

SPECIAL ARTICLE

Relationship between Number of Medical Conditions and Quality of Care

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ABSTRACT

BACKGROUND

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There is emerging concern that the methods used to measure the quality of care unfairly penalize providers caring for patients with multiple chronic conditions. We therefore sought to study the relationship between the quality of care and the number of medical conditions a patient has.

METHODS

We assessed measurements of the quality of medical care received in three cohorts of community-dwelling adult patients in the Community Quality Index study, the Assessing Care of Vulnerable Elders study, and the Veterans Health Administration project (7680 patients in total). We analyzed the relationship between the quality of care that patients received, defined as the percentage of quality indicators satisfied among those for which patients were eligible, and the number of chronic medical conditions each patient had. We further explored the roles of characteristics of patients, use of health care (number of office visits and hospitalizations), and care provided by specialists as explanations for the observed relationship.

RESULTS

The quality of care increased as the number of medical conditions increased. Each additional condition was associated with an increase in the quality score of 2.2% (95% confidence interval [CI], 1.7 to 2.7) in the Community Quality Index cohort, of 1.7% (95% CI, 1.1 to 2.4) in the Assessing Care of Vulnerable Elders cohort, and of 1.7% (95% CI, 0.7 to 2.8) in the Veterans Health Administration cohort. The relationship between the quality of care and the number of conditions was little affected by adjustment for the difficulty of delivering the care recommended in a quality indicator and for the fact that, because of multiple conditions requiring the same care, a patient could be eligible to receive the same care process more than once. Adjustment for characteristics of patients, use of health care, and care provided by specialists diminished the relationship, but it remained positive.

CONCLUSIONS

The quality of care, measured according to whether patients were offered recommended services, increases as a patient's number of chronic conditions increases.

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EVIDENCE-BASED QUALITY INDICATORS, developed by a wide array of groups,¹⁻⁴ are increasingly being used to evaluate providers^{5,6} and to promote both transparency of care and competition based on quality.^{7,8} In pay-for-performance programs, reimbursement is linked to performance measured with the use of such quality metrics.⁹⁻¹¹

Quality indicators are typically developed for patients with one condition. Yet many patients have multiple conditions of varying severity. Sixty-five percent of Medicare beneficiaries have more than one condition, and almost 32% have four or more.^{11,12} Furthermore, physicians and systems provide care for patients with conditions that vary in complexity.

As interest in public reporting and pay-for-performance programs grows, many worry that providers who treat patients with more complex conditions will be unfairly penalized, with unintended consequences.¹³⁻¹⁵ Some prevailing concerns are that existing sets of performance measures do not adequately account for the number and severity of conditions^{16,17} or for the presence of specific conditions, such as major depression, that may affect the care of other conditions.^{18,19} Concerns about physicians having insufficient time to address the many needs of patients with multiple coexisting conditions have been bolstered by the results of simulation studies that show the mismatch between the time available to perform the vast number of recommended care processes and the time and personnel resources available to a typical primary care provider.^{20,21} Additional concerns are that the treatment of vulnerable subgroups such as homeless patients or patients with uncommon conditions, whose clinical needs and priorities may not be adequately represented in sets of performance measurements,^{22,23} will suffer if pay-for-performance programs create incentives that are misaligned with the needs of patients with complex conditions.

However, there is little empirical information about the influence of the number of chronic conditions on the quality of care. We therefore evaluated the variation in quality of care as the number of chronic conditions increases. We used clinically detailed data sets from three separate studies of various populations that measured disease-specific and aggregate quality of care for more than 7500 patients, 956 of whom had three or more chronic conditions.

METHODS

PATIENT POPULATIONS

We analyzed data for patients in the Community Quality Index (CQI) study,⁴ the Assessing Care of Vulnerable Elders (ACOVE) study,^{24,25} and the Veterans Health Administration (VHA) quality-of-care project.²⁶ A total of 6712 adults living in 12 metropolitan areas across the United States were enrolled in the CQI study between October 1998 and August 2000. They were asked to complete a telephone interview regarding their health care experiences in the 2 years before the interview and to provide written informed consent to obtain copies of their medical records from all providers. All patients provided such consent.

ACOVE recruited 372 vulnerable older patients, defined as community-dwelling persons aged 65 years or older who were at increased risk for death or functional decline, through two large managed-care organizations. Randomly selected patients were contacted by telephone between October 1999 and January 2000, and those who were determined to be at increased risk according to the Vulnerable Elders Survey-13 scale were included in that study.²⁷ All patients provided written informed consent.

The VHA project involved 596 male veterans, aged 35 years or older, who were receiving care at 26 clinical sites in 12 systems of two Veterans Integrated Service Networks. These veterans received care from a participating VHA facility at least once in each of the 2 years between October 1997 and September 1999. The institutional review boards of the VHA waived the requirement for written informed consent.

