Depression-Related Costs in Heart Failure Care

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Background: Behavioral factors may play a role in heart failure (HF) care costs by increasing hospital readmission rates. This study sought to estimate the effect of depression on health care costs for patients hospitalized for HF.

Methods: A 3-year retrospective cohort study of a staff-model health maintenance organization. Following a first hospitalization with a primary diagnosis of HF, 1098 health maintenance organization patients were evaluated. Median annualized health care costs for 3 depression groups were identified: (1) no depression (n=672; cost, $7474), (2) antidepressant prescription only (n=312; cost, $11012), and (3) antidepressant prescription and depression diagnosis recorded (n=114; cost, $9550). Depression and HF status were determined through diagnostic, laboratory, and pharmacy records.

Results: After adjusting for age, sex, medical comorbidity, and length of stay at index hospitalization (as proxy for HF severity), costs were 26% higher in the antidepressant prescription only group and 29% higher in the antidepressant prescription and depression diagnosis recorded group when compared with the no depression group (both P<.001). Increased inpatient and outpatient utilization contributed to the increased costs.

Conclusion: Costs of care for patients hospitalized for HF are significantly higher for patients with evidence of depression.

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An estimated 4.9 million Americans have heart failure (HF). While mortality from coronary artery disease is declining, mortality from HF is increasing. This is due, in part, to the aging of our population. Each year, 400,000 Americans are diagnosed with HF, and 200,000 die from the disease. Heart failure deaths have increased by more than 100% between 1979 and 1995. Heart failure is now the leading cause for hospitalization in those older than 65 years and is the most costly cardiovascular disease in the United States, with estimated total costs exceeding $20 billion in 1998.1

It is not clear what can be done to reduce HF costs. Attention has focused on preventing hospital readmission since 40% to 50% of Medicare beneficiaries are readmitted within 6 months of their first HF hospitalization.2 Recent advances in HF care, such as angiotensin-converting enzyme inhibitors and β-blockers, have improved survival rates in clinical trials.3 Several disease management programs involving patient education, nurse follow-up, and home visits have been able to reduce readmissions and costs,4 5 although others have not reduced costs.6 Krumholz et al7 recently identified the following independent clinical predictors of readmission for HF within 6 months: a previous admission within the past year, prior HF, diabetes, and discharge creatinine level greater than 2.5 mg/dl (221 µmol/L). Nonadherence to dietary and medication regimens was not examined in the Krumholz et al study, but is thought to play a prominent role in hospital readmission.8 Vinson et al9 estimated that half of HF readmissions are preventable; however, little research has been done to identify the possible causes of this nonadherence. The general issue of behavioral and psychological factors in HF utilization and costs has not been well studied. We therefore studied the association between evidence of depression and utilization and costs in health maintenance organization (HMO) patients hospitalized for HF using computerized diagnosis, utilization, pharmacy, and cost data. We hypothesized that depression would be associated with increased util-
lization and costs in HF patients due to the challenges of self-care for depressed HF patients.

PARTICIPANTS AND METHODS

STUDY SETTING

The Group Health Cooperative (GHC) of Puget Sound, Wash, is a large staff-model HMO that serves approximately 450,000 residents of western Washington. This HMO provides comprehensive care on a capitated basis. Members typically receive their coverage through employer-subsidized plans. The GHC includes approximately 45,000 Medicare members and 35,000 members covered by Medicaid or Washington’s Basic Health Plan, a state program for low-income residents. Group Health Cooperative members are similar demographically to Seattle-area residents, except that GHC members have a higher average educational level and include fewer high-income residents. Approximately 80% of GHC members make 1 or more primary care visits per year, with the average member making approximately 4 visits. Over 90% of the primary care physicians and specialists who provide services through GHC are certified by the appropriate specialty boards. All general medical and mental health providers are paid by salary, with no individual financial incentives tied to utilization or referral patterns. Within GHC, the number of mental health visits allowed per year varies by insurance group. At least 10 visits per year are allowed for everyone. Some plans allow 20 visits, and some have no limit. Medication management visits (ie, antidepressant prescription without psychotherapy) do not count against this limit—they are unlimited for everyone. Primary care physicians prescribe the vast majority of antidepressants at GHC.

