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A Longitudinal Evaluation of Persons With Disabilities: Does a Longitudinal Definition Help Define Who Receives Necessary Care?

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Abstract

Objective—To assess, using a longitudinal definition, the impact of disability on a broad range of objective health care quality indicators.

Design—Longitudinal cohort study following up with patients over several years. The first 2 interviews, 1 year apart, were used to determine each patient's disability status in activities of daily living (ADLs). Assessment of the health care indicators commenced after the second interview and continued throughout the survey period (an additional 1–3y).

Setting—National survey.

Participants—Participants (N[H11005]29,074) of the Medicare Current Beneficiary Survey (1992–2001) with no, increasing, decreasing, and stable ADL disability.

Interventions—Not applicable.

Main Outcome Measure—The incidence of 5 avoidable outcomes, receipt of 3 preventive care measures, and adherence to 32 diagnostically based indicators assessing the quality of treatment for acute myocardial infarction [AMI], angina, breast cancer, cerebrovascular accident, transient ischemic attack, cholelithiasis, chronic obstructive pulmonary disease [COPD], congestive heart failure, depression, gastrointestinal bleeding, diabetes, and hypertension.

Results—For most indicators, less than 75% of eligible patients received necessary care, regardless of disability status. For 5 indicators, less than 50% of patients received appropriate treatment. In a logistic regression analysis that controlled for patient age, sex, race, and income, disability status was a significant factor in 7 quality measures (AMI, breast cancer, COPD, diabetes, angina, pneumonia, annual visits).

Conclusions—Using a longitudinal definition of disability and objective health quality indicators, we found that disability status can be an important factor in determining receipt of quality health care in a broad range of diagnostic categories. However, the impact of disability

status varies depending on the indicator measured. In this cohort of patients, the changing nature of a person's disability seems to have less impact than whether they ever have had any functional deficits.

Keywords

Disability evaluation; Medicare; Rehabilitation

Disability has been shown to be a risk factor for a variety of poor outcomes in health care. These adverse outcomes have been documented in several populations experiencing a wide variety of limitations including mobility limitation, communication limitation, as well as physical, sensory, and psychiatric disability.¹⁻⁵ In these studies, subjects with disabilities were at risk for receipt of fewer preventive measures, such as mammograms and Papanicolaou (Pap) smears, as well as decreased satisfaction in a number of domains of the care provided, including ease of getting to the doctor, cost of care, and availability of specialists. In addition, the risk for these adverse outcomes appears to grow with increasing levels of disability even after adjusting for other factors such as age, sex, race, and socioeconomic factors.^{6,7}

Although these initial studies have been revealing, they are hampered by several limitations. First, the outcome measures assessed have been limited to self-reported health maintenance items such as vaccinations, mammograms, and Pap smears and have not included other, more extensive, process measures of care that avoid recall bias.^{8,9} Second, most of the population-based studies to date have been cross-sectional in nature.¹⁰ In a cross-sectional analysis, the dynamic nature of disability is not measured. People may be on a variety of disability trajectories: stable, improving, or worsening. These groups may be affected differently by health care disparities.

There is a growing body of evidence to suggest that persons whose activity limitations are increasing may be at more risk for adverse outcomes.¹⁰ This may be due to the facts that activity limitations are tightly linked to health status and that an increase in disability likely also signals an increase in health care needs. At the same time, a person with greater mobility or communication difficulties may find it harder to access these needed services.¹¹ Finally, health care providers may treat patients with declining functional status less aggressively.¹²

To address the limitations of prior studies, we performed a longitudinal evaluation of over 29,000 Medicare beneficiaries using survey and claims data. Beneficiaries were categorized by their disability trajectories and then followed up over time regarding their medical care usage. We used claims data to assess the degree to which their disability trajectories affected the use of 40 necessary care health care indicators. These indicators span a wide variety of disease states and a variety of sites and types of services. We hypothesized that beneficiaries on different disability trajectories would have differing proportions of patients who receive necessary care and that those with increasing disability would have the lowest proportions.