The study protocols of the three projects were approved by the RAND institutional review board. The VHA project was approved by the institutional review boards of individual VHA facilities.

MEASUREMENT OF THE QUALITY OF CARE

In all three projects, the quality of care was measured with the use of quality indicators related to care processes.^{4,24,26} Each quality indicator specified which patients were eligible and which care processes the eligible patients should receive. These quality indicators were developed on the basis of systematic reviews of the medical literature and formal judgments by an expert panel. The CQI study involved 439 quality indicators covering 30 clinical conditions and preventive

care.²⁸ The VHA project used the 348 quality indicators from the CQI study that were relevant to the care of male veterans, covering 26 clinical areas.²⁶ The 236 quality indicators in the ACOVE study specifically targeted vulnerable older patients, covering 22 medical and geriatric conditions and crosscutting clinical areas.²⁵ Examples of the quality indicators are presented in Table 1. Information on medical care provided to the study patients was derived from medical records and supplemented by interviews with patients in the CQI and ACOVE studies about selected quality indicators for which the patient was judged to provide information that was more reliable than the medical records. Medical records were abstracted by nurses with previous experience in medical-record abstraction who also underwent rigorous training. Abstraction of data used to determine the satisfaction of quality indicators was uniform, as indicated by kappa statistics of 0.80 or higher.

Quality-of-care scores were calculated at the patient level as the percentage of recommended care processes received. All analyses were conducted at the patient level. Patients were eligible for various quality indicators, depending on their conditions. For example, a patient who had three conditions — diabetes, heart failure, and hypertension — might have been eligible for six diabetes indicators, four heart-failure indicators, and five hypertension indicators. If four, two, and three indicators, respectively, were satisfied, the patient's average quality score would be 60%.

MEDICAL CONDITIONS

The primary predictor variable in this study was the total number of identified conditions affecting each patient. We selected chronic conditions that require continuous management, and we studied both common and unique sets of conditions. The conditions common to patients across the three studies were depression, diabetes mellitus, heart failure, stroke, hypertension, coronary artery disease, osteoarthritis, chronic obstructive pulmonary disease, and atrial fibrillation. Conditions unique to patients in the ACOVE study were dementia, pressure ulcer, osteoporosis, urinary incontinence, and renal insufficiency. Conditions unique to patients in the CQI and VHA projects were benign prostatic hypertrophy, dyspepsia, asthma, colorectal cancer, and prostate cancer. Breast cancer was present only in the CQI cohort.

STATISTICAL ANALYSIS

Main Analysis

We first plotted the relationship between the number of conditions a patient had and the overall quality of care the patient received. After confirming the linear trend, we ran linear regression models at the patient level, using quality of care as the outcome variable and the number of conditions as the primary predictor variable. The coefficient of the number of conditions was used to estimate the increase in the quality of care associated with the addition of a coexisting condition.

There were at least two types of potential artifacts in the main statistical analysis. The first arose from the fact that patients were eligible for various sets of quality indicators (according to their medical conditions) and that the difficulty of delivering the care recommended in an indicator could vary.²⁵ To adjust for this, we calculated an expected quality score, on the basis of population scores, for the quality indicators for which the patient was eligible.²⁹ We subtracted the expected score from the patient's actual score to calculate a quality score adjusted for difficulty. We then examined the relationship between the adjusted quality score and the number of conditions the patient had.

A second potential artifact was that the same care processes satisfy quality indicators that target different conditions. For example, daily antiplatelet therapy is recommended both for patients with diabetes and for patients with coronary heart disease. Therefore, patients with both conditions are eligible for aspirin therapy twice. To control for this artifact, we counted multiple eligibilities for the same indicator only once in the score calculation.

Exploratory Analysis of Mechanisms of the Quality–Care Relationship

To explore potential mechanisms of the observed relationship between the number of conditions and the quality score, we tested the effect of three potentially contributing factors: demographic characteristics of patients, use of health care, and care provided by specialists. After adjusting for demographic characteristics and use of health care in the model, we examined the change in the slope of the regression curve for the quality of care and number of conditions. Quality scores for the ACOVE and CQI data were adjusted for

Table 1. Examples of Quality Indicators Used in the Community Quality Index (CQI), the Veterans Health Administration (VHA), and the Assessing Care of Vulnerable Elders (ACOVE) Projects.