The HMO computerized information systems include data on all inpatient admissions at the HMO hospitals, all outpatient visits to clinics in the HMO, and all outpatient prescriptions filled at pharmacies affiliated with the HMO. Previous surveys of GHC members have found that more than 93% of prescriptions filled by members, including those for antidepressant drugs, are filled at pharmacies affiliated with the HMO. The formulary policies concerning access to selective serotonin reuptake inhibitors (SSRIs) at GHC were in transition during the study period (1993-1997). From 1993 to 1995 there was an official policy that tricyclic antidepressants should be tried first with SSRIs (specifically fluoxetine) for those who had failed treatment with tricyclics. However, this policy was not much enforced by 1995. After 1996, formulary policy dictated that SSRIs could be used as first-line treatment. Through 1997, the preferred first-line agent (based on price) was fluoxetine.

SAMPLE SELECTION

Potential subjects were all GHC members, 18 years or older, receiving a first hospitalization with a primary diagnosis of HF between January 1, 1993, and December 31, 1997. Subjects were selected at the time of their first congestive heart failure (CHF) hospitalization to obtain a cohort at a similar phase in their illness. Pharmacy data were assessed for angiotensin-converting enzyme inhibitor, digoxin, and loop diuretic use for 3 months following the index hospitalization to provide confirmation of HF diagnosis. Ejection fractions, evidence of systolic vs diastolic dysfunction, or myocardial oxygen consumption are not regularly collected on CHF patients in this HMO. Therefore, serum creatinine levels, serum urea nitrogen levels, and sodium levels, as well as length of stay at index hospitalization were assessed as measures of HF severity.

The sampling window for cost information was from 2 years before this hospitalization to 1 year after this hospitalization.

This allowed for an adequate period of cost assessment even for those subjects who died soon after their index hospitalization. To assure complete availability of relevant data, the sample was limited to those continuously enrolled during this sampling window. Subjects who had evidence of receiving any care outside of GHC facilities were excluded. Figure 1 describes the process of sample selection.

To capture all those who might meet criteria for depression at the time of this hospitalization, we assessed for any outpatient antidepressant prescription or depression diagnosis from 6 months before to 1 year after this hospitalization (excluding bupropion hydrochloride prescriptions for smoking cessation). We included primary and secondary outpatient diagnoses of depression. Patients were placed in the no depression group if they had no antidepressant prescriptions or depression diagnoses recorded during the 3-year sampling window. If an antidepressant prescription was filled, but no depression diagnosis was recorded among the outpatient diagnoses during that period, a subject was placed in the antidepressant prescription only group. If any diagnosis of depression was made and an antidepressant prescription was filled, a subject was placed in the antidepressant prescription and depression diagnosis recorded group. Only 20 subjects in the cohort received a depression diagnosis without an antidepressant prescription. Because this group was so small and was very different from the other depression groups (much higher mental health costs and lower medical costs), they were excluded from analyses. A random sample of 50 charts in the antidepressant prescription only group were reviewed to determine whether depression was mentioned as a reason for the prescription in the chart notes.

UTILIZATION AND COST DATA

For each of the 1098 subjects, we examined use and cost of all health care services covered by the GHC for the 2 years before and 1 year after each patient’s index HF hospitalization. Data were extracted from the HMO computerized cost accounting system. This system tracked each unit of service, such as an outpatient visit, a prescription, or an inpatient day that is provided or paid for by the health plan. For services produced by the health plan, including outpatient visits, diagnostic testing, and hospitalization at the HMO facilities, the system estimates actual cost of production. Each service center, outpatient clinic, laboratory, or pharmacy must allocate actual costs of operation to each unit of service provided. Health plan administrative costs are distributed proportionally across service centers. This system also accounts for patients out-of-pocket contributions (copayments or coinsurance) so that the final cost estimates reflect the health plan’s actual expenses. In summary, data from this system reflect the health plan’s actual costs of providing health care services, that is, cost from the insurer’s perspective. All costs were standardized to 1998 dollars.

For the present study, we assessed actual costs (the amount of money expended by the health care system) and utilization (the number of contacts between the patient and the health care system). These were allocated to 3 groups: inpatient, outpa-
tient, and mental health. Inpatient costs include all costs incurred during any hospitalization. Outpatient costs include primary care, specialty care, emergency department, pharmacy (including antidepressants), laboratory, and radiology costs. Mental health costs include all inpatient admissions to mental facilities and outpatient specialist visits for mental health and substance abuse treatment. Total costs include all of these plus long-term care costs, ambulance, and home equipment costs. Inpatient utilization includes number of admissions and total number of hospital days. Outpatient utilization includes all primary care, specialty care, emergency department, pharmacy, laboratory, and radiology visits. Total utilization is the sum of all these contacts with the patient, counting a hospital day, a clinic visit, or a pharmacy refill as 1 contact.