METHODS

We used data from the Medicare Current Beneficiary Survey (MCBS) from 1992 to 2001 (N[H11005]29,074). The MCBS is a stratified national survey of Medicare beneficiaries that has been described previously.¹³ A complex sampling design is used: the United States is separated into 107 primary sampling units by county and then clustered by postal ZIP codes. Beneficiaries within each cluster are randomly selected within age groups to participate in the survey. The survey is administered, in person, to between 12,000 and 13,000 Medicare

beneficiaries annually, and a nationally representative sample of all Medicare beneficiaries is obtained.¹⁴

The survey is longitudinal, and beneficiaries receive the same interview yearly for up to 4 consecutive years. About 3000 to 4000 beneficiaries are added to the sample every year, with a similar number exiting the sample. Data collected included satisfaction with medical care, health status and functioning, and use of health services, as well as demographic information such as income, education level, and living arrangements.

To define a person's disability trajectory, we used a modification of a grading system suggested by Ferrucci et al¹⁵ in their longitudinal study of the disablement process. In our study, disability trajectory was defined by a person's responses to yes and no questions regarding the number of difficulties in health-related activities of daily living (ADLs) over a 1-year period. Those who claimed no limitations at either interview 1 or interview 2 were classified as having no disability. Those whose preexisting limitations did not change over time were considered to have stable disability. Those who had a higher number of ADL limitations at interview 2 were classified as having increasing disability. Those who had fewer ADL limitations at interview 2 were considered to have decreasing disability.

To measure the quality of care provided to these disability groups, we used a tool that was developed to measure disparities in health care using Medicare claims data,⁹ because these data are linked to each MCBS participant's survey responses. This tool was developed using information from published research and expert opinion (Delphi method). The indicators we assessed represent outcomes for 14 common acute and chronic medical and surgical conditions (acute myocardial infarction [AMI], anemia, angina, breast cancer, cerebrovascular accident [CVA], transient ischemic attack [TIA], cholelithiasis, chronic obstructive pulmonary disease [COPD], congestive heart failure [CHF], depression, pneumonia, diabetes, gastrointestinal [GI] bleeding, hypertension). Thirty-eight of the indicators represent underuse of necessary care (eg, care that should have been delivered but was not), 6 represent avoidable outcomes, and 3 are measures of preventive care. Five of the indicators are based on the results of randomized trials, 7 on observational studies, and the remainder on expert opinion. Six of the indicators in the original tool were not measured in our study because of inadequate sample size. One was not used because of poor quality of the claims data.

The supporting evidence for these indicators has been published elsewhere.¹⁶ In a validation study, 345,253 randomly selected Medicare beneficiaries from 1994 to 1996 were analyzed. All of these patients were eligible for at least 1 preventive care indicator, and 46% were eligible for 1 nonpreventive care indicator. In addition, the indicators were discriminatory, because certain groups performed significantly worse on most indicators. This methodology is unique in that it uses administrative data and its indicators span a wide range of diagnoses and many phases of care: prevention, initial evaluation, diagnostic testing and therapeutics, as well as inpatient hospitalization, follow-up, and monitoring.

Descriptive analysis was performed for all variables. For each indicator, we calculated the proportion of patients receiving care based on the total number of people who were eligible for that indicator. For each indicator, we performed a logistic regression, using the indicator use (yes or no) as the response variable, and age, sex, socioeconomic status ([H11349]\$25,000 vs [H11022]\$25,000/y), race (white vs nonwhite), and ADL disability as explanatory variables. To account for comorbidities, patients were categorized as having 0, 1 to 2, 3 to 5, or 6 or more conditions. The conditions included cancer, hypertension, diabetes, AMI, coronary heart disease, stroke, rheumatoid arthritis or osteoarthritis, Alzheimer's and Parkinson's diseases, emphysema, and hip fracture. Because our findings did not differ

substantially from those models without comorbidities, we have chosen not to report them. Significance level was set at .05. Statistical analyses were performed using SPSS.^a

RESULTS

The demographic characteristics of the study cohort can be found in table 1. Sixty percent of the cohort had no disability, and 13% had increasing, 18% had decreasing, and 9% had stable disability. In general, any type of disability tended to increase with increasing age, being overweight or underweight, female sex, being nonwhite, being unmarried, and having less education and less income. In addition, people with ADL limitations were markedly more likely to report having fair or poor health and to have more comorbidities than those without ADL limitations.