Target Condition	Quality Indicator
CQI and VHA Projects	
Asthma	At the time of an exacerbation, patients receiving theophylline should have the theophylline level measured.
Benign prostatic hypertrophy	Patients with a diagnosis of benign prostatic hypertrophy who report symptoms of moderate prostatism should have treatment options discussed or offered within 1 mo after the onset of symptoms.
Coronary artery disease	Patients presenting with acute myocardial infarction should receive at least 160 mg of aspirin within 2 hr after presentation or admission, unless they have contraindications to aspirin use.
Atrial fibrillation	Patients presenting with new-onset atrial fibrillation or atrial fibrillation of unknown duration should have thyroid function checked within 2 wk after presentation.
Diabetes mellitus	Patients with newly diagnosed diabetes should receive counseling about diet and exercise.
Depression	Patients hospitalized for depression should have a follow-up visit with a mental health specialist or their primary care doctor within 2 wk after discharge.
Hypertension	Patients with hypertension who have a consistent average systolic blood pressure >140 mm Hg or diastolic blood pressure >90 for 6 mo should receive one of the following two interventions, which should be recorded in the medical record: a change in dose or regimen of antihypertensive agents, or repeated education regarding lifestyle modification.
Osteoarthritis	Patients with a new diagnosis of osteoarthritis who wish to take medication for symptoms of the joints should be offered a trial of acetaminophen.
Stroke	Patients with newly diagnosed stroke without a known cardiac cause should receive antiplatelet therapy within 1 wk after diagnosis unless contraindications are documented.
Prostate cancer	Men with a new diagnosis of prostate cancer who have a prostate-specific antigen level >10 mg per milliliter should be offered a radionuclide bone scan within 1 mo after diagnosis or before initiation of any treatment, whichever comes first.
Colorectal cancer	All patients with positive screening-sigmoidoscopy tests should be offered diagnostic colonoscopy within 3 mo.
Breast cancer	Women with stage I or stage II breast cancer should be offered a choice of modified radical mastectomy or breast-conserving surgery, unless contraindications to breast-conserving surgery are present.
ACOVE Project	
Atrial fibrillation	If a vulnerable older patient is taking warfarin for atrial fibrillation, then the international normalized ratio should be checked within 4 days after the first dose and at least every 6 wk thereafter.
Coronary artery disease	If a vulnerable older patient with established coronary heart disease is a smoker, then the patient should be offered counseling for smoking cessation at least annually, and this counseling should be documented in the medical record.
Dementia	If a vulnerable older patient with dementia has a caregiver (and, if capable of doing so, the patient assents), then the physician should discuss with the patient and caregiver (or refer them for discussion) patient safety, educate them about how to deal with conflicts at home, and inform them about community resources for dementia.
Depression	If a vulnerable older patient receives a diagnosis of depression, then antidepressant treatment, psychotherapy, or electroconvulsive therapy should be offered within 2 wk after diagnosis unless there is documentation within that period that the patient has improved or unless the patient has substance abuse or dependence, in which case treatment may be held until 8 wk after the patient is in a drug- or alcohol-free state.
Diabetes mellitus	If a vulnerable older patient has an elevated glycosylated hemoglobin level, then the patient should be offered a therapeutic intervention aimed at improving glycemic control within 3 mo if the glycosylated hemoglobin level is 9.0 to 10.9% and within 1 mo if the level is 11% or greater.
Heart failure	If a vulnerable older patient has asymptomatic left ventricular dysfunction with a left ventricular ejection fraction of 40% or less, then the patient should be offered an angiotensin-converting-enzyme inhibitor.
Hypertension	If a vulnerable older patient has a new diagnosis of hypertension, then there should be documentation regarding the presence or absence of other cardiovascular risk factors.
Osteoarthritis	If an ambulatory vulnerable older patient receives a new diagnosis of symptomatic osteoarthritis of the knee, has no contraindication to exercise, and is physically and mentally able to exercise, then a directed or supervised strengthening or aerobic exercise program should be prescribed within 3 mo after diagnosis.
Osteoporosis	If a female vulnerable older patient has a new diagnosis of osteoporosis, then the patient should be offered treatment with hormone-replacement therapy, bisphosphonates, a selective estrogen-receptor modulator, or calcitonin within 3 mo after diagnosis.
Pressure ulcer	If a vulnerable older patient presents with a pressure ulcer, then the pressure ulcer should be assessed for location, depth and stage, size, and presence of necrotic tissue.
Stroke	If a vulnerable older patient is admitted to the hospital with a diagnosis of acute ischemic or hemorrhagic stroke, then the patient should be admitted to a specialized or combined acute, rehabilitative stroke unit or transferred to a specialized stroke unit, if there is such a unit in the hospital.
Urinary incontinence	All vulnerable older patients should have documentation of the presence or absence of urinary incontinence during the initial evaluation.

age, sex, education level, annual income, self-reported health, and geographic characteristics (i.e., the two managed-care organizations in the ACOVE study and the 12 metropolitan areas in the CQI study). The CQI data were further adjusted for race and ethnic group and for type of health insurance. We did not adjust the ACOVE data for these variables, because the patients were predominantly white, and all were enrolled in a managed-care plan for seniors. All patients from the VHA project were male, and their other demographic data were limited; therefore, we adjusted only for age and geographic region (i.e., Veterans Integrated Service Network). The adjustment for the use of health care addressed the number of office visits in each of the three data sets and the number of hospitalizations in the CQI and ACOVE data sets.

