal poverty level	38	36	< 0.01	38	38	38
% No high school education	27	26	< 0.01	27	27	27
% Rural	2.2	2.9	0.01	2.2	2.4	2.2
Charlson Index (mean)	1.6	1.6	0.96	1.3	1.5	2.1
ACOVE condition count (mean)	4.4	4.4	0.64	4.2	4.3	4.7
ACOVE quality indicators triggered (mean)	7.1	7.0	0.13	6.4	6.8	8.0
Quality of care (pass rate; mean)	46	45	< 0.01	23	46	69
Death in 2000 (%)	15	0	-	18	16	12
Function						
Baseline ADL needs index (1998)	7.1	6.7	< 0.01	7.9	7.1	6.4
Baseline IADL needs index (1998)	13.6	13.3	< 0.01	13.9	13.5	13.3
Baseline IHSS 11-item functional index (1998)	2.7	2.7	< 0.01	2.8	2.7	2.6
Follow-up ADL needs index (2000)	10.7	-	-	11.9	10.7	9.5
Follow-up IADL needs index (2000)	14.1	-	-	14.4	14.1	13.9
Time between baseline and follow-up (mean, months)	23.6	-	-	23.5	23.6	23.6

Included individuals who received In-Home Supportive Services (IHSS) and were alive throughout 1999.

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Quality of Care Terciles based on the full sample of all dually enrolled vulnerable elders alive on January 1, 2000.
p¹ - Significance of difference between included and excluded IHSS participants;
p² - Significance of difference between quality terciles.

Table 2
Multivariate Regression Models Predicting Function and Survival at follow-up with Quality by Tercile

	ADL needs index at Follow-up			IADL needs index at Follow-up			Death		
	Beta	95% CI	P	Beta	95% CI	P	OR	95% CI	P
Quality of Care									
Lowest tercile	-	-	-	-	-	-	-	-	-
Middle tercile	-0.56	-0.78 -0.34	< 0.01	-0.08	-0.13 -0.03	< 0.01	0.84	0.76 0.92	< 0.01
Highest tercile	-1.35	-1.57 -1.13	< 0.01	-0.12	-0.18 -0.07	< 0.01	0.57	0.52 0.63	< 0.01
Condition (count)	0.62	0.56 0.69	< 0.01	0.08	0.07 0.09	< 0.01	1.25	1.22 1.29	< 0.01
Male	0.62	0.39 0.85	< 0.01	0.08	0.03 0.13	< 0.01	1.43	1.30 1.56	< 0.01
Race									
White	-	-	-	-	-	-	-	-	-
Black	-0.27	-0.54 -0.01	0.05	0.09	0.03 0.15	< 0.01	0.75	0.67 0.85	< 0.01
Latino	-0.66	-0.92 -0.40	< 0.01	-0.07	-0.13 -0.01	0.02	0.60	0.53 0.68	< 0.01
Asian	-0.88	-1.10 -0.65	< 0.01	0.13	0.08 0.19	< 0.01	0.50	0.45 0.57	< 0.01
Other	-0.33	-0.69 0.03	0.07	0.00	-0.08 0.08	0.98	0.71	0.60 0.83	< 0.01
Age	0.16	0.15 0.18	< 0.01	0.02	0.02 0.03	< 0.01	1.07	1.06 1.07	< 0.01
% < 200% poverty level	-0.01	-0.02 -0.01	< 0.01	0.00	-0.01 0.00	< 0.01	1.00	0.99 1.00	< 0.01
Rural	0.87	0.20 1.54	0.01	0.11	-0.04 0.27	0.16	1.22	0.96 1.55	0.11
Charlson Index	0.30	0.24 0.36	< 0.01	0.03	0.02 0.04	< 0.01	1.12	1.09 1.14	< 0.01
Baseline ADL needs index	0.80	0.78 0.81	< 0.01	0.02	0.01 0.02	< 0.01	1.05	1.04 1.05	< 0.01
Baseline IADL needs index	0.16	0.12 0.20	< 0.01	0.68	0.66 0.69	< 0.01	1.01	0.99 1.03	0.31
Intercept	-12.46	-13.94 -10.97	< 0.01	2.84	2.50 3.19	< 0.01	-	-	-

N = 21,310 individuals receiving In-Home Supportive Services. All individuals were alive throughout 1999.

ADL needs index – Need among Activities of Daily Living (6 items) with a range of 0 to 24, higher is greater need.