Ninety-seven percent of the cohort was eligible for 10 or fewer indicators, 56% were eligible for 3 or fewer indicators. Overall measures of any underuse by disability category can be found on figure 1A. These results show that, as the number of indicators for which a person is eligible increases, the likelihood that they will all be adhered to decreases. For example, although about 75% of those eligible for 3 indicators had perfect treatment, only 40% of those eligible for 4 indicators received all the care recommended. In addition, the 4 disability groups display similar patterns of care. Similar figures (figs 1B–D) were constructed by age, race, and socioeconomic status. In general, we found similar results; however, those who were nonwhite and those whose income was less than \$25,000 a year were less likely to receive care than their counterparts.

We also looked beyond those who received ideal care (people who received appropriate care in all cases) and assessed the performance of each indicator. These results, by ADL disability status, can be found in table 2. For most indicators, less than 75% of eligible beneficiaries received necessary care, regardless of disability status. For 5 indicators, less than 50% of patients received appropriate treatment (patients with iron deficiency anemia, a GI tract workup, lipid profile within 6 months from initial diagnosis of angina, glycosylated hemoglobin every 6 months for patients with diabetes, eye examination every year for patients with diabetes, visit within 2 weeks after discharge of patients hospitalized for depression).

In logistic regression analyses, patient characteristics were associated with receipt of necessary care in 21 of the indicators (table 3). Disability status was a significant factor in 7 of these quality measures (3 underuse of necessary care indicators, 1 avoidable outcome, 3 preventive care measures). In these analyses, compared with those with no disability, those with increasing, decreasing, or stable disability were more likely to have an annual health visit and a hematocrit test after the diagnosis of anemia but were less likely to have a mammogram (with and without a history of breast cancer), or an eye examination (with and without the diagnosis of diabetes). In addition, those with disability were more likely to experience 1 important avoidable outcome: more than 3 visits a year to the emergency department for angina.

DISCUSSION

Our results suggest several important conclusions. First, the percentage of those receiving ideal care was low and dropped significantly below 50% for those eligible for 4 or more indicators. This group was sizable and represented 76.5% of the cohort. In addition, we found that the relationship between disability and health care quality is complex and

^aSupplier Version 13.0; SPSS Inc, 233 S Wacker Dr, 11th Fl, Chicago, IL 60606.

heterogeneous. When we use a more sophisticated, longitudinal definition of ADL disability and apply it to a range of quality indicators, disability status seems to have an impact, but this effect is not consistent in either direction or magnitude. In our logistic regression analyses, ADL disability was statistically associated with 7 of 33 indicators and in certain cases, having a disability increased the chances of receiving appropriate care. Last, our longitudinal definition of disability largely failed to help shed additional light on disability-related health care disparities.

Our results are consistent with those found by Asch et al⁹ in their analysis of the underuse of necessary care in over 345,000 Medicare beneficiaries, which found that beneficiaries experienced underuse about two thirds of the time and that minorities and those living in poverty were especially at risk. Our study now expands the use of these underuse measures to include the impact of disability.

To our knowledge, there is only one other study¹⁰ that uses a longitudinal definition of disability in an assessment of health outcomes. Iezzoni et al¹⁰ followed up patients over a 2-year period and assessed their changes in physical and sensory function. They found that those with worse functioning in the second year were more dissatisfied with various aspects of their health care than those who were stable. Our study expands on these results, because we have now examined 10 years of survey data and have included many detailed process measures of care. However, our results failed to find a consistent pattern, suggesting that change in disability status over time is not as important as whether or not a person has a disability at all.

Although we now understand that people with disabilities face several health care disparities, there are few validated models of care that attempt to eliminate them. Iezzoni and O'Day¹⁷ outline several items that might improve health care quality and access for people with disabilities. These include the application of universal design to accommodate variations in human function, enhancing self-management and advocacy, improving patient-clinician communication, and the full utilization of accessible communication and information technologies. At this point, we need to design models of care for people with disabilities, perhaps based on suggestions made by Iezzoni and O'Day, and test their efficacy and effectiveness.