Using the ACOVE data, we examined the effect of the involvement of specialists and the number of providers. Data on the specialty of providers were not collected in the CQI and VHA projects. We performed the first analysis by consecutively adding two variables to the linear-regression model of quality score and number of conditions: first, a binary variable indicating whether or not the patient received any specialist care, and second, the interaction term for the binary variable and the number of conditions. The interaction term was used to examine the difference in the relationship of quality score to the number of conditions between patients who were treated only by generalists and patients who received any care from specialists. We conducted the second analysis by adding data on the number of providers to the linear regression model adjusted for demographic characteristics.

All analyses were conducted with the use of Stata software, version 9.2. P values less than 0.05 were considered to indicate statistical significance.

RESULTS

PATIENT POPULATIONS

Table 2 describes the characteristics of the three populations of patients. The numbers of conditions ranged from zero to eight among patients in the ACOVE study and from zero to seven among patients in the CQI and VHA projects. Patients were eligible for a mean of 20, 16, and 19 quality indicators in the ACOVE, CQI, and VHA data sets,

respectively. The mean quality scores were 55% in both the ACOVE and CQI cohorts and 67% in the VHA cohort.

RELATIONSHIPS BETWEEN QUALITY SCORE AND NUMBER OF CONDITIONS

Figure 1 shows the relationship between the number of conditions and the quality of care received in each of the three cohorts. In general, as the number of conditions increased from zero to five, the quality-of-care scores also increased; small numbers of patients with six or seven conditions resulted in imprecision of those point estimates. The unadjusted linear regression analysis showed that each additional condition was associated with a 2.2% increase in the quality score (95% confidence interval [CI], 1.7 to 2.7) for the CQI cohort, 1.7% (95% CI, 1.1 to 2.4) for the ACOVE cohort, and 1.7% (95% CI, 0.7 to 2.8) for the VHA cohort. Figure 2 shows the effect of adjustment for two potential artifacts of measurement on the slope of the relationship between the quality of care and number of conditions. Since the effect was minimal, later analyses did not involve such adjustment.

POTENTIAL MECHANISMS OF THE QUALITY-CONDITION RELATIONSHIP

Figure 3 presents the effect of adjustment for characteristics of patients and use of health care. For the ACOVE and CQI cohorts, the relationship between the quality score and the number of conditions remained moderately positive after adjustment; in the VHA cohort, the adjusted slope was positive but not significantly different from a slope of zero ($P=0.17$). The adjustment for care provided by specialists and number of providers was possible only in the ACOVE data set. Among the 372 ACOVE patients who were eligible for 10,711 care processes, 233 saw at least one specialist for a condition for which there was a quality indicator. Addition of the binary variable indicating whether or not the patient received any care from a specialist did not change the relationship between the number of conditions and the quality score. The analysis including the interaction term between receipt of care from a specialist and number of conditions showed that the relationship between the number of conditions and the quality score was significantly smaller (but still positive) among patients who did not receive care from specialists than among those

Table 2. Patient Characteristics, According to Cohort.*

Characteristic	CQI (N=6712)	ACOVE† (N=372)	VHA (N=596)	Characteristic	CQI (N=6712)	ACOVE† (N=372)	VHA (N=596)
Male sex (%)	40	36	100	Mean no. of conditions	1.2	2.5	2.2
Age (%)‡				Type of conditions (%)			
18–30 yr	19	0		Depression	5	17	7
31–40 yr	24	0		Diabetes	7	24	39
41–50 yr	22	0		Heart failure	2	15	12
51–64 yr	20	0		Stroke	2	1	6
≥65 yr	15	100		Hypertension	29	63	69
Mean quality score (%)§	55	55	67	Coronary artery disease	6	31	26
Mean no. of annual outpatient visits	3.8	8.1	9.4	Osteoarthritis	9	48	29
Mean no. of annual hospitalizations	0.1	0.3	—	COPD or asthma	6	25	20
Race (%)¶				Atrial fibrillation	1	13	5
White	81	97	—	Dementia	—	8	—
Other	19	3	—	Pressure ulcer	—	2	—
Highest education level attained (%)				Osteoporosis	—	21	—
Some high school	9	41	—	Urinary incontinence	—	9	—
High-school graduation or higher	91	59	—	Renal insufficiency	—	6	—
Annual income (%)				Benign prostatic hypertrophy	2	—	5
<\$15,000	18	57	—	Dyspepsia	4	—	4
≥\$15,000	82	43	—	Colorectal cancer	<1	—	<1
Self-reported health (%)				Prostate cancer	<1	—	<1
Good, very good, or excellent	86	81	—	Breast cancer	2	—	0
Fair or poor	14	19	—				
Insurance provider (%)							
Medicaid	4	0	NA				
Medicare	17	0	NA				
Health maintenance organization	38	100	NA				
Private	32	0	NA				
None	8	0	NA				

