Impact of a Depression Care Management Program for Hospitalized Cardiac Patients

Jeff C. Huffman, MD; Carol A. Mastromauro, LICSW; Gillian Sowden, BA; Gregory L. Fricchione, MD; Brian C. Healy, PhD; James L. Januzzi, MD, FACC

Background—Depression is independently associated with poor outcomes among patients with acute cardiac disease. Collaborative care depression management programs have been used in outpatients to improve depression outcomes, but such a program had never been initiated in the hospital or used for patients with a wide range of cardiac illnesses.

Methods and Results—This was a prospective, randomized trial of a low-intensity, 12-week collaborative care program versus usual care for 175 depressed patients hospitalized for acute coronary syndrome, arrhythmia, or heart failure. Study outcomes, assessed using mixed regression models to compare groups at 6 weeks, 12 weeks, and 6 months, included mental health (depression, cognitive symptoms of depression, anxiety, and mental health-related quality of life) and medical (physical health-related quality of life, adherence to medical recommendations, and cardiac symptoms) outcomes. Collaborative care subjects (n=90) had significantly greater improvements on all mental health outcomes at 6 and 12 weeks, including rates of depression response (collaborative care, 59.7% versus usual care 33.7%; odds ratio, 2.91; P=0.003 at 6 weeks; 51.5% versus 34.4%; odds ratio, 2.02; P=0.04 at 12 weeks), though these effects decreased after intervention. At 6 months, intervention subjects had significantly greater self-reported adherence and significantly reduced number and intensity of cardiac symptoms.

Conclusions—Among patients with a broad range of cardiac diagnoses, a collaborative care depression management program initiated during hospitalization led to significant improvements in multiple clinically important mental health outcomes and had promising effects on relevant medical outcomes after intervention.

Clinical Trial Registration—URL: http://www.clinicaltrials.gov. Unique identifier: NCT00847132.

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Key Words: myocardial infarction ▪ arrhythmia ▪ heart failure ▪ depression
academic medical center between September 2007 and June 2009. Enrolled subjects were randomly assigned to a multicomponent collaborative care intervention or to usual care (screening and feedback to providers); full details of recruitment and the in-hospital intervention have been described elsewhere. Overall, the collaborative care intervention in this study was shorter and lower in intensity than prior collaborative care programs, with at most 3 phone contacts (and often fewer) between patients and a depression care manager over the 12-week postdischarge period. This is in contrast to scheduled weekly to every other week interventions and assessments, often in person, in other programs. Study procedures were approved by our institution’s institutional review board.

**WHAT IS KNOWN**

- Depression in patients with cardiac disease is independently associated with adverse cardiac outcomes.
- Collaborative care depression management programs have been shown to improve depression outcomes in outpatients with medical illness but have not been evaluated for inpatient settings or in patients with a broad range of cardiac disease.

**WHAT THE STUDY ADDS**

- A depression collaborative care program for patients with a variety of acute cardiac illnesses, initiated in the hospital and continued by phone after discharge, was associated with significant improvements in depression, anxiety, and mental health-related quality of life during the 12-week intervention.
- Subjects receiving collaborative care also reported improvements in the number and intensity of their cardiac symptoms as well as self-reported adherence to medical recommendations at 6 months after enrollment.

### Participants and Procedures

Eligible patients were admitted to 1 of 3 inpatient cardiac units at an urban academic medical center for acute cardiac disease, defined as admission for myocardial infarction, unstable angina, decompensated heart failure, or arrhythmia. We selected these 4 diagnoses because we wished to capture a wide spectrum of acute cardiac illness on the inpatient units and because depression has been associated with adverse effects in patients with each condition. Each clinical diagnosis was assigned by the admitting cardiologist and ascertainment from chart review. Informed consent was obtained by a physician investigator for patients who met all study criteria. Patients admitted to the units underwent depression screening via the Patient Health Questionnaire-2 (PHQ-2), performed by the admitting nurse as part of clinical care. For positive-screen patients (PHQ-2 ≥3) who had an included cardiac diagnosis, study social work care managers administered the 9-item Patient Health Questionnaire-9 (PHQ-9) to assess for clinical depression. Clinical depression was defined as a PHQ-9 score ≥10, with 5 or more symptoms—including either depressed mood or anhedonia—present more than half the days for at least the preceding 2 weeks. We selected this definition for clinical depression because it parallels diagnostic criteria for major depression more closely than a simple PHQ-9 cutoff score.