IADL needs index – Need among Instrumental Activities of Daily Living (4 items), higher is greater need.

If a patient died, ADL needs index and IADL needs index were set to the maximum.

Table 3
Multivariate Regression Model Predicting Function and Survival at follow-up using Continuous Measure of Quality

	ADL needs index at Follow-up			IADL needs index at Follow-up			Death - IHSS Only			Death - All Dual Eligibles*		
	Beta	95% CI	P	Beta	95% CI	P	OR	95% CI	P	OR	95% CI	P
Quality	-2.12	-2.52	-1.72	< 0.01	0.05	0.01	0.05	0.01	0.05	0.01	0.05	0.01
Condition (count)	0.60	0.53	0.66	< 0.01	0.08	0.06	0.09	< 0.01	0.08	0.06	0.09	< 0.01
Male	0.63	0.40	0.86	< 0.01	0.08	0.03	0.13	< 0.01	0.08	0.03	0.13	< 0.01
Race												
White	-	-	-	-	-	-	-	-	-	-	-	-
Black	-0.27	-0.54	< 0.01	0.05	0.09	0.03	0.15	< 0.01	0.05	0.09	0.03	0.15
Latino	-0.67	-0.93	-0.41	< 0.01	-0.07	-0.13	-0.01	0.02	0.60	0.53	0.69	< 0.01
Asian	-0.89	-1.11	-0.66	< 0.01	0.13	0.08	0.18	< 0.01	0.50	0.45	0.57	< 0.01
Other	-0.34	-0.69	0.02	0.06	0.00	-0.08	0.08	0.95	0.70	0.60	0.83	< 0.01
Age	0.16	0.15	0.18	< 0.01	0.02	0.02	0.03	< 0.01	1.07	1.06	1.08	< 0.01
% < 200% poverty level	-0.01	-0.02	-0.01	< 0.01	0.00	-0.01	0.00	< 0.01	1.00	0.99	1.00	< 0.01
Rural	0.88	0.21	1.55	0.01	0.11	-0.04	0.27	0.16	1.22	0.96	1.56	0.10
Charlson Index	0.29	0.23	0.36	< 0.01	0.03	0.02	0.04	< 0.01	1.12	1.09	1.14	< 0.01
Baseline ADL needs index	0.80	0.78	0.81	< 0.01	0.02	0.01	0.02	< 0.01	1.05	1.04	1.05	< 0.01
Baseline IADL needs index	0.16	0.12	0.20	< 0.01	0.68	0.66	0.69	< 0.01	1.01	0.99	1.03	0.33
Intercept	-12.20	-13.70	-10.70	< 0.01	2.88	2.53	3.23	< 0.01	-	-	-	-

N = 21,310. All individuals in the N=21,310 sample receiving In-Home Supportive Services and were alive throughout 1999

* N = 91,597

ADL needs index – Need among Activities of Daily Living (6 items plus respiratory care), higher is greater need.

IADL needs index – Need among Instrumental Activities of Daily Living (4 items), higher is greater need.

If a patient dies, ADLs and IADLs needs are set to the maximum possible.

Appendix Table 1**In-home Supportive Services Function Limitation Assessments**

Function Assessment	Scoring	Type
Housework	1 to 5	IADL
Laundry	1, 4 or 5	IADL
Shopping and errands	1, 3 or 5	IADL
Meal preparation and clean up	1 to 5 or, 6 if recipient receives tube feeding	IADL
Mobility inside/Ambulation	1 to 5	ADL
Bathing and grooming	1 to 5	ADL
Dressing	1 to 5	ADL
Bowel, bladder and menstrual	1 to 5	ADL
Repositioning	1 to 5	ADL
Eating	1 to 5 or, 6 if recipient receives tube feeding	ADL
Respiration	1, 5 or 6 if recipient receives paramedical suctioning	Other

ADL – Activity of Daily Living; **IADL** – Instrumental Activity of Daily Living

Note: Scoring goes from least functional need (1) to most functional need (5 or 6)

Appendix Table 2**California In-Home Supportive Services Function Limitations Assessments**