DATA ANALYSES

Data were analyzed using SPSS 8.0 for Windows (SPSS Inc, Chicago Ill). Differences in sample characteristics between the 3 study groups were examined using χ² tests for dichotomous variables and analyses of variance for continuous ones. In the event of a significant result, planned post hoc tests between the 3 groups were conducted. Actual health care costs are presented as annualized means and medians. Due to the extreme nonnormality of the cost and utilization data, median tests were performed between the groups. In the event of significant results, pairwise median tests were performed. These analyses do not adjust for relevant covariates. To allow for adjustment for relevant covariates (using the analytic methods described by Diehr et al), we applied a 1-stage linear regression model to relevant covariates (using the analytic methods described by Diehr et al). The second stage was a linear regression on the costs representing the 2 subgroup comparisons.

Sample characteristics are displayed in Table 1. Subjects were elderly with a mean age of 75 years and slightly fewer than half were men. Groups did not differ in age, serum creatinine levels, serum urea nitrogen levels, sodium levels, or in rates of loop diuretic, angiotensin-converting enzyme inhibitor, or digoxin prescription.

### Table 1. Sample Characteristics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Total (N = 1098)</th>
<th>No Depression Group (n = 672)</th>
<th>Antidepressant Prescription Only Group (n = 312)</th>
<th>Antidepressant Prescription and Depression Diagnosis Recorded Group (n = 114)</th>
<th>Statistical Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age at index hospitalization, y</td>
<td>75.7 (12.4)</td>
<td>76.1 (11.9)</td>
<td>74.8 (13.3)</td>
<td>75.1 (12.3)</td>
<td>F2,1095 = 1.39</td>
</tr>
<tr>
<td>% Male</td>
<td>46.5</td>
<td>53</td>
<td>38</td>
<td>31</td>
<td>χ²1 = 34.5‡</td>
</tr>
<tr>
<td>Chronic Disease Score estimated costs (comorbidity), $</td>
<td>3997 (3364)</td>
<td>3505 (2297)</td>
<td>5014 (5078)</td>
<td>4125 (1820)</td>
<td>F2,1095 = 22.3‡</td>
</tr>
<tr>
<td>Serum creatinine (during hospitalization), mg/dL †</td>
<td>1.61 (1.35)</td>
<td>1.58 (1.15)</td>
<td>1.78 (1.68)</td>
<td>1.47 (1.42)</td>
<td>F2,1095 = 1.69</td>
</tr>
<tr>
<td>Serum urea nitrogen (during hospitalization), mg/dL †</td>
<td>30.4 (20.7)</td>
<td>30.5 (21.4)</td>
<td>31.7 (20.5)</td>
<td>28.1 (19.0)</td>
<td>F2,1095 = 0.75</td>
</tr>
<tr>
<td>Serum sodium (during hospitalization), mEq/L</td>
<td>137 (3.9)</td>
<td>137 (3.8)</td>
<td>137 (4.1)</td>
<td>137 (3.6)</td>
<td>F2,1095 = 0.36</td>
</tr>
<tr>
<td>Loop diuretic use (≥40 mg of furosemide) after index hospitalization, %</td>
<td>64</td>
<td>62</td>
<td>67</td>
<td></td>
<td>χ²1 = 2.56</td>
</tr>
<tr>
<td>ACE inhibitor use after index hospitalization, %</td>
<td>73</td>
<td>73</td>
<td>73</td>
<td></td>
<td>χ²1 = 0.3</td>
</tr>
<tr>
<td>Digoxin use after index hospitalization, %</td>
<td>56</td>
<td>56</td>
<td>56</td>
<td>62</td>
<td>χ²1 = 1.83</td>
</tr>
<tr>
<td>Loop diuretic, digoxin, or ACE inhibitor use, %</td>
<td>90</td>
<td>91</td>
<td>90</td>
<td>89</td>
<td>χ²1 = 0.19</td>
</tr>
<tr>
<td>Length of stay for index hospitalization, d</td>
<td>3.6 (3.0)</td>
<td>3.4 (3.1)</td>
<td>4.1 (3.0)</td>
<td>3.3 (2.1)</td>
<td>F2,1095 = 6.61‡</td>
</tr>
<tr>
<td>Died within first year after hospitalization, %</td>
<td>31</td>
<td>31</td>
<td>34</td>
<td>23</td>
<td>χ²1 = 4.63§</td>
</tr>
</tbody>
</table>

*Data are given as mean (SD) unless otherwise indicated. ACE indicates angiotensin-converting enzyme.