* Dashes denote that data were not available. NA denotes not applicable, and COPD chronic obstructive pulmonary disease.

† In the ACOVE cohort, data on race and education level were available for 245 patients, and data for annual income were available for 337 patients.

‡ The mean age of patients in the VHA cohort was 63 years.

§ Quality score was defined as the mean percentage of quality indicators satisfied for all patients.

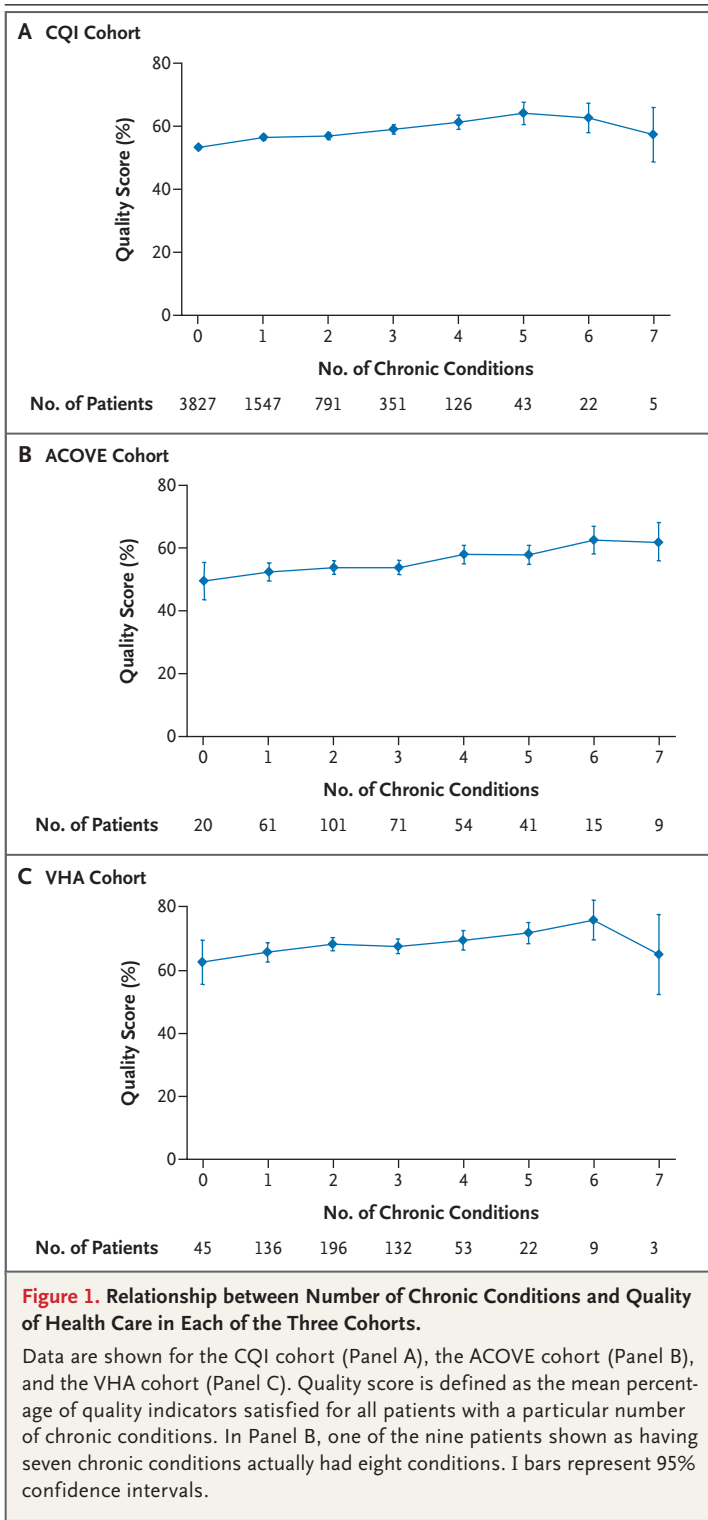
¶ Race was self-reported.

who did, although this difference was significant only in the unadjusted analysis (the change in the slope of the regression curve, 0.6 vs. 2.2 percentage points for the unadjusted analysis, $P=0.02$; 0.73 vs. 2.0 percentage points for the analysis adjusted for demographic characteristics, $P=0.07$; and 0.49 vs. 1.8 percentage points for the analysis adjusted for demographic characteristics and use of health care, $P=0.08$). The addition of the number of providers to the model adjusted for demographic characteristics minimally reduced

the magnitude of the increase in the slope of the quality–condition curve (from 1.60 percentage points for each additional condition to 1.54 percentage points). Each additional provider involved was associated with an increase of 0.3 percentage point ($P=0.39$).

