Variations among Hospitals in the Quality of Care for Heart Failure

CONTEXT. Determining variations in quality of care among hospitals can help direct attention to poorly performing institutions.

PRACTICE PATTERN EXAMINED. The proportion of patients with congestive heart failure meeting various quality criteria in 69 hospitals.

HOSPITAL SELECTION. The hospitals were voluntary participants in a quality improvement program in five states (Colorado, Connecticut, Georgia, Oklahoma, and Virginia).

PATIENT SELECTION. All patients with congestive heart failure discharged from the participating hospitals during a 15-month period in 1995 to 1996 (or, for hospitals with more than 50 eligible patients, a random sample of 50 patients). The total sample consisted of 2077 patients.

DATA SOURCE. Documentation in the hospital medical record of left ventricular function, discharge medications, and discharge instructions.

RESULTS. Left ventricular function was determined in 72% of patients (range across hospitals, 18% to 97%). Among patients with left ventricular systolic dysfunction, 79% were prescribed an angiotensin-converting enzyme inhibitor (range, 54% to 94%). Only 23% of the patients prescribed angiotensin-converting enzyme inhibitors received the target dose (range, 0% to 60%). Sixty-four percent of patients were counseled about the importance of a low-sodium diet at discharge (range, 25% to 97%), but only 8% were counseled about daily weight monitoring (range, 0% to 30%).

CONCLUSION. Our results show substantial hospital-to-hospital variation in the quality of care for patients with heart failure.

Congestive heart failure is a common reason for hospital admission. Treatment with angiotensin-converting enzyme (ACE) inhibitors has been shown to reduce both morbidity and mortality in patients with heart failure caused by systolic dysfunction of the left ventricle.[1–4] Consequently, clinical practice guidelines include recommendations that ACE inhibitors be used in the management of systolic dysfunction.[5, 6] Despite these guidelines, however, there is considerable evidence that diagnosis of systolic dysfunction is often not pursued and that ACE inhibitors are underused.[7–10] A recent review of Medicare beneficiaries hospitalized with congestive heart failure found that left ventricular function was documented in the hospital records for 59% of patients. Of the patients who had documented systolic dysfunction and no contraindications, only 73% were prescribed ACE inhibitors at discharge.[11]

However, there is reason to believe that not all care for congestive heart failure in hospitals is suboptimal. For example, a recent study found that prescription of ACE inhibitors at discharge for patients with documented systolic dysfunction ranged from 77% to 95% across nine hospitals in Connecticut.[12] Hospital-to-hospital

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variations in congestive heart failure management would be consistent with previously described differences in management of cardiovascular disease.[13–20] If significant variations among hospitals exist, efforts to improve practice might be most appropriately directed to poorly performing institutions. This paper examines the hospital-to-hospital variation in the quality of care for patients with heart failure in 69 hospitals participating in a five-state quality improvement program.

Methods

Setting and Patients

We conducted a cross-sectional study of Medicare beneficiaries discharged after hospitalization for congestive heart failure. The patients were admitted to one of 69 hospitals in five states (Colorado, Connecticut, Georgia, Oklahoma, and Virginia). The hospitals were voluntary participants in a multistate health care quality improvement program project.[21]

The patients were Medicare beneficiaries aged 65 years and older with the principal diagnosis of congestive heart failure (*International Classification of Diseases, 9th revision, Clinical Modification* [ICD-9-CM] codes 428.0 through 428.9) identified from the Health Care Financing Administration's MEDPRO file for each state. We excluded patients from the study if chart review revealed that they had left the hospital against medical advice; were transferred to another acute care facility; or had a diagnosis of valvular heart disease, acute myocardial infarction, cor pulmonale, or chronic obstructive pulmonary disease requiring home oxygen; had chronic renal failure; or had heart failure attributed to thiamine deficiency, amyloidosis, or thyrotoxicosis. Patients were eligible for the study if they had been hospitalized between June 30, 1995, and September 30, 1996, and were discharged from the hospital. We randomly selected 50 patients from each participating hospital; if fewer than 50 eligible patients had been discharged during the enrollment period, we evaluated all admissions for congestive heart failure.