HOUSEWORK	
Sweeping, vacuuming, and washing floors; washing kitchen counters and sinks; cleaning the bathroom; storing food and supplies; taking out garbage; dusting and picking up; cleaning oven and stove; cleaning and defrosting refrigerator; bringing in fuel for heating or cooking purposes from a fuel bin in the yard; changing bed linen.	
1	Independent: Able to perform domestic chores without a risk to health or safety.
2	Able to perform tasks but needs directions or encouragement from another person.
3	Requires physical assistance from another person for some chores; e.g., has a limited endurance or limitations in bending, stooping, reaching, etc.
4	Although able to perform a few chores (e.g., dust furniture or wipe counters) help from another person is needed for most chores.
5	Totally dependent upon others for all domestic chores.
LAUNDRY	
Gaining access to machines, sorting, manipulating soap containers, reaching into machines, handling wet laundry, operating machine controls, hanging laundry to dry, folding and sorting. Ability to iron non-wash-and-wear garments is ranked as part of this function only if this is required because of the individual's condition; e.g., to prevent pressure sores or for employed recipients who do not own a wash-and-wear wardrobe.	
1.	Independent: able to perform all chores.
4.	Requires assistance with most tasks. May be able to do some laundry tasks; e.g., hand wash underwear, fold and/or store clothing by self or under supervision.
5.	Cannot perform any task. Is totally dependent on assistance from another person.
SHOPPING and ERRANDS	
Compile shopping list, bending, reaching, and lifting, managing cart or basket, identifying items needed, transferring items to home, putting items away, phoning in and picking up prescriptions, and buying clothing.	
1.	Independent: Can perform all tasks without assistance.
3.	Requires the assistance of another person for some tasks; e.g., help with major shopping needed, but consumer can go to nearby store for small items or needs direction or guidance.
5.	Unable to perform any tasks for self.
MEAL PREPARATION AND CLEANUP	
Planning menus. Washing, peeling, slicing vegetables, opening packages, cans and bags, mixing ingredients, lifting pots and pans, reheating food, cooking, safely operating stove, setting the table, serving the meal, cutting food into bite-sized pieces. Washing and drying dishes, and putting them away.	
1	Independent: Can plan, prepare, serve and clean up meals.
2	Needs only reminding or guidance in menu planning, meal preparation and/or cleanup.
3	Requires another person to prepare and cleanup main meal(s) on less than a daily basis; e.g., can reheat food prepared by someone else, can prepare simple meals and/or needs help with cleanup on a less than daily basis.
4	Requires another person to prepare and cleanup main meal(s) on a daily basis.
5	Totally dependent on another person to prepare and cleanup all meals.
6	Is tube-fed.
MOBILITY INSIDE / AMBULATION	
Walking or moving around inside the house, changing locations in a room, moving from room to room. Can respond adequately if (s) he stumbles or trips. Can step over or maneuver around pets or obstacles, including uneven floor surfaces. Climbing or descending stairs if stairs are inside dwelling. Does not	

HOUSEWORK

refer to transfers, to abilities or needs once destination is reached, to ability to come into or go out of the house, or to moving around outside.

- 1 Independent: Requires no physical assistance though consumer may experience some difficulty or discomfort. Completion of the task poses no risk to his/her safety.
 - 2 Can move independently with only reminding or encouragement. For example, needs reminding to lock a brace, unlock a wheelchair or to use a cane or walker.
 - 3 Requires physical assistance from another person for specific maneuvers; e.g., pushing wheelchair around sharp corner, negotiating stairs or moving on certain surfaces.
 - 4 Requires assistance from another person most of the time. At risk if unassisted.
 - 5 Totally dependent upon others for movement. Must be carried, lifted or pushed in a wheelchair or gurney at all times.
-

6. BATHING, ORAL HYGIENE AND GROOMING, ROUTINE BED BATHS

Bathing means cleaning the body using a tub, shower or sponge bath, including getting a basin of water, managing faucets, getting in and out of a tub, reaching head and body parts for soaping, rinsing, and drying. Grooming includes hair combing and brushing, shampooing, oral hygiene, shaving and fingernail and toenail care.

- 1 Independent: Able to bathe and groom self safely without help from another person.
 - 2 Able to bathe and groom self with direction or intermittent monitoring. May need reminding to maintain personal hygiene.
 - 3 Generally able to bathe and groom self, but needs assistance with some areas of body care; e.g., getting in and out of shower or tub, shampooing hair, or can sponge bathe but another person must bring water, soap, towel, etc.
 - 4 Requires direct assistance with most aspects of bathing and grooming. Would be at risk left alone.
 - 5 Totally dependent on others for bathing and grooming.
-

7. DRESSING

Putting on and taking off, fastening and unfastening garments and undergarments, special devices such as back or leg braces, corsets, elastic stockings/garments and artificial limbs or splints.