DISCUSSION

Contrary to our expectations, we found that the percentage of care recommended in quality indi-



cators that was delivered to each patient increased, rather than decreased, as a patient's number of chronic conditions increased. The fact that we found essentially the same relationship in three different data sets, using two different sets of quality indicators, increases the likelihood that this effect is real, rather than an artifact of any one particular study. This finding does not provide support for the argument that incentive programs based on quality indicators of care processes will necessarily penalize providers who provide care to patients with multiple conditions.

Unlike our study, previous studies that have examined the effect of coexisting conditions on the provision of necessary care processes have generally focused on single areas of care, such as preventive care, with mixed results. Redelmeier and colleagues³⁰ reported finding a negative effect of the presence of diabetes on receipt of estrogen-replacement therapy, of pulmonary emphysema on the necessary use of lipid-lowering medications, and of psychotic syndromes (as identified by the use of haloperidol) on treatment for arthritis. Desai and colleagues³¹ found little difference in the care received for diabetes among veterans with mental disorders and those without. Heflin and colleagues³² found an increased likelihood of undergoing a clinical breast examination, Papanicolaou smears, and fecal occult-blood testing among older patients with hypertension, whereas the likelihood of mammography was reduced among patients with hip fracture. They found no evidence that patients with other conditions, such as stroke and diabetes, had a reduced likelihood of undergoing four cancer-screening processes.

Although we had limited data on the mechanisms underlying the positive relationship between the quality score and the number of conditions, several of our analyses were informative. First, the increased use of health care by patients with more conditions explained some of the positive quality-condition relationship. In all three data sets, the slope of the curve was less after we adjusted for the use of health care than before adjustment. This effect was particularly prominent in the VHA data set, for which the slope was essentially flat after adjustment. This finding does provide support for the hypothesis that patients with more conditions receive higher-quality care than patients with fewer conditions, because they have more opportunities to receive

care. Second, the data from the ACOVE study suggest that the involvement of specialists plays a modest role in the positive relationship between the number of conditions and the quality of care. The quality score for each additional condition increased more for patients who had seen a relevant specialist than for those who had not. This result is consistent with reports in the literature that specialists provide higher-quality care in their areas of specialty than do generalists.³³⁻³⁵ However, for patients who received only generalist care, the relationship between the quality score and the number of conditions remained positive. These data suggest that generalists can provide equivalent care to patients with complex conditions and to those with less complex conditions. A potential mechanism that we could not assess in our study, however, is the possibility that seeing a specialist is a marker for patients who advocate more effectively for the care they need.

Our study had several limitations. First, we used a simple count of conditions as the primary predictor variable. This variable is a crude measure of complexity, since clinicians do not view all coexisting conditions as equivalent. For example, they view depression as a more challenging coexisting condition than hypertension or osteoarthritis. Furthermore, our data do not take into account the severity of illness for any particular condition, such as severe diabetes as compared with mild diabetes. The data sets were, in general, too small to permit the examination of specific positive and negative effects on the quality of care processes for various combinations of conditions. Because we considered only conditions that had corresponding quality indicators, we underestimated the total disease burden. Our sets of quality indicators did not assess psychosocial issues, which may be an additional contributor to the difficulty in providing quality care. However, the sets were extensive, covering the most prevalent conditions.

Second, the quality score appeared to decrease for patients in the CQI and VHA cohorts who had seven conditions (five patients [$<0.1\%$] and three patients [0.5%], respectively), although the small samples prevent us from making any conclusions for these patients. Future studies should focus on the quality of care provided to patients with a highly complex disease burden, although such patients are likely to account for a very small fraction of any provider's patients. Third, since

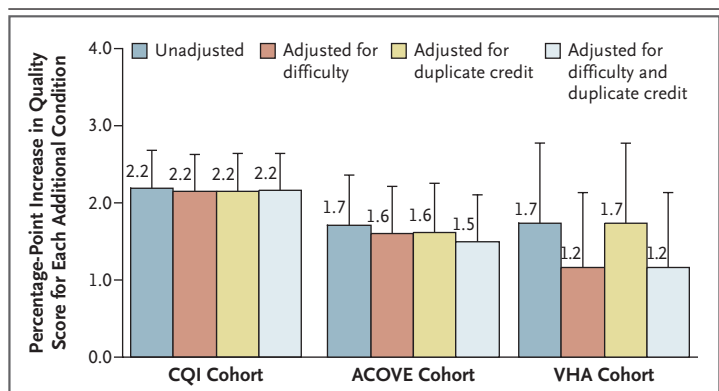


Figure 2. Effect of Adjustment for Measurement Artifacts on the Relationship between Number of Chronic Conditions and Quality Score.