There were 2943 patients with a principal diagnosis of heart failure admitted to the participating hospitals between June 30, 1995, and September 30, 1996. We excluded 136 patients with incomplete charts, 7 patients who were transferred to another acute care facility, 2 patients who died during the hospitalization (despite our inclusion criteria), 121 patients younger than 65 years, and 1 patient for whom information about age could not be obtained. We also excluded 599 patients for one or more of the following medical conditions: cor pulmonale or chronic obstructive pulmonary disease requiring home oxygen (n = 283), aortic stenosis (n = 202), mitral valve stenosis (n = 49), chronic renal failure necessitating dialysis (n = 38), acute myocardial infarction (n = 41), and heart failure attributed to thyrotoxicosis (n = 3). The final sample was 2077 patients.

Data Abstraction

Medical record personnel at each hospital sent copies of the medical records of the eligible patients to the peer-review organization in each state for data abstraction. Data were abstracted by trained nurses and medical record specialists at each organization. Interrater reliability was assessed by a random replicate sample of 35 charts, which were reabstracted.[22] In the estimation of interrater reliability for the quality-of-care measures, the κ value ranged from 0.81 for the treatment with an ACE inhibitor for patients with systolic dysfunction to 0.92 for daily weight counseling.

Data abstracted from each chart included age; race; sex; smoking status; and a recorded history of myocardial infarction, chronic obstructive pulmonary disease, bronchitis, emphysema, hypertension, or diabetes. Clinical information abstracted included a history of paroxysmal nocturnal dyspnea, dyspnea on exertion, or orthopnea. Physical findings abstracted included pedal edema, pulmonary rales, S_3 gallop, and evidence of elevated jugular vein pressure. The highest serum creatinine and potassium values during the hospitalization were recorded, as were the results of the admission chest x-ray and electrocardiogram.

Specific Quality Indicators

We measured three quality indicators relating to evaluation and management of systolic dysfunction and two indicators relating to discharge counseling. The level of evidence for each is shown in **Table 1**. **Figure 1** details how the numerators and denominators were determined for the three evaluation and management indicators.

Assessment of Left Ventricular Function

We identified patients with left ventricular systolic dysfunction by first searching the chart for a value for any current or previously performed objective test of ventricular function (e.g., echocardiography, radionuclide ventriculography, or cardiac catheterization). The quality indicator was the proportion of patients with congestive heart failure who had had a measurement of left ventricular function.

Use of ACE Inhibitors for Systolic Dysfunction

To calculate the denominator for this indicator, we first had to determine which patients had documented systolic dysfunction and then had to exclude patients with a recorded contraindication to ACE inhibitors. We classified patients as having systolic dysfunction if we found a

TABLE 1
Guidelines for Congestive Heart Failure*

QUALITY INDICATOR	GUIDELINE	LEVEL OF EVIDENCE	
		AHRQ†	ACC‡
Evaluation and management			
Assessment of left ventricular function	Patients with suspected heart failure should undergo echocardiography or radionuclide ventriculography to measure ejection fraction.	B	Class I
Use of ACE inhibitors for systolic dysfunction	Patients found to have systolic dysfunction should be given a trial of ACE inhibitors unless contraindicated.	A	Class I
Prescription of target dose	Doses of ACE inhibitors should be titrated upward to the doses shown to decrease mortality in a randomized trial.	A	Class I
Discharge counseling			
Low-sodium diet	Dietary sodium should be restricted to as close to 2 g/d as possible. In no case should sodium intake exceed 3 g/d.	C	Not graded
Daily weight monitoring	All patients should also be told to obtain a bathroom scale and to weigh themselves each morning (after urinating and before eating). Patients should be instructed to notify their physicians if they experience an unexplained weight gain greater than 3 to 5 pounds since their last clinical evaluation.	C	Not graded

**ACE = angiotensin-converting enzyme.*
†*AHRQ = Agency for Health Care Research and Quality[6] rating system. A = good evidence: evidence from well-conducted, randomized, controlled trials or cohort studies; B = fair evidence: evidence from other types of studies; C = expert opinion.*
‡*ACC = American College of Cardiology[5] rating system. Class I = usually indicated; always acceptable; Class II = acceptable, but of uncertain efficacy and may be controversial; Class III = generally not indicated.*

narrative description of left ventricular function that included any of the following phrases: *systolic dysfunction, dilated cardiomyopathy, congestive cardiomyopathy,* and *diffuse* or *global hypokinesis*. We examined the admission history, nursing assessment, admission notes, progress notes, and discharge summary. We also recorded narrative description of the ejection fraction by using the terms *normal*; *increased*; or *mildly*, *moderately*, or *severely reduced*. We characterized patients as having left ventricular systolic dysfunction (i.e., systolic dysfunction) if any reported measure of left ventricular ejection fraction was equal to or less than 40%, or in the absence of an objective measure, if the ejection fraction was described as *reduced* in the narrative. We then excluded patients with any recorded contraindication to ACE inhibitors: cough, renal insufficiency, skin rash, hyperkalemia, angioedema, neutropenia, and hypotension related to ACE inhibitor use.