Study Limitations

Our study has certain limitations. First, our results can only be generalized to the fee-for-service Medicare population. We do not have data on those in health maintenance organizations, those covered by Medicaid or private insurance, or the 46 million Americans without health care.¹⁸ However, because Medicare provides some of the richest health care benefits of all insurers (all of our indicators are covered by Medicare insurance), our study represents close to the ideal situation. It is likely that other patient populations, particularly the underinsured or uninsured, receive much less of the necessary care given to our cohort. There are also those who question the accuracy of self-reported changes in functional limitations.¹⁹ Our analyses assess only associations between activity limitations and health outcomes, not causality. Finally, our analyses examined only those patients who had enough access to health care so that they met an indicator. We cannot extend our conclusions to those who may have a condition but never received a diagnosis. This may have particular bearing on people with disabilities who cannot access the health care system.

In our logistic regression analyses, the association of age and activity limitations may have affected our results such that we may be underestimating the degree to which activity limitations affected compliance with the indicators. In addition, there are some limitations to our definition of disability trajectory. First, we were able to measure activity limitations at

only 2 points in time. Although this methodology has been used before, it may not be an adequate representation of a patient's disability trajectory, particularly in the year we assessed the outcome measures. In addition, by presenting the data divided into only 4 disability groups, we may have lost interesting distinctions between groups that differ significantly in their overall disability status. Stated another way, our increasing disability group contains those with 1 ADL limitation who increased to 2 and those with 5 limitations who increased to 6, despite the fact that these are potentially 2 very different respondents in terms of outcomes. To deal with this limitation, we initially created a much larger number of disability groupings; however, we found that the cell sizes were too limited for many of the outcome measures to be of use. We were also limited in our ability to control for the existence of comorbid illnesses. In the past, the existence of comorbid illnesses has been shown to alter conclusions regarding disability disparities.²⁰ In the MCBS, comorbid conditions are measured at baseline and thus may have changed by the time an indicator was created. More important, the number of comorbidities did not reflect the severity of those conditions. Although we did attempt to model the impact of comorbid conditions as described in the methods section, we recognize that this remains a significant limitation of the MCBS.

Because this was an exploratory cohort study and not a randomized trial, we were comfortable using *P* less than .05 to judge the significance of our results. However, we recognize that we performed multiple comparisons. Were we to use an adjusted significance level of *P* less than .001, 2 of the 7 indicators (mammograms every year for breast cancer, blood testing for anemia) would no longer be significant.

CONCLUSIONS

Despite these limitations, our results describe one of the most complete pictures to date of the health care delivered to people with disabilities. We found that disability status has an impact on receipt of necessary care but that this relationship is more heterogeneous and complex than has been previously described.

Acknowledgments

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Fig 1. The percentage of patients who received “perfect” care by the number of indicators for which they were eligible. The cohort is displayed using a variety of patient categorizations, including (A) disability trajectory, (B) income, (C) age, and (D) race.

Table 1
Demographic Characteristics of All Subjects in the Sample by Disability Category

Characteristic	ADL Disability Classification				All Subjects
	No Disability	Decreasing Disability	Stable Disability	Increasing Disability	
Sample size, no. of subjects (% of the total)	17,452 (60.0)	3787 (13.0)	2736 (9.4)	5099 (17.6)	29,074
Mean age $\pm$ SD (y)	75.5 $\pm$ 6.4	78.8 $\pm$ 7.7	80.1 $\pm$ 8.1	80.0 $\pm$ 7.7	77.2 $\pm$ 7.3
Mean BMI $\pm$ SD (kg/m ²)	25.5 $\pm$ 4.1	26.6 $\pm$ 5.6	26.0 $\pm$ 6.0	26.0 $\pm$ 5.3	25.8 $\pm$ 4.8
BMI categoric (% underweight or overweight)	14.7	26.1	28.0	23.0	18.9
Sex (% male)	45.1	34.5	32.2	34.4	40.6
Live in nonmetropolitan area	27.6	29.8	28.9	28.5	28.2
Race (% nonwhite)	11.2	14.1	13.6	12.6	12.1
SES (% with income $\leq$ \$25,000)	64.9	78.5	81.4	78.8	70.6
Marital status (% married)	59.0	44.3	37.7	41.5	52.0
Education level (% with high school or more years)	66.0	51.9	51.2	52.2	60.4
Living situation (% living alone)	30.3	34.0	33.2	35.9	32.0
Health status (% reporting fair or poor health)	11.5	42.3	46.2	34.8	22.9
Smoking status (% smokes now)	11.5	11.0	11.0	10.6	11.2
Comorbidities (%)					
None	19.3	5.9	4.7	7.0	14.0
1-2	51.7	35.1	30.9	38.0	45.2
3-5	25.9	46.4	48.7	43.7	33.8
6	3.1	12.6	15.7	11.4	7.0

Abbreviations: BMI, body mass index; SD, standard deviation; SES, socioeconomic status.