Quality score was defined as the mean percentage of quality indicators satisfied by patients with a particular number of chronic conditions. Difficulty was defined as the difficulty of delivering the care recommended in a quality indicator. Duplicate credit was defined as multiple conditions rendering a patient eligible for the same care process more than once. All percentage-point increases in the quality score are significantly different from zero. T bars indicate the upper limit of the 95% CI.

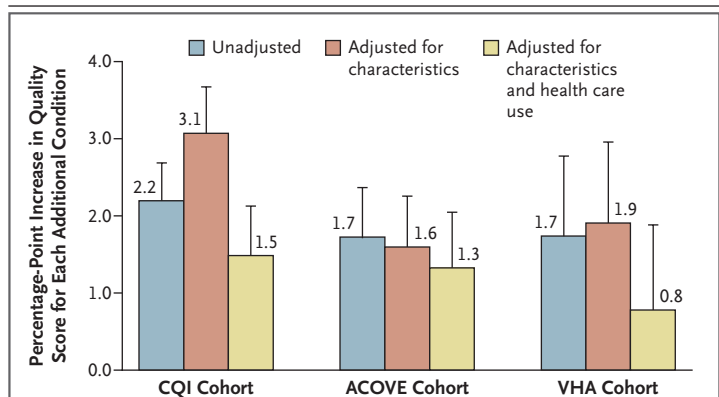


Figure 3. Effect of Adjustment for Characteristics of Patients and Use of Health Care on the Relationship between Number of Conditions and Quality Score.

Quality score was defined as the mean percentage of quality indicators satisfied by patients with a particular number of chronic conditions. The increase of 0.8 percentage point for the VHA cohort after adjustment for characteristics and use of health care was not significantly different from zero; all other percentage-point increases were significantly different from zero. T bars indicate the upper limit of the 95% CI.

our performance measures focused on technical quality of care (whether or not patients were offered recommended services), we cannot draw conclusions about the relationship between the number of conditions and the experience of the patient, the quality of communication between the patient and physician, or the outcomes of care. Finally, the CQI, ACOVE, and VHA projects mea-

sured quality with the use of a comprehensive set of care processes that were carefully constructed to account for a patient's detailed clinical status. Our results may not be generalizable to quality indicators based on outcomes or quality indicators that are less clinically detailed or that assess a smaller percentage of the care received.

In summary, contrary to expectations, we found that patients with more conditions that have corresponding quality indicators consistently received

better technical quality of care for these conditions than did patients with fewer conditions. This finding suggests that comprehensive, clinically detailed sets of care processes received can be used to assess the quality of care without creating a disincentive for providers to avoid patients with the most prevalent chronic conditions.