The numerator for the indicator included those patients discharged on ACE inhibitors. Discharge medications were sought in the physician's discharge summary, nurse's discharge summary, and last progress note. We identified the following ACE inhibitors by both generic and trade name: benazepril, captopril, enalapril, fosinopril, lisinopril, quinapril, and ramipril.

Prescription of Target Dose

We also measured the proportion of patients discharged on ACE inhibitors who received the target dose. We defined the target dose as the dose tested in a randomized trial that demonstrated a reduced risk for death in patients with systolic dysfunction. Target doses were as follows: captopril, 50 mg three times daily; enalapril, 10 mg twice daily; lisinopril, 20 mg once daily; ramipril, 5 mg twice daily.[23] For patients treated with an ACE inhibitor without clinical trial evidence to guide dose selection, we used the following targets based on the manufacturer's stated average doses: benazepril, 20 mg once daily; fosinopril, 40 mg once daily; and quinapril, 10 mg twice daily.[24]

Discharge Counseling

Finally, we abstracted the discharge instructions to determine counseling for daily weight monitoring and consumption of a low-salt diet. We also determined

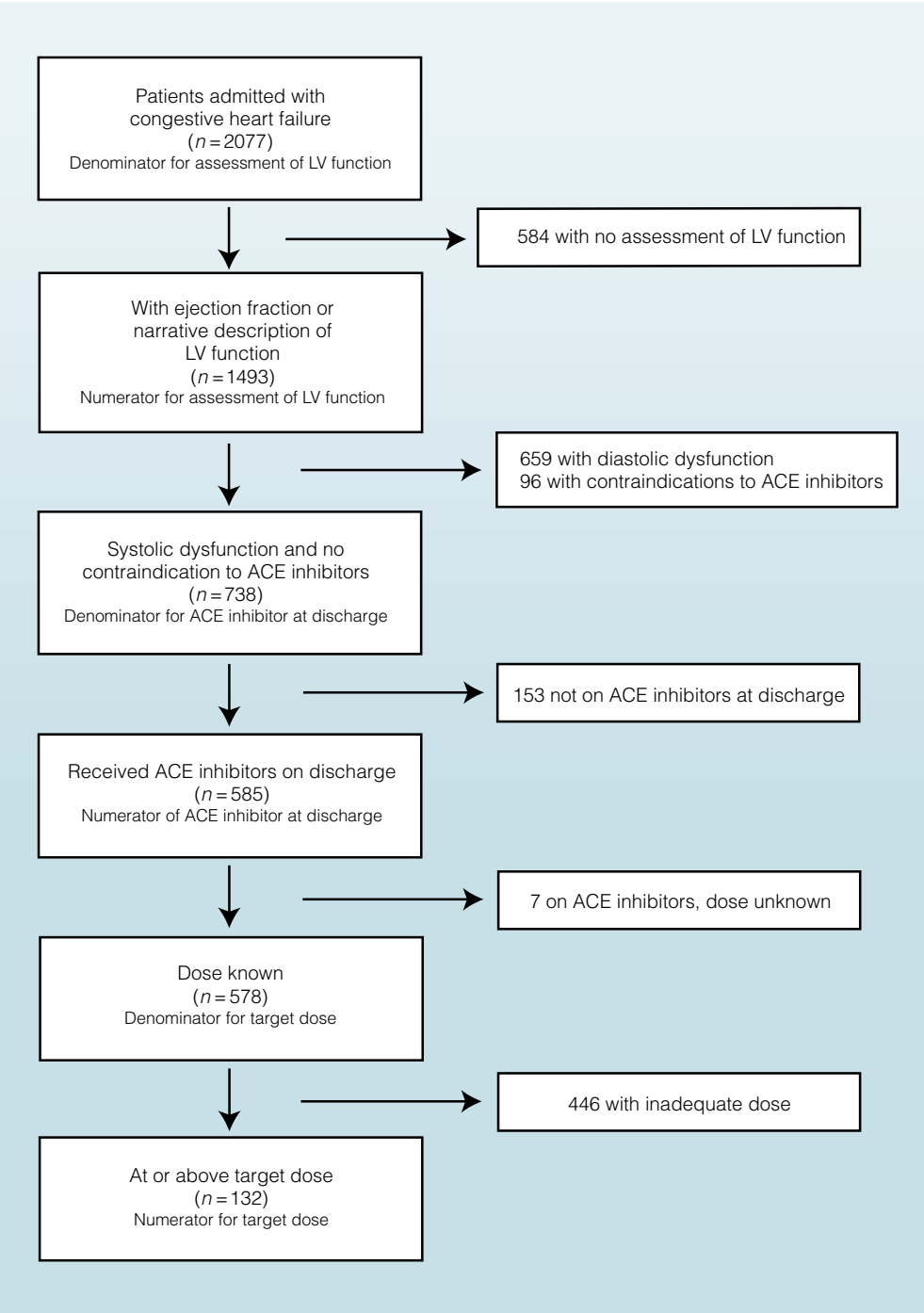

FIGURE 1. Flow chart illustrating the determination of three evaluation and management indicators. ACE = angiotensin-converting enzyme; LV= left ventricular.

whether patients who currently smoked were counseled about smoking cessation.

Analysis

First, a descriptive analysis of patient characteristics of the study cohort was done. Then, we described hospital-to-hospital variations in the management of congestive heart failure. For these hospital-specific analyses, we report only on hospitals with 10 or more patients who were eligible for the specific quality indicator.

We examined the hospital-to-hospital variation in hospital-specific care in several ways. First, we described the degree of variability that occurred using the interquartile (25th to 75th percentile) range, the overall range, and the extremal quotient (i.e., the highest value to the lowest value in a distribution.[25, 26]) We also used chi-square and Fisher exact tests to test the hypothesis

that the observed hospital-to-hospital variations in care had occurred by chance alone.

All analyses were implemented with SAS software (SAS Institute, Cary, North Carolina) except for the κ analysis, for which we used Stata Statistical Software: Release 5.0 (Stata Corporation, College Station, Texas).