Table 2
Percentage Patients Receiving Appropriate Care for Each Indicator and the Number of Patients Eligible

Quality Indicator	No Disability	Decreasing Disability	Stable Disability	Increasing Disability	Total
AMI					
1. Visit 4 weeks after discharge of patients hospitalized for AMI	75.4 (171)	63.6 (66)	71.9 (57)	64.4 (90)	70.3 (384)
2. Cholesterol test every 6mo for patients hospitalized for AMI and who have hypercholesterolemia	62.7 (59)	76.9 (26)	61.5 (13)	50.0 (28)	62.7 (126)
Anemia					
3. For patients with iron deficiency anemia: GI tract workup (no later than 3mo after first diagnosis)	13.7 (379)	22.1 (140)	15.5 (97)	16.0 (187)	15.9 (803)
4. Hematocrit/hemoglobin test 1–6mo after initial diagnosis of anemia	56.2 (991)	64.3 (336)	64.3 (252)	63.9 (450)	60.2 (2029)
Angina					
5. Visit 4wk after discharge for patients hospitalized for unstable angina	72.7 (238)	67.9 (84)	71.2 (66)	73.3 (105)	71.8 (493)
6. Visit every 6mo for patients with chronic stable angina	93.8 (1354)	93.5 (446)	95.3 (297)	94.5 (567)	94.1 (2664)
7. Follow-up visit or hospitalized 4wk after initial diagnosis of unstable angina	93.1 (204)	94.3 (53)	92.9 (42)	92.6 (68)	93.2 (367)
8. Lipid profile within 6mo from initial diagnosis of angina	38.6 (479)	40.6 (160)	35.1 (97)	37.3 (193)	38.3 (929)
Breast cancer					
9. For patients with breast cancer and eventual mastectomy, interval from biopsy to definitive therapy <3mo	63.0 (46)	76.9 (13)	66.7 (3)	70.6 (17)	67.1 (79)
10. At initial diagnosis of breast cancer, mammogram	70.0 (140)	64.0 (50)	66.7 (18)	61.7 (47)	67.1 (255)
11. At initial diagnosis of breast cancer, chest radiograph	62.9 (140)	61.7 (47)	55.0 (20)	60.4 (48)	61.6 (255)
12. Visit every year for breast cancer patients (mastectomy without chemotherapy)	100.0 (34)	100.0 (11)	100.0 (3)	92.9 (14)	98.4 (62)
13. Mammography every year for patients with history of breast cancer	75.5 (326)	68.0 (103)	58.3 (48)	54.2 (107)	68.8 (584)
CVA					
14. For patients hospitalized for carotid artery stroke, carotid imaging 2wk after initial diagnosis	67.3 (150)	71.1 (45)	74.2 (31)	73.4 (64)	70.0 (290)
15. For CVA patients with eventual CE, interval between carotid imaging and CE <2mo	87.7 (65)	100.0 (7)	78.6 (14)	93.8 (16)	88.2 (102)