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REFERENCES

- Schuster MA, McGlynn EA, Brook RH. How good is the quality of health care in the United States? *Milbank Q* 1998;76:517-63.
- Jencks SF, Cuerdon T, Burwen DR, et al. Quality of medical care delivered to Medicare beneficiaries: a profile at state and national levels. *JAMA* 2000;284:1670-6.
- Shekelle PG, MacLean CH, Morton SC, Wenger NS. Assessing care of vulnerable elders: methods for developing quality indicators. *Ann Intern Med* 2001;135:647-52.
- McGlynn EA, Asch SM, Adams J, et al. The quality of health care delivered to adults in the United States. *N Engl J Med* 2003;348:2635-45.
- Health Plan Employer Data and Information Set (HEDIS). Washington, DC: National Committee for Quality Assurance. (Accessed May 18, 2007, at <http://www.ncqa.org/programs/hedis/>)
- Kizer KW, Demakis JG, Feussner JR. Reinventing VA health care: systematizing quality improvement and quality innovation. *Med Care* 2000;38:Suppl 1:I7-I16.
- Davies HT, Marshall MN. Public disclosure of performance data: does the public get what the public wants? *Lancet* 1999;353:1639-40.
- Marshall MN, Shekelle PG, Leatherman S, Brook RH. The public release of performance data: what do we expect to gain? A review of the evidence. *JAMA* 2000;283:1866-74.
- Epstein AM. Paying for performance in the United States and abroad. *N Engl J Med* 2006;355:406-8.
- Christianson JB, Knutson DJ, Mazze RS. Physician pay-for-performance: implementation and research issues. *J Gen Intern Med* 2006;21:Suppl 2:S9-S13.
- Berenson RA, Horvath J. Confronting the barriers to chronic care management in Medicare. *Health Aff (Millwood)* 2003; Suppl Web Exclusives:W3-37-53.
- Wolff JL, Starfield B, Anderson G. Prevalence, expenditures, and complications of multiple chronic conditions in the elderly. *Arch Intern Med* 2002;162:2269-76.
- Forrest CB, Villagra VV, Pope JE. Managing the metric vs managing the patient: the physician's view of pay for performance. *Am J Manag Care* 2006;12:83-5.
- Mannion R, Davies H, Marshall M. Impact of star performance ratings in English acute hospital trusts. *J Health Serv Res Policy* 2005;10:18-24.
- Werner RM, Asch DA. The unintended consequences of publicly reporting quality information. *JAMA* 2005;293:1239-44.
- Walter LC, Davidowitz NP, Heineken PA, Covinsky KE. Pitfalls of converting practice guidelines into quality measures: lessons learned from a VA performance measure. *JAMA* 2004;291:2466-70.
- Shen Y. Selection incentives in a performance-based contracting system. *Health Serv Res* 2003;38:535-52.
- Ciechanowski PS, Katon WJ, Russo JE. Depression and diabetes: impact of depressive symptoms on adherence, function, and costs. *Arch Intern Med* 2000;160:3278-85.
- Piette JD, Kerr EA. The impact of comorbid chronic conditions on diabetes care. *Diabetes Care* 2006;29:725-31.
- Yarnall KS, Pollak KI, Ostbye T, Krause KM, Michener JL. Primary care: is there enough time for prevention? *Am J Public Health* 2003;93:635-41.
- Ostbye T, Yarnall KS, Krause KM, Pollak KI, Gradison M, Michener JL. Is there time for management of patients with chronic diseases in primary care? *Ann Fam Med* 2005;3:209-14.
- Davies HT, Washington AE, Bindman AB. Health care report cards: implications for vulnerable patient groups and the organizations providing them care. *J Health Polit Policy Law* 2002;27:379-99.
- Boyd CM, Darer J, Boulton C, Fried LP, Boulton L, Wu AW. Clinical practice guidelines and quality of care for older patients with multiple comorbid diseases: implications for pay for performance. *JAMA* 2005;294:716-24.
- Wenger NS, Shekelle PG. Assessing care of vulnerable elders: ACOVE project overview. *Ann Intern Med* 2001;135:642-6.
- Wenger NS, Solomon DH, Roth CP, et al. The quality of medical care provided to vulnerable community-dwelling older patients. *Ann Intern Med* 2003;139:740-7.
- Asch SM, McGlynn EA, Hogan MM, et al. Comparison of quality of care for patients in the Veterans Health Administration and patients in a national sample. *Ann Intern Med* 2004;141:938-45.
- Saliba D, Elliott M, Rubenstein LZ, et al. The Vulnerable Elders Survey: a tool for identifying vulnerable older people in the community. *J Am Geriatr Soc* 2001;49:1691-9.
- The quality of health care delivered to adults in the United States: Appendix. Santa Monica, CA: RAND, 2006. (Accessed May 18, 2007, at http://www.rand.org/pubs/working_papers/WR174-1/)
- Min LC, Reuben DB, MacLean CH, et al. Predictors of overall quality of care provided to vulnerable older people. *J Am Geriatr Soc* 2005;53:1705-11.
- Redelmeier DA, Tan SH, Booth GL. The treatment of unrelated disorders in patients with chronic medical diseases. *N Engl J Med* 1998;338:1516-20.
- Desai MM, Rosenheck RA, Druss BG, Perlin JB. Mental disorders and quality of diabetes care in the Veterans Health Administration. *Am J Psychiatry* 2002;159:1584-90.
- Heflin MT, Oddone EZ, Pieper CF, Burchett BM, Cohen HJ. The effect of comorbid illness on receipt of cancer screening by older people. *J Am Geriatr Soc* 2002;50:1651-8.
- Diette GB, Skinner EA, Nguyen TT, Markson L, Clark BD, Wu AW. Comparison of quality of care by specialist and generalist physicians as usual source of asthma care for children. *Pediatrics* 2001;108:432-7.
- Donohoe MT. Comparing generalist and specialty care: discrepancies, deficiencies, and excesses. *Arch Intern Med* 1998;158:1596-608.
- Harrold LR, Field TS, Gurwitz JH. Knowledge, patterns of care, and outcomes of care for generalists and specialists. *J Gen Intern Med* 1999;14:499-511.

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