Results

There were 2077 patients available for analysis among 69 hospitals. There was a mean of 30 patients per hospital. To be included in the analysis, hospitals had to have 10 or more patients eligible for the quality indicator. This criterion provided 60 hospitals for the assessment of left ventricular function and discharge counseling indicators, 41 hospitals for the use of ACE inhibitors for systolic dysfunction indicator, and 29 for the target dose indicator.

Patient characteristics are shown in **Table 2**. The typical patient was a 79-year-old white woman with hypertension. Of note, 29% of the patients had atrial fibrillation on admission, 50% of whom were discharged on anticoagulants (95% CI, 46% to 54%).

Overall Performance

Left systolic ventricular function was assessed in 72% of patients (CI, 70% to 74%). The determination was made by either a current or previous measure of ejection fraction (69%) or by narrative (31%). Among patients with systolic dysfunction and no contraindications for therapy, 79% ($n = 585$) were discharged on ACE inhibitors (CI, 76% to 82%). The ACE inhibitors prescribed included captopril (34%), enalapril (29%), lisinopril (25%), quinapril (4%), benazepril (4%), fosinopril (3%), and ramipril (1%). Among these patients, 23% were prescribed the target dose (CI, 19% to 26%). Target dose was achieved in 10% of the patients prescribed captopril, 29% of those prescribed enalapril, and 27% of those prescribed lisinopril.

Sixty-four percent of patients received discharge counseling about consuming a low-sodium diet (CI, 61% to 66%), but only 8% were counseled about monitoring their weight daily (CI, 7% to 9%). Among the 218 patients who were current smokers, 17% received smoking cessation counseling (CI, 12% to 22%).

Hospital Variation

Table 3 summarizes hospital-to-hospital variation. **Figure 2** shows the data on individual hospitals with regard to the three evaluation and management indicators. The variation in each was significant ($P \leq 0.001$). There was marked hospital-to-hospital variation in the documentation of left ventricular function. The average compliance across hospitals was 70%, and compliance ranged from 18% to 97%. Similar variation was observed when we restricted the analysis to recorded ejection fraction—both for proportion of patients with a previous ejection fraction and for current ejection fraction.