- 1 Independent: Able to put on, fasten and remove all clothing and devices without assistance. Clothes self appropriately for health and safety.
 - 2 Able to dress self, but requires reminding or direction with clothing selection.
 - 3 Unable to dress self completely, without the help of another person; e.g., tying shoes, buttoning, zipping, putting on hose or brace, etc.
 - 4 Unable to put on most clothing items by self. Without assistance would be inappropriate or inadequate clothed.
 - 5 Unable to dress self at all. Requires complete assistance from another.
-

8. BOWEL, BLADDER, AND MENSTRUAL

Assisting person to and from, on and off toilet or commode and emptying commode, managing clothing and wiping and cleaning body after toileting, assistance with using and emptying bedpans, ostomy and/or catheter receptacles and urinals, application of diapers and disposable barrier pads. Menstrual care limited to external application of sanitary napkin and cleaning. (NOTE: Catheter insertion, ostomy irrigation and bowel program are evaluated as Paramedical Services.

- 1 Independent: Able to manage bowel, bladder and menstrual care with no assistance from another person.
 - 2 Requires reminding or direction only.
 - 3 Requires minimal assistance with some activities but the constant presence of the provider is not necessary.
 - 4 Unable to carry out most activities without assistance.
 - 5 Requires physical assistance in all areas of care.
-

9. TRANSFER

Moving from one sitting or lying position to another sitting or lying position; e.g., from bed to and from a wheelchair, or sofa, coming to a standing position and/or

HOUSEWORK

repositioning to prevent skin breakdown. (NOTE: If pressure sores have developed, the need for care of them is evaluated as a Paramedical Service.)

- 1 Independent: Able to do all transfers safely without assistance from another person.
 - 2 Able to transfer but needs encouragement or direction.
 - 3 Requires some help from another person; e.g., routinely requires a boost or assistance with positioning.
 - 4 Unable to complete most transfers without physical assistance. Would be at risk if unassisted.
 - 5 Totally dependent upon another person for all transfers. Must be lifted or mechanically transferred.
-

10. FEEDING

Reaching for, picking up, grasping utensil and cup; getting food on utensil, bringing food, utensil, cup to mouth, chewing, swallowing food and liquids, manipulating food on plate. Cleaning face and hands as necessary following a meal.

- 1 Independent: Able to feed self.
 - 2 Able to feed self, but needs verbal assistance such as reminding or encouragement to eat.
 - 3 Assistance needed during the meal e.g., to apply assistive device, fetch beverage or push more food within reach, etc., but constant presence of another person not required.
 - 4 Able to feed self some foods, but cannot hold utensils, cups, glasses, etc., and requires constant presence of another person.
 - 5 Unable to feed self at all and is totally dependent upon assistance from another person.
 - 6 Is tube-fed.
-

11. RESPIRATION

Respiration is limited to non-medical services such as assistance with self-administration of oxygen and cleaning oxygen equipment and IPPB machines.

1. Does not use respirator or other oxygen equipment or able to use and clean independently.
 5. Needs help with self-administration and/or cleaning.
 6. Needs Paramedical Service such as suctioning.
-

California In-Home Supportive Services Function Limitations Assessments, Full Description, adapted from "Request for Information Documenting Patient's Functional Limitations - #5467.01"

Appendix Table 3**In-Home Supportive Services Function Limitation Index Weightings**

Function Assessments	Weight
housework	0.038
laundry	0.037
shopping and errands	0.040
meal preparation and clean up	0.222
mobility inside (ambulation)	0.079
bathing and grooming	0.095
dressing	0.057
bowel, bladder and menstrual	0.129
transfer	0.094
eating	0.127
respiration	0.082

Note – Items that are scored ‘6’ (meals, eating, and respiration), which indicate paramedical assistance, are replaced as ‘5’ (requiring full assistance) in the construction of the IHSS Function Limitation Index.

