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. Actual utilization and cost values were derived from administrative data.

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,4-7 although others have not reduced costs.8 Krumholz et al9 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’s study, but is thought to play a prominent role in hospital readmission.10 Vincent et al11 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-

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Participation and methods

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 95% 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 1993. 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.
Diehr et al, we applied a 1-stage linear regression model to the 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 the data using the log transformations of the cost data for total, inpatient, and outpatient costs. These analyses adjusted for age, sex, HF severity, medical comorbidity, and length of assessment. In the case of the mental health cost data, a 2-stage model was applied. The 2-stage model for mental health costs consisted of a first-stage logistic regression model predicting the odds of having at least 1 mental health visit after adjusting for covariates. The second stage was a linear regression on the costs involving only individuals with at least $1 in mental health care costs using the same set of covariates. Length of assessment was 36 months for patients who did not die. For patients who died, the minimum length of assessment was 24 months and the maximum was 36 months. The sample mean was 33 months of assessment with a 4-month SD.

Multivariate analyses were adjusted for HF severity and medical comorbidity. As a proxy for HF severity and complications, we used length of stay for the index hospitalization. Heart failure severity and complications explain only a portion of the variance in length of stay, so this is an approximation; however, it is likely to introduce a conservative bias in estimates of the effect of depression on costs and utilization. Depression is associated with increased length of stay, so adjusting for length of stay will tend to minimize its effect. Medical comorbidity was rated by means of the Chronic Disease Score, a technique developed at GHC for estimating chronic medical illness burden using automated pharmacy data. The method classifies each patient according to the number of medications typically used to treat chronic medical conditions and is therefore a measure of recognized and treated medical illness. In prior research, the Chronic Disease Score was correlated with physician ratings of physical disease severity and predicted mortality. It is less affected by current psychological distress than self-report measures of health status. For the current analyses, antidepressants were excluded from the Chronic Disease Score. Diseases not treated with prescribed medications, such as Alzheimer disease during the 1992 to 1997 time period, are not reflected in the Chronic Disease Score.

Tests for heteroscedasticity of the log-transformed data were performed. Heteroscedasticity may invalidate results of log-transformed analyses. Cost ratios of estimated median health care costs adjusted for the covariates (with 95% confidence intervals) between the no depression group and the other 2 groups were calculated by exponentiating the regression coefficients representing the 2 subgroup comparisons.

### RESULTS

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.
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 (χ² = 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 (χ² = 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 prescribed had significantly higher costs than patients with

Table 2. Average Annual Health Care Costs (in 1998 Dollars)*

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Median (SD)</th>
<th>Median (SD)</th>
<th>Median (SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>No Depression</td>
<td>Antidepressant</td>
<td>Antidepressant</td>
</tr>
<tr>
<td></td>
<td>Group (n = 672)</td>
<td>Prescription Only</td>
<td>and Depression</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Group (n = 312)</td>
<td>Diagnosis Recorded (n = 114)</td>
</tr>
<tr>
<td>Inpatient</td>
<td>3796 (7837)</td>
<td>5621 (9742)</td>
<td>4352 (7096)</td>
</tr>
<tr>
<td>Outpatient</td>
<td>3390 (2629)</td>
<td>4706 (3738)</td>
<td>4872 (2927)</td>
</tr>
<tr>
<td>Mental health</td>
<td>0 (150)</td>
<td>47 (200)</td>
<td>0 (167)</td>
</tr>
<tr>
<td>Total</td>
<td>7474 (9163)</td>
<td>11 012 (11 557)</td>
<td>9550 (9035)</td>
</tr>
</tbody>
</table>

*Columns do not exactly sum because total costs include long-term care, ambulance, and equipment costs. Results of post hoc tests are as follows: no depression group vs antidepressant prescription only group differ on all measures (P < .001); no depression group vs antidepressant prescription and depression diagnoses recorded group do not differ on inpatient (P = .54), but do for the other 3 cost categories (P < .001); antidepressant only group vs antidepressant prescription and depression diagnoses recorded group differ only in mental health costs (P = .001).