There was considerably less variation among hospitals in the proportion of eligible patients (those with systolic dysfunction and no contraindication) receiving ACE inhibitors. Among the 41 hospitals with 10 or more patients with systolic dysfunction eligible for an ACE inhibitor, the mean proportion of patients discharged on these medications was 77% (range, 54% to 94%). However, prescription of the target dose of ACE inhibitors varied substantially among the 29 hospitals with 10 or more patients discharged on the medication. The mean proportion of patients prescribed an ACE inhibitor at the target dose was 26% (range, 0% to 60%).

Figure 3 shows the data on the two discharge instruction indicators for individual hospitals. The mean proportion of patients instructed about consuming a low-sodium diet was 64% (range, 25% to 97%), whereas the mean proportion of patients counseled about daily weight monitoring was 7% (range, 0% to 30%).

TABLE 2
Patient Characteristics*

VARIABLE	LENGTH OF TIME OR PERCENTAGE OF STUDY SAMPLE WITH THE CHARACTERISTIC
General	
Mean age	79 years
Female	56%
African American ($n = 2058$)	15%
Median length of stay	5 days
Risk factors	
Previous myocardial infraction	41%
Chronic obstructive pulmonary disease	35%
Hypertension	68%
Diabetes	39%
Current smoker	11%
Admission symptoms	
Paroxysmal nocturnal dyspnea	28%
Dyspnea on exertion	36%
Orthopnea	38%
Admission findings	
Leg edema	69%
Rales	87%
S_3 gallop	23%
Jugular vein dilatation	47%
Atrial fibrillation ($n = 1973$)	29%
CHF on chest x-ray ($n = 2006$)	83%

*n = *2077 unless otherwise noted. CHF = congestive heart failure.*

TABLE 3
Hospital Variation in Quality Indicators*

QUALITY INDICATORS	NUMBER OF HOSPITALS	MEAN (ACROSS HOSPITALS)	MEDIAN	RANGE		EXTREMAL QUOTIENT‡
				INTERQUARTILE†	OVERALL	
Evaluation and management						
Assessment of left ventricular function	60	70%	76%	63%–85%	18%–97%	5.5
Use of ACE inhibitors for systolic dysfunction	41	77%	81%	69%–85%	54%–94%	1.7
Prescription of target dose	29	26%	29%	13%–36%	0%–60%	Undefined
Discharge counseling						
Low-sodium diet	60	63%	62%	53%–73%	25%–97%	3.9
Daily weight monitoring	60	7%	5%	0%–11%	0%–30%	Undefined

**ACE = angiotensin-converting enzyme.*
†*25th to 75th percentile.*
‡*The extremal quotient is the ratio of extreme values.*

Discussion

Heart failure is a source of considerable morbidity among Medicare beneficiaries. In 1995, it was the most common cause of hospitalization among Medicare fee-for-service beneficiaries aged 65 to 114 years, and this group had more than 600,000 hospitalizations for congestive heart failure.[27] In this population, heart failure is the third most common cause of emergency department use, accounting for 4% of all visits; it is also the third most common cause of immediate readmission (within 2 days of hospital discharge) and the second most common cause of 1-month readmission to the hospital.[27] Because the appropriate diagnosis and treatment