Quality Indicator	No Disability	Decreasing Disability	Stable Disability	Increasing Disability	Total
16. Visit 4wk after discharge of patients hospitalized for CVA	64.8 (369)	62.2 (180)	62.0 (129)	59.5 (247)	62.5 (925)
TIA					
17. Visit 4wk after discharge of patients hospitalized for TIA	75.9 (174)	74.6 (63)	59.6 (47)	75.0 (96)	73.4 (380)
18. Visit every year for patients with diagnosis of TIA	97.8 (811)	98.0 (255)	97.4 (227)	97.8 (459)	97.8 (1752)
Cholelithiasis					
19. Cholecystectomy for patients with cholelithiasis and 1 or more of the following: cholecystitis, cholangitis, gallstone pancreatitis	94.0 (134)	89.2 (37)	91.7 (24)	87.9 (33)	92.1 (228)
COPD					
20. Visit every 6mo for patients with COPD	92.3 (2264)	91.5 (804)	93.6 (609)	92.5 (1141)	92.4 (4818)
CHF					
21. Chest radiograph 3mo after initial diagnosis of CHF	72.9 (988)	74.1 (459)	72.3 (394)	72.8 (624)	73.0 (2465)
22. Visit 4wk after discharge of patients hospitalized for CHF	72.0 (429)	69.5 (246)	64.0 (211)	69.3 (348)	69.4 (1234)
23. Visit every 6mo for patients with CHF	92.5 (1964)	92.3 (943)	92.2 (837)	93.1 (1416)	92.6 (5160)
Depression					
24. Visit 2wk after discharge of patients hospitalized for depression	47.2 (36)	75.0 (16)	26.7 (15)	48.6 (35)	49.0 (102)
Diabetes					
25. Glycosylated hemoglobin every 6mo for patients with diabetes	38.3 (2410)	34.4 (844)	30.4 (602)	32.2 (1003)	35.4 (4859)
26. Eye examination every year for patients with diabetes	48.0 (2341)	43.4 (804)	38.0 (555)	43.4 (944)	45.1 (4644)
27. Visit 4wk after discharge of patients hospitalized for diabetes	72.5 (153)	67.3 (104)	60.7 (61)	72.4 (123)	69.6 (441)
28. Visit every 6mo for patients with diabetes	96.5 (2642)	96.7 (941)	95.7 (669)	96.1 (1150)	96.3 (5402)
GI bleeding					
29. Visit 4wk after discharge of patients hospitalized for GI bleeding	71.8 (195)	69.6 (92)	71.9 (57)	74.8 (119)	72.1 (463)
30. Hematocrit 4wk after discharge of patients hospitalized for GI bleeding	44.7 (188)	46.0 (87)	42.1 (57)	42.6 (115)	44.1 (447)
31. Follow-up visit 4wk after initial diagnosis of GI bleeding	92.2 (450)	91.1 (146)	85.7 (91)	85.7 (161)	90.1 (848)
Hypertension					
32. Visit 4wk after discharge of patients from the	74.3 (35)	75.0 (12)	35.7 (14)	77.3 (22)	68.7 (83)

Quality Indicator	No Disability	Decreasing Disability	Stable Disability	Increasing Disability	Total
hospital with severe hypertension					
Avoidable outcomes					
33. Among patients with known angina, 3 ED visits for cardiovascular-related diagnoses in 1y	3.8 (1470)	8.9 (609)	10.2 (469)	10.6 (320)	6.7 (2868)
*34. Among patients with known COPD, subsequent admission for respiratory distress	83.1 (2309.8)	85.2 (844.1)	86.4 (634.0)	91.4 (1115.0)	85.8 (4902.9)
35. Nonelective admission for CHF	6.8 (17452)	14.6 (3787)	18.5 (2736)	16.7 (5099)	10.6 (29074)
*36. Among patients with known diabetes, admission for hyperosmolar or ketotic coma	0.1 (2854.3)	0.6 (1049.4)	0.5 (749.6)	0.7 (1220.7)	0.04 (5873.9)
37. Among patients with pneumonia, diagnosis of lung abscess or emphysema	3.1 (226)	0.0 (100)	2.5 (79)	0.8 (124)	1.9 (529)
Preventive care					
38. Visit every year	91.2 (12367)	92.6 (3167)	92.9 (2336)	93.8 (4269)	92.1 (23327)
39. Eye examination every 2y	86.9 (6813)	82.9 (1505)	76.8 (1014)	83.0 (1971)	84.8 (11303)
40. Mammography every 2y in women younger than 75y	87.4 (2137)	81.0 (316)	77.1 (166)	81.0 (331)	85.4 (2950)

NOTE. Values are percentage (n).

Abbreviations: CE, carotid endarterectomy; ED, emergency department.

* Entries for indicators 35 and 37 are rated per 100 person-years and number of person-years.