Patients meeting study criteria for depression had additional structured assessments using the Mini Neuropsychiatric Interview and the CAGE questionnaire to evaluate for psychiatric exclusion criteria. These included bipolar disorder, psychotic symptoms, active substance abuse, and active suicidal ideation (ie, with current intent/plan) because these conditions generally require treatment by a specialist. If patients responded positively to item No. 9 of the PHQ-9 (regarding thoughts that life was not worth living), a systematic assessment for active suicidality was performed. Finally, patients who did not speak English or could not provide informed consent due to cognitive problems or the severity of their current medical illness were excluded.

After enrollment, subjects were randomly assigned via random-number generator to collaborative care or usual care. In the usual care arm, the care manager informed the inpatient treatment team of the subject’s depression and recommended that the patient receive treatment. For subjects in the collaborative care arm, several in-hospital interventions occurred. Briefly, the care manager provided written and verbal education about depression and its impact on cardiac disease, helped the patient to schedule plausurable activities after discharge, and described treatment options (pharmacotherapy or psychotherapy referral). The care manager then consulted with the study psychiatrist, who developed individualized depression treatment recommendations for the patient, based on prior treatment history, comorbid medical conditions, current medications, and patient preference. Once treatment recommendations were created, the care manager worked to coordinate these recommendations with inpatient and outpatient medical care providers. The patient’s medical providers prescribed all antidepressant medication, and therapy referrals were coordinated through the medical teams.

Medication recommendations were made by the study psychiatrist based on patients’ individual histories. Selective serotonin reuptake inhibitors are the most studied agents in patients with cardiac disease and appear to be safe and effective in treating depression in this population. Medication recommendations were therefore made for patients with cardiac disease and appear to be safe and effective in treating depression in this population.5,20 We therefore recommended selective serotonin reuptake inhibitors for patients in the study unless there were specific clinical reasons to choose another class of agents.

### Postdischarge Interventions

Postdischarge interventions lasted 12 weeks. After discharge, patients received 3 assessments by a blinded study research assistant during the 12-week postdischarge intervention period that included PHQ-9 administration to assess depression symptoms. The research assistant entered the PHQ-9 data from each follow-up into a secure database that could be accessed by the study team. At weekly team meetings, the care managers and study psychiatrist reviewed PHQ-9 scores for all subjects.

If subjects in the usual care arm continued to meet criteria for clinical depression (based on PHQ-9 score) at any of the follow-up calls, the subject’s primary care physician was informed via written communication (via fax/mailing of a letter) that the patient had ongoing depression and would benefit from treatment. For subjects in the collaborative care arm, if subjects met criteria for clinical depression at any of the 3 follow-up calls, a multicomponent intervention—similar to the in-hospital intervention—was undertaken. The care manager contacted the patient and discussed the case with the team psychiatrist, and written treatment recommendations were generated as appropriate (eg, increase of antidepressant dose, therapy referral). These recommendations were discussed with the patient and the patient’s primary medical physician (and faxed to the physician), and the care manager worked to coordinate implementation (eg, having the physician call in a prescription or see the patient).

### Study Outcomes

After discharge, blinded study staff reviewed subjects’ medical records for demographic information, cardiac risk factors, and admission medications. Study outcome measures were obtained at the time of consent (before randomization) and at 6 weeks, 12 weeks, and 6 months by study staff blinded to subjects’ treatment condition. The following measures were used:

**Mental Health Outcomes**

The PHQ-9 was used for depressive symptoms. We used this as a continuous measure of depression and also evaluated rates of
categorical depression response (50% reduction of symptoms, with total score <10).

The Medical Outcomes Study Short Form-12 (SF-12)^21 was used to assess HRQoL. Results of the SF-12 provide a mental component score (MCS) to measure mental HRQoL. The Hospital Anxiety and Depression Scale—Anxiety Subscale (HADS-A)^22 was used to assess anxiety. The Massachusetts General Hospital Cognitve and Physical Functioning Questionnaire (CPFQ)^23 was used to assess cognitive symptoms of depression.

The patient global (mental health) improvement survey was taken at the 6-month follow-up. Subjects were asked, “On a scale of 1 to 5, how much did your participation in this study help you with your overall mental health?” with 1 being “not at all” and 5 “very much.” We planned to compare rates of subjects who rated their improvement as 4 to 5 on the 5-point scale, consistent with satisfaction/improvement ratings in similar studies.14

Physical Health Outcomes
A cardiac symptom list adapted from the Women and Ischemia Syndrome Evaluation study (WISE)^24 was used to assess the presence and intensity of ten cardiac symptoms (chest pain/pressure, palpitations, dizziness/ lightheadedness, sweating, jaw pain, arm/shoulder pain, weakness, nausea, and indigestion). Total number of symptoms were recorded, as well as severity of each symptom^1–3 to allow a measure of both number (maximum score = 10) and intensity (maximum score = 30) of symptoms.