Figure 2. Depression group costs by 6-month intervals. 1, No depression group; 2, antidepressant prescription only group; and 3, antidepressant prescription and depression diagnosis recorded group.
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 is 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. Stigma and preoccupation with ongoing serious medical disorders combine to keep mental health utilization very low in this group. Other studies have showed similar rates of utilization in the elderly and medically ill group. One additional reason our mental health visit rates are low is that they can be explained by the low rates of mental health visits in the elderly and medically ill group. 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.

### Table 3. Annualized Automated Utilization Data

<table>
<thead>
<tr>
<th>Utilization</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>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Median (Mean (SD))</td>
<td>Median (Mean (SD))</td>
<td>Median (Mean (SD))</td>
</tr>
<tr>
<td>Inpatient admissions</td>
<td>0.7 (0.8 (0.6))</td>
<td>1.0 (1.0 (0.7))</td>
<td>0.7 (1.0 (0.9))</td>
</tr>
<tr>
<td>Inpatient days</td>
<td>2.3 (3.4 (5.5))</td>
<td>3.7 (4.8 (4.6))</td>
<td>2.7 (4.1 (4.5))</td>
</tr>
<tr>
<td>Outpatient visits</td>
<td>10.0 (11.2 (7.1))</td>
<td>13.0 (14.5 (8.8))</td>
<td>14.3 (16.1 (9.2))</td>
</tr>
<tr>
<td>Pharmacy fills</td>
<td>31.3 (34.7 (21.4))</td>
<td>56.7 (61.9 (34.3))</td>
<td>57.2 (62.9 (36.6))</td>
</tr>
<tr>
<td>Mental health (days/visits)</td>
<td>0 (0.1 (0.3))</td>
<td>0 (0.3 (0.9))</td>
<td>0 (1.1 (2.8))</td>
</tr>
<tr>
<td>Total (days + visits + fills)</td>
<td>49.9 (49.4 (27.1))</td>
<td>76.3 (81.6 (40.0))</td>
<td>74.7 (84.1 (46.5))</td>
</tr>
</tbody>
</table>

### Table 4. Adjusted Cost Ratios for Median Health Care Costs (1998 Dollars)

<table>
<thead>
<tr>
<th>Treatment</th>
<th>No Depression Group vs Antidepressant Prescription Only Group</th>
<th>No Depression Group vs Antidepressant Prescription and Depression Diagnosis Recorded Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inpatient</td>
<td>1.26 (1.10-1.45)*</td>
<td>1.22 (1.01-1.49)*</td>
</tr>
<tr>
<td>Outpatient</td>
<td>1.32 (1.21-1.43)*</td>
<td>1.41 (1.25-1.59)*</td>
</tr>
<tr>
<td>Mental health</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stage 1 – any vs no costs‡</td>
<td>5.29 (3.30-8.50)*</td>
<td>13.63 (7.94-23.39)*</td>
</tr>
<tr>
<td>Stage 2 – only those with costs‡</td>
<td>0.76 (0.45-1.28)</td>
<td>1.37 (0.79-2.36)</td>
</tr>
<tr>
<td>Total</td>
<td>1.26 (1.15-1.39)*</td>
<td>1.29 (1.12-1.47)*</td>
</tr>
</tbody>
</table>

*P < .001. †P < .05. ‡Odds ratio.
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.

Although depression in coronary heart disease is increasingly well studied, studies of depressive disorders and their effects in HF patients are much more limited. Koenig 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 al recently showed that lack of emotional support for elderly patients hospitalized with HF increased the risk of fatal 9-year period. Self-efficacy has strong links to depression and may be the principal means by which depression affects adherence to self-care regimens.

Despite the recognition of depression as an independent predictor of dependence in activities of daily living after hospitalization in acutely ill older persons, and as 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. 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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REFERENCES