Table 3

Results of the Logistic Regressions

Quality Indicator	P Values for Each Explanatory Variable				
	ADL Disability Trajectory (ref: none)	Age	Sex (ref: female)	Income (ref: >\$25,000)	Race (ref: white)
AMI					
1. For patients with iron deficiency anemia; GI tract workup (no later than 3mo after first diagnosis)	.265	.150	.996	.034 1.7 (1.04–2.77)	.240
Anemia					
2. Hematocrit or hemoglobin test 1–6mo after initial diagnosis of anemia	.006 I: 1.36 (1.08–1.73) D: 1.42 (1.09–1.84) S: 1.43 (1.06–1.91)	.546	.385	.147	.492
Angina					
3. Visit 4wk after discharge for patients hospitalized for unstable angina	.808	.938	.114	.912	.049 .61 (.37–.997)
4. Visit every 6mo for patients with chronic stable angina	.637	.511	.869	.467	.023 .61 (.40–.93)
Breast cancer					
5. At initial diagnosis of breast cancer, mammogram	.988	.007 .94 (.91–.98)	NA	.164	.662
6. Mammography every year for patients with history of breast cancer	.020 I: .50 (0.31–0.81) D: .84 (0.51–1.38) S: .53 (0.28–1.01)	.000 .95 (.92–.98)	NA	.141	.083
CVA					
7. For CVA patients with eventual CE, interval between carotid imaging and CE <2mo	.825	.966	.028 .16 (.03–.83)	.417	.246
8. Visit 4wk after discharge of patients hospitalized for CVA	.721	.512	.260 .64 (.45–.93)	.161	.017
TIA					
9. Visit every year for patients with diagnosis of TIA	.966	.242	.004 .38 (.20–.74)	.339	.034 .35 (.13–.92)
COPD					
10. Visit every 6mo for patients with COPD	.544	.664	.145	.143	.038 .75 (.58–.99)

Quality Indicator	P Values for Each Explanatory Variable				
	ADL Disability Trajectory (ref: none)	Age	Sex (ref: female)	Income (ref: >\$25,000)	Race (ref: white)
CHF					
11. Visit 4wk after discharge of patients hospitalized for CHF	.257	.632	.094	.010 .65 (.46-.90)	.025 .68 (.49-.95)
12. Visit every 6mo for patients with CHF	.788	.625	.574	.003	.025 .72 (.54-.96)
Diabetes					
13. Glycosylated hemoglobin every 6mo for patients with diabetes	.137	.000 .97 (.96-.98)	.664	.041 .84 (.71-.99)	.000 .76 (.66-.88)
14. Eye examination every year for patients with diabetes	.000 I: .84 (.71-.98) D: .85 (.72-1.0) S: .67 (.55-.82)	.821	.000 .76 (.67-.86)	.018 .82 (.70-.97)	.000 .66 (.57-.76)
15. Visit every 6mo for patients with diabetes	.538	.004 1.03 (1.01-1.05)	.104	.077	.000 .44 (.29-.68)
GI bleeding					
16. Hematocrit 4wk after discharge of patients hospitalized for GI bleeding	.965	.882	.465	.028 .56 (.33-.94)	.648
Hypertension					
17. Visit 4wk after discharge of patients hospitalized with severe hypertension	.087	.570	.028 6.7 (1.2-36.7)	.073	.349
Avoidable outcomes					
18. Among patients with known angina, 3 ED visits for cardiovascular-related diagnoses in 1y	.000 I: 2.1 (1.4-3.0) D: 2.5 (1.7-3.7) S: 2.7 (1.8-4.1)	.061	.151	.033 1.51 (1.03-2.19)	.068
Preventive care					
19. Visit every year	.000 I: 1.4 (1.2-1.6) D: 1.2 (1.03-1.40) S: 1.21 (1.02-1.44)	.000 1.02 (1.01-1.02)	.000 .77 (.70-.85)	.009 .83 (.72-.95)	.000 .63 (.56-.71)
20. Eye examination every 2y	.000 I: .75 (.65-.87) D: .76 (.65-.89) S: .52 (.44-.61)	.002 1.01 (1.00-1.02)	.000 .70 (.63-.78)	.001 .77 (.66-.91)	.000 .42 (.37-.48)
21. Mammography every 2y in women younger than 75y	.004 I: .67 (.50-.92) D: .74 (.54-1.01) S: .58 (.39-.87)	.013 .95 (.19-.89)	NA	.011 .69 (.52-.92)	.000 .33 (.25-.44)

NOTE. Values are P , and when statistically significant, odds ratio and 95% confidence intervals in parentheses. Boldface denotes statistical significance at $P < .05$.

Abbreviations: D, decreasing; I, increasing; NA, not applicable; S, stable.