†To convert creatinine to micromoles per liter, multiply by 88.4. To convert urea nitrogen to millimoles per liter, multiply by 0.357.

‡P<.001.

§P<.05.
Ninety percent of the sample had received a prescription for a loop diuretic, angiotensin-converting enzyme inhibitor, or digoxin within 3 months of their index hospitalization. The depression groups were more often women and had a higher level of medical comorbidity. The antidepressant prescription only group had greater Chronic Disease Score (medical comorbidity) and a longer length of stay for the index hospitalization (initial HF severity). On review of 50 random charts from the antidepressant prescription only group, depression was mentioned as a reason for the prescription in 28 charts. Anxiety or insomnia was mentioned in another 19 charts. No reason could be identified for the antidepressant prescription in 3 charts. Because of the range of diagnoses for which antidepressant medications were prescribed, we interpreted this group as having significant psychological distress but analyzed them separately from those with a submitted diagnosis of depression. The antidepressant prescription and depression diagnosis recorded group had a lower 1-year mortality rate than the antidepressant prescription only group (23% vs 34%; \( P = .03 \)), but the mortality risk was no longer significantly different after accounting for differences in age, sex, comorbidity, and antidepressant type (odds ratio, 0.66; 95% confidence interval, 0.39-1.1). In the antidepressant prescription only group, 56% received a tricyclic, 27% received an SSRI, and 17% received another type of antidepressant. In the antidepressant prescription and depression diagnosis recorded group, 30% received a tricyclic, 47% received an SSRI, and 23% received another type of antidepressant. These rates were significantly different \( (\chi^2_{1,426} = 24.3; P < .001) \). The antidepressant prescription only group received a median of 11 antidepressant prescriptions (mean, 19; mode, 1) during the study period, while the antidepressant prescription and depression diagnosis recorded group received a median of 22 antidepressant prescriptions (mean, 32; mode, 6). These were significantly different \( (\chi^2_{1,429} = 25.5; P < .001) \).

Unadjusted annualized actual health care cost data are displayed in Table 2. Median costs are listed first for each category, followed by mean costs and SDs. No patients had zero costs in the inpatient or outpatient categories since all patients had an HF hospitalization. All categories of cost show significant differences between the 3 groups using the median tests \( (P < .001) \). Post hoc tests revealed that for all costs, the antidepressant prescription only group had greater median costs than the no depression group, and that the no depression and antidepressant prescription and depression diagnosis recorded groups differed in outpatient, mental health, and total costs, but not inpatient costs. The 2 depression groups only differed in mental health costs, with the antidepressant prescription and depression diagnosis recorded group having significantly greater average mental health costs than the antidepressant prescription only group. Figure 2 displays total cost differences for the 3 groups by breaking down the 3-year assessment period into 6-month time periods. Although cost differences are most marked in the 6 months that include the index hospitalization, costs appear to be greater in the depression groups for all the 6-month periods.

Annualized utilization data are displayed in Table 3. Median admissions, days, or visits are listed first, followed by means and SDs. The median tests revealed that all categories of utilization are higher in the groups with evidence of depression compared with the group without. Table 4 presents the adjusted median cost ratios and 95% confidence intervals for the 3 groups. The results show that patients with an antidepressant prescription had significantly higher costs than patients with...
COMMENT

This cohort study of HMO patients with a first hospitalization with a primary diagnosis of HF demonstrates significantly increased costs and utilization for those patients with some evidence of depression. These increased costs were due to increased inpatient and outpatient medical utilization, not increased mental health utilization. These differences were evident even after adjustment for additional medical comorbidity. Contrary to the expectation that behavior-related hospitalizations would produce the largest effects, outpatient costs showed more robust differences between groups than inpatient costs. After adjustment for covariates (age, sex, medical comorbidity, and length of stay for index hospitalization), the depression groups had 26% to 29% greater costs over a period of 3 years than the no depression group. Applying these cost ratios to the $20 billion total costs for HF care for 1998 suggests that up to $5 billion of the cost of HF care may be associated with depression and other psychological distress.