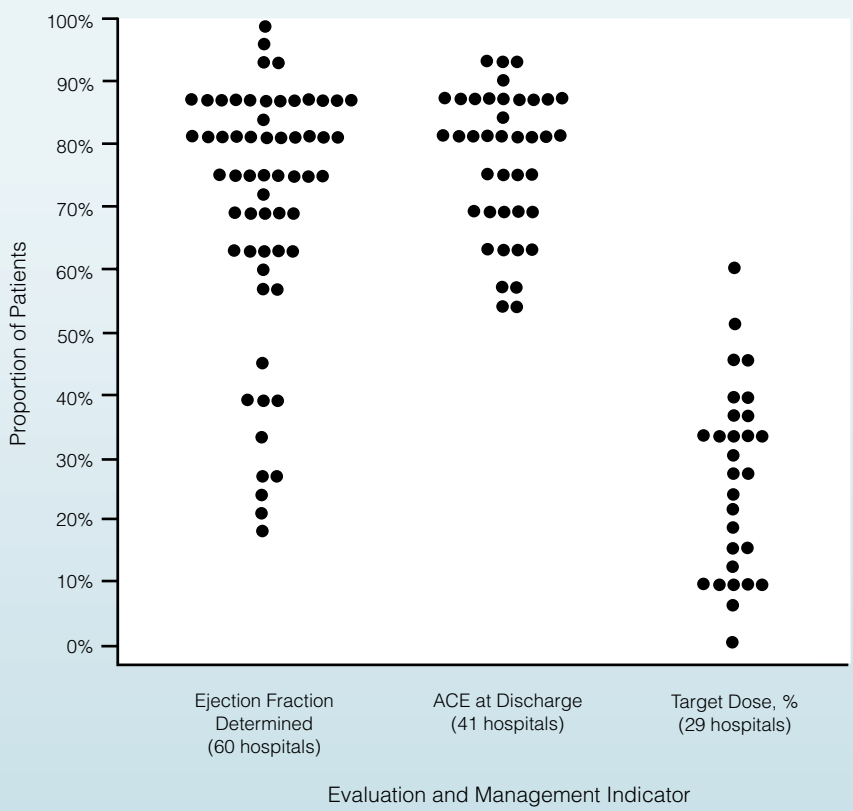

FIGURE 2. Variation among hospitals in three evaluation and management indicators. ACE = angiotensin-converting enzyme.

of heart failure due to systolic dysfunction has been shown to reduce rates of morbidity and mortality associated with this disorder, we felt that it was important to determine the degree to which care of these patients conformed to evidence-based clinical guidelines.[5, 6]

Our findings that substantial numbers of individual patients with systolic dysfunction receive substandard care are consistent with the results of earlier studies. A large study that examined the care of 6749 randomly selected Medicare patients with congestive heart failure in 10 states during 1993 and 1994 found that ejection fraction was not documented in 41% of cases.[11] Krumholz and colleagues[12] evaluated the care of Medicare patients with congestive heart failure in nine Connecticut hospitals during 1994 and found that 25% of patients had no documentation of ventricular function.

Similarly, our finding that 79% of patients who had left ventricular systolic dysfunction and no contraindications received an ACE inhibitor is consistent with earlier reports of Krumholz and coworkers,[12] who described a rate of 86%, and with the Large State Peer Review Organization Consortium, which reported a rate of 73%.[11] These recent findings contrast with data from earlier periods, which showed that ACE inhibitors were considerably underused for the treatment of congestive heart failure.[7–10]

Finally, our observation that nearly 23% of our patients with systolic dysfunction were receiving the target ACE inhibitor dose is similar to the result of 14% in the study by Krumholz and colleagues.[12] Because inadequate target dosing of ACE inhibitors at discharge may reflect dose titration in patients just starting therapy with the drug, we also calculated the adequacy of the discharge dose for those patients admitted on ACE inhibitors. Among patients previously treated with ACE inhibitors, only 30% were receiving the target dose. Consequently, we believe that inadequate target dosing is not an artifact of initiation of therapy.

Despite the availability of published clinical guidelines for the management of heart failure during the 1.5 years before our study began, we found significant hospital-to-hospital variations in the proportion of patients with determined ejection fraction, proportion of patients with systolic dysfunction who were treated with ACE inhibitors, and attainment of the target dose of ACE inhibitors. These findings are consistent with previous studies of care of noncardiovascular diseases.[28–30] Variations have also been found in the use of cardiac procedures after acute myocardial infarction[16–20] and in the use of coronary artery bypass surgery.[13–15]

Several alternative explanations for the variations we observed should be entertained. First, we did not have a random, and therefore representative, sample of the hospitals in the five participating states. This raises the possibility of selection bias in which hospitals at either end of the spec-