Appendix Table 4

Individual Quality Indicator Pass Rates and Relationship to Mortality

Condition	Operationalized Quality Indicator	PASS		FAIL		P
		n	Mortality	n	Mortality	
1 Continuity of Care	IF VE discharged from hospital, THEN follow-up within 6 wks	4,225	0.22	1,126	0.33	<0.01
2 Dementia	IF VE has newly diagnosed dementia, THEN check B12 & TSH	88	0.32	1,162	0.33	0.89
3 Dementia	IF VE with dementia has new depression, THEN treat the depression	29	0.48	122	0.40	0.43
4 Dementia	IF VE with new dementia, then start cholinesterase inhibitor	438	0.12	2,393	0.32	<0.01
5 Depression	IF VE has new depression, THEN antidepressant, psychotherapy, or ECT within 2 wks of diagnosis	132	0.26	322	0.31	0.29
6 Depression	IF VE is treated with new antidepressants, THEN TCAs, MAOIs, benzodiazepines, and stimulants should not be 1st or 2nd line therapy	102	0.23	15	0.13	0.39
7 Depression	IF VE has new depression with psychosis, THEN refer to psychiatrist & treat with antidepressant & antipsychotic or ECT	7	0.57	100	0.38	0.32
8 Depression	IF VE with a history of CAD is started on TCA, THEN baseline ECG should be performed within 3 months before initiation.	1	0.00	2	0.00	-
9 Depression	IF VE is taking an SSRI, THEN MAOI should not be taken within specified time period after stopping SSRI	0		0		-
10 Diabetes	IF VE has diabetes, THEN hemoglobin A1C should be measured at least every 12 months.	3,502	0.14	4,515	0.17	<0.01
11 Diabetes	IF VE has diabetes, does not have established renal insufficiency, and is not on an ACE inhibitor, THEN should have an annual test for proteinuria.	1,335	0.11	2,224	0.13	0.23
12 Diabetes	IF VE has diabetes and proteinuria, THEN should be offered (received) therapy with an ACE inhibitor.	5,262	0.15	77	0.23	0.06
13 Diabetes	IF VE has diabetes and is not blind, THEN should have an annual dilated eye exam.	3,562	0.11	3,272	0.17	<0.01
14 Heart Failure	IF VE has asymptomatic left ventricular dysfunction and LVEF < 40%, THEN an ACE inhibitor or ARB should be offered (received)	5,663	0.19	4,987	0.22	<0.01
15 Heart Failure	IF VE has newly diagnosed CHF, THEN chest x-ray, ECG, CBC, serum sodium/potassium/creatinine, and TSH should be checked within 1 month of diagnosis (or 3 months prior to diagnosis)	1,125	0.17	1,722	0.19	0.11
16 Heart Failure	IF VE has newly diagnosed CHF, THEN Left Ventricular Ejection Fraction (LVEF) should be evaluated within 1 month.	374	0.12	2,473	0.19	<0.01
17 Heart Failure	IF VE is diagnosed with CHF and has no contraindications, THEN should receive a beta blocker.	1,188	0.13	2,747	0.17	<0.01
18 Heart Failure	IF VE has CHF, LVEF < 40%, and no atrial fibrillation, THEN should not receive a 1st or 2nd generation calcium channel blocker.	6,034	0.15	184	0.16	0.58
19 Hypertension	IF VE has newly diagnosed hypertension, THEN ECG should be	1,315	0.20	2,100	0.14	<0.01