Items from the Medical Outcomes Study Specific Adherence Scale^25 were used to assess self-reported adherence to physician recommendations regarding diet, exercise, stress reduction, and medication adherence over the preceding month. Each item noted the patient’s reported frequency of following the recommendation from 1 (“none of the time”) to 6 (“all of the time”), and the total adherence score was the sum of the 4 items (maximum score = 24). Adherence was only measured at the postdischarge follow-ups, given that patients may not have had preexisting cardiac disease before admission and therefore subjects’ physicians may not have prescribed medications or recommended specific cardiac health behaviors before the index admission.

The SF-12 physical component score (PCS) was used to assess physical HRQoL.

Cardiac readmissions over the 6-month postenrollment period were also recorded, using multiple sources of information (patients, primary care physicians, and medical records) to ascertain whether patients were readmitted and the primary diagnosis for such readmissions.

Data Analysis
We compared baseline sociodemographic and clinical characteristics by treatment group using t tests for continuous variables and χ² analysis for categorical variables. Our main outcomes for this trial were differences in improvements in mental and physical health outcomes between the intervention and usual care groups at 6 weeks, 12 weeks, and 6 months after enrollment. We selected these time points for analysis to ensure that depression treatment initiated in the hospital would have adequate time to take effect (6 months was considered an exploratory time point given that interventions lasted only 12 weeks).

For our main analyses, we assessed between-group differences in change in the outcome variables (PHQ-9, SF-12 MCS/PCS, HADS-A, CPEQ, cardiac symptom scale) from baseline using a random-effects regression model with a random intercept for each patient.26 Robust standard errors were used to accommodate departures from the assumed correlation structure. Time was treated as a categorical variable in the analysis to allow estimation of the differences at each time point. We used an intent-to-treat model for all outcomes. We used random-effects regression models for our main study outcomes (rather than isolated tests at each time point) because this approach allowed assessment of all time points in a single model and allowed us to include subjects with some missing data.

To assess between-group differences in rates of depression response at 6 weeks, 12 weeks, and 6 months, we used a generalized estimating equations model with an unstructured covariance matrix.27 For between-group differences in self-reported adherence at 6 weeks, 12 weeks, and 6 months, we used the same mixed model as described above. Finally, for rates of cardiac readmissions and satisfaction with care at 6 months, we performed a χ² test and t test, respectively.

All analyses were performed using Stata statistical software (version 11.0, StataCorp College Station, TX) and SAS (version 9.2, SAS Institute Inc, Cary, NC). All probability values were 2-tailed. We considered each time point a separate comparison so that a probability value of 0.05 or less for any time point was considered statistically significant. If all comparisons had been considered together, a Bonferroni correction for multiple comparisons would have required a probability value of ≤0.0167 at any time point to be statistically significant.

Results
Patients
Overall, 175 subjects were enrolled (90 randomly assigned to collaborative care, 85 to usual care). Figure 1 displays the flow of patients through the study. Table 1 lists subject characteristics by randomization status. Patients in the intervention and usual care groups were similar on all baseline demographic and clinical characteristics, and there were no significant between-group differences on baseline study outcome measures.

At least 1 follow-up assessment was available for 164 (93.7%) subjects (Figure 1). Two subjects died while in the hospital, and 14 died during the follow-up period (total mortality, 9 [10.6%] usual care subjects versus 7 [8.8%] collaborative care; χ²=0.416; P=0.52). A total of 127 subjects (77.4% of nondeceased subjects) completed the 6-week follow-up, 138 (86.3%) completed the 12-week follow-up, and 137 (86.2%) completed the 6-month follow-up.

Clinical Outcomes: Mental Health
Clinical outcomes are detailed in Table 2.

Depression
Collaborative care subjects had significantly greater improvements of depressive symptoms at 6 weeks (between-group difference in PHQ-9 improvement = −3.03 points; 95% confidence interval, −4.97 to −1.10; P=0.002) and 12 weeks (−3.43; 95% confidence interval, −5.41 to −1.45; P<0.001), with probability value slightly larger than the statistical threshold at 6 months (−1.77; 95% confidence interval, −3.76 