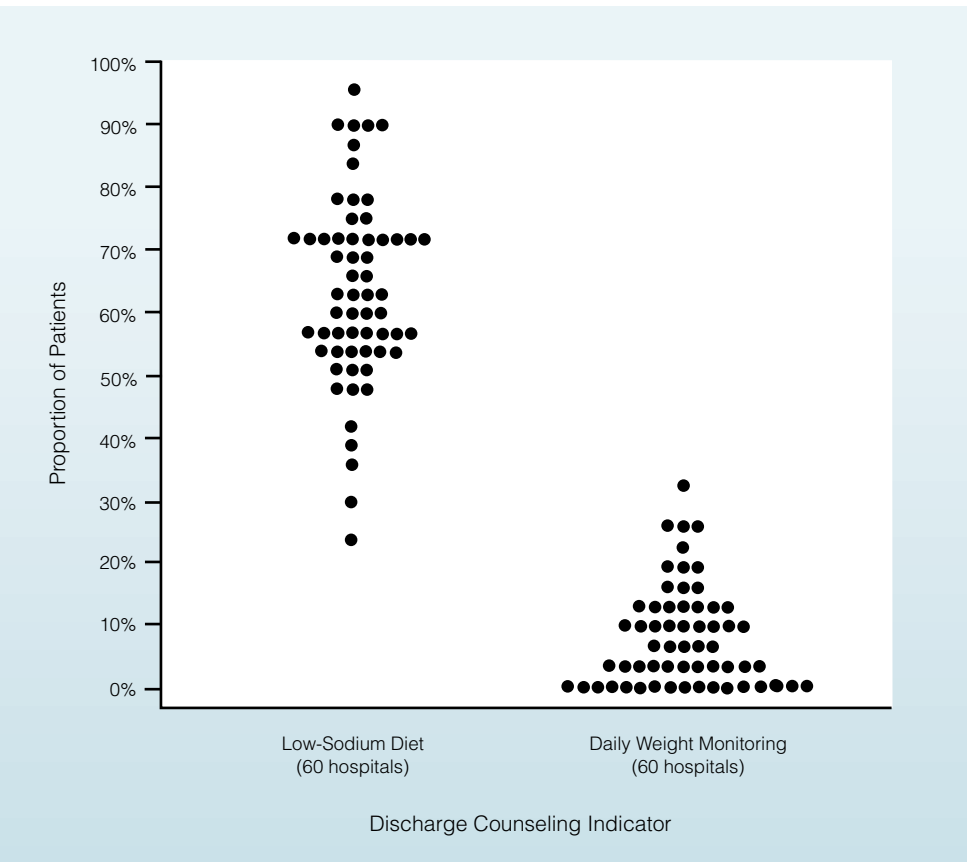

FIGURE 3. Variation among hospitals for two discharge counseling indicators.

trum of care decided to volunteer for the quality improvement project. Although we cannot exclude this possibility, the lack of correlation between hospital-specific quality indicators would show considerable variability within hospitals with respect to quality performance. Second, because our study included patients who were hospitalized over an interval of 15 months, it is possible that we missed changes in patterns of care. Another possible limitation arises because one state used diagnosis-related group (DRG) codes instead of ICD-9-CM codes, thus creating a different sampling procedure. However, the diagnosis of congestive heart failure was not determined by DRG or ICD-9-CM codes but was confirmed for all patients by clinical indicators, thus eliminating incorrect selection purely due to different codes. Indeed, we observed no significant differences between patients from this state and those in the other four states on the specific quality indicators.

Our findings have practical implications for efforts to encourage the dissemination of clinical practice guidelines for heart failure. Clearly, failure to take into account the possibility that inadequate care of heart failure might be nonrandomly distributed among hospitals may result in inefficient recruitment for quality improvement projects like ours. Furthermore, strategies that target hospitals that have been slow to adopt clinical practice guidelines should also involve investigation into factors that may explain the differential use of these tools. Finally, it is evident that considerable opportunity to improve the care of Medicare beneficiaries may exist, and quality improvement interventions targeted at populations of physicians rather than individual clinicians should be considered.

Take-Home Points

- **Determining variations in quality of care among hospitals can help direct attention to poorly performing institutions.**
- **To determine hospital-to-hospital variation, we measured compliance with certain quality indicators for patients with heart failure in 69 hospitals voluntarily participating in a quality improvement program.**
- **Determination of left ventricular function ranged from 18% to 97% across hospitals; angiotensin-converting enzyme inhibitor use in patients with systolic dysfunction ranged from 54% to 94%.**
- **The proportion of patients counseled about the need for a low-sodium diet ranged from 25% to 97%; counseling about monitoring daily weights ranged from 0% to 30%.**
- **There are substantial variations in the quality of care for patients with heart failure.**

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