Condition	Operationalized Quality Indicator	PASS		FAIL		P
		n	Mortality	n	Mortality	
	performed within 4 weeks of diagnosis.					
20 Hypertension	IF VE has hypertension and renal disease with serum creatinine > 1.5 mg% or proteinuria (> 1gm protein/24 hrs), THEN ACE inhibitor should be offered	2,034	0.21	2,520	0.32	< 0.01
21 Hypertension	IF VE has hypertension and asthma, THEN beta blocker should not be used.	2,704	0.17	921	0.13	< 0.01
22 Ischemic Heart Disease	IF VE is hospitalized for AMI, THEN should be offered assessment of LVEF within 3 days after hospital discharge	220	0.34	126	0.35	0.88
23 Ischemic Heart Disease	IF VE has AMI or unstable angina and no contraindications, THEN should be offered stress testing 4 to 21 days after the event.	87	0.22	405	0.33	0.04
24 Ischemic Heart Disease	IF VE has AMI or unstable angina and no contraindications, THEN urgent catheterization should be offered.	198	0.17	514	0.31	< 0.01
25 Ischemic Heart Disease	IF VE has known CAD and LDL cholesterol is greater than 130 mg% and diet change is unsuccessful, THEN should be offered cholesterol-lowering agent.	4,117	0.08	4,894	0.17	< 0.01
26 Ischemic Heart Disease	IF VE has known CAD and unknown LDL cholesterol, then check lipid profile.	1,123	0.13	2,315	0.28	< 0.01
27 Medication Usage	IF VE is prescribed warfarin, THEN INR checked within 4 days of start and every 6 weeks thereafter	809	0.21	218	0.19	0.52
28 Medication Usage	IF VE is prescribed thiazide or loop diuretic, THEN electrolytes checked within 1 week of initiation and yearly thereafter	8,802	0.17	947	0.18	0.51
29 Medication Usage	IF VE is prescribed an oral hypoglycemic, THEN chlorpropamide should not be used	4,706	0.16	83	0.10	0.08
30 Medication Usage	All VE should not be prescribed medications with strong anticholinergic effects (IF alternatives are available)	12,236	0.17	9,074	0.12	< 0.01
31 Medication Usage	IF VE does not need control of seizures, THEN barbiturates should not be used	18,841	0.15	1,074	0.07	< 0.01
32 Medication Usage	IF VE needs analgesia, THEN meperidine should not be used	21,269	0.15	41	0.27	0.06
33 Medication Usage	IF VE is receiving an ACE inhibitor, THEN serum potassium and creatinine should be checked within 4 weeks of initiation of therapy	1,196	0.17	4,164	0.13	< 0.01
34 Osteoarthritis	IF VE is older than 75 years of age and is treated with warfarin or has a history of PUD or GI bleeding, AND is treated with NSAIDS, THEN should be offered misoprostol or a PPI	2,118	0.11	6,507	0.13	0.02
35 Osteoporosis	IF a female VE is newly diagnosed with osteoporosis, THEN the patient should be offered HRT or bisphosphonates within 3 months of diagnosis	334	0.10	491	0.22	< 0.01
36 Stroke and AF	IF VE has atrial fibrillation then offer anticoagulation or antiplatelet treatment	1,395	0.21	4,248	0.27	< 0.01
37 Vision	All VE should be offered an eye evaluation every 2 years	6,551	0.10	12,166	0.15	< 0.01
38 Vision	IF VE has new diagnosis of primary open angle glaucoma, THEN initial	16	0.00	40	0.15	.

Condition	Operationalized Quality Indicator	PASS		FAIL		P
		n	Mortality	n	Mortality	
39 Vision	exam should include a comprehensive eye examination (with appropriate documentation) IF VE is diagnosed with proliferative diabetic retinopathy, THEN a dilated eye exam should be done every 4 months	102	0.14	388	0.19	0.20
40 Vision	IF VE is diagnosed with macular edema, THEN should receive a dilated eye exam every 6 months.	188	0.20	483	0.14	0.07
41 Vision	IF VE undergoes cataract surgery, THEN follow-up ocular exam should occur within 3 months.	112	0.13	822	0.10	0.26

P-values in bold: $P < 0.05$

Appendix Table 5

Grouped Quality Indicator Pass Rates and Relationship to Mortality

	N	Odds Ratio 95%_CI	P
Condition Grouping			
Continuity	5,351	0.58	0.67 < 0.01
Dementia	2,965	0.33	0.25 0.45 < 0.01
Depression	456	0.77	0.47 1.28 0.32
Diabetes	9,714	0.69	0.60 0.81 < 0.01
Heart Failure	11,024	0.63	0.55 0.72 < 0.01
Hypertension	9,420	0.80	0.72 0.89 < 0.01
Ischemic Heart Disease	11,653	0.32	0.29 0.37 < 0.01
Medication	21,310	3.41	2.76 4.22 < 0.01
Osteoarthritis	8,625	0.84	0.72 0.98 0.02
Osteoporosis	825	0.41	0.27 0.61 < 0.01
Atrial Fibrillation/Stroke	5,643	0.70	0.60 0.81 < 0.01
Vision	19,063	0.59	0.53 0.65 < 0.01
Domain Grouping			
Diagnosis	12,326	0.73	0.66 0.82 < 0.01
Follow-up Care	14,211	1.22	1.09 1.37 < 0.01
Treatment	21,310	0.21	0.17 0.25 < 0.01
Screening and Prevention	20,635	0.59	0.53 0.65 < 0.01

P-values in bold: P < 0.05