Based on review of a random sample of charts from the antidepressant prescription only group, depression was mentioned as a reason for antidepressant prescription in over half of this group. If prescriptions for anxiety and insomnia are added to these, this accounts for over 90% of the antidepressant prescriptions. To be conservative, we have analyzed the depression groups separately; however, cost increases are very similar for the 2 depression groups, suggesting similar effects on utilization for the groups. Mental health costs for our sample are quite low, but are typical for an elderly and medically ill group. One additional reason our mental health visit rates are low is that no depression. The estimates of the increase in cost ranged from 32% for outpatient costs to 26% for total and inpatient costs. Although patients who are prescribed an antidepressant are 5 times more likely to have mental health care costs, once costs were incurred, they did not differ between the groups. Patients diagnosed with depression had significantly greater costs than patients with no depression, ranging from 41% for outpatient costs to 23% for inpatient costs. Total costs were 29% higher after controlling for the covariates. Patients in the antidepressant prescription and diagnosis recorded group were 13 times more likely to have at least some mental health costs, but users of mental health services in the 2 depression groups did not differ in amount of services used.
primary care physicians prescribe the vast majority of antidepressants at GHC. Further studies with structured psychiatric interviews will be needed to confirm our findings about these depression effects on HF care costs.

There are a number of possible reasons why depression might be associated with increased HF care costs. Depression could be a “marker” for more severe heart disease. Depression could increase HF morbidity by impairing self-care. Depression could affect symptom perception and health behavior, leading to “excess” utilization. The neuroendocrine changes typical of depression could exacerbate HF pathophysiology. Higher rates of medical comorbidity not reflected in the Chronic Disease Score (eg, dementia), or greater severity of HF not captured by our length of stay proxy for HF severity may also account for these observations. Replication of our findings with better depression assessment and HF characterization will be needed to clarify these issues.

Though depression in coronary heart disease is increasingly well studied, studies of depressive disorders and their effects in HF patients are much more limited. Koenig20 assessed 107 hospitalized patients with a primary or secondary diagnosis of CHF. Major depression was present in 36% of those with CHF compared with 17% without CHF. Minor depression was present in 21% of those with CHF compared with 17% without CHF. Those who were depressed had more severe medical illnesses and more functional impairment and were more likely to have a history of previous depression. Depressed CHF patients made more outpatient visits over the next 3 months, but it was not possible to determine if this was due to more severe medical illnesses. Few depressed patients received treatment and 40% failed to remit over the following year. Stressful life events and low social support, but not medical severity, were associated with depression persistence. Krumholz et al21 recently showed that lack of emotional support for elderly patients hospitalized with HF increased the risk of fatal heart disease. Depression has been shown to be a driver of increased health care costs for elderly medical comorbidity, depression has not been well evaluated in studies of HF patients. Medical, behavioral (eg, noncompliance), and social (eg, living alone) predictors of hospitalization in HF have been examined in prospective studies, but psychological predictors have not been included. Multidisciplinary interventions ranging from home monitoring to home visits to intensive education and medical follow-up have been shown to decrease rates of rehospitalization. But these interventions have neither monitored nor targeted depression, so it is not known how much depression treatment might reduce health care utilization rates in CHF. Given the magnitude of depression-related costs suggested by the present study, depression treatment may be an inexpensive way to decrease CHF-related health care utilization and improve the quality of life of patients with CHF.

All the subjects in our present study did receive at least 1 antidepressant prescription. Thus, it may appear that this is a sample with treated depression. But previous studies at GHC have demonstrated that fewer than half of patients receiving antidepressants receive adequate dose or duration of treatment according to Agency for Healthcare Research and Quality guidelines. Treatment adequacy is much worse than this in the elderly and the medically ill.35 It is therefore not possible, based on our data, to rule out the reversibility of these depression-associated costs.

Some limitations of the present study should be noted. Primary among these is the use of only automated claims data. These data have limited information on depression diagnosis and HF severity. Further clinical studies, using structured psychiatric interviews and detailed assessment of HF severity, are needed to confirm our findings.

In conclusion, our study suggests that depression and other conditions requiring the use of antidepressant medications may be contributing significantly to direct medical costs for HF care. This effect is not limited to rehospitalization risk, but extends throughout the spectrum of HF care. Because we rely upon automated data proxies for standardized medical and psychiatric diagnoses, our results should be interpreted with caution. In randomized trials, disease management programs have generally been able to decrease costs and improve some outcomes in HF care; however, none of these programs have targeted depression. Our study suggests that depression treatment should be tested to determine if it can become a cost-effective component of HF disease management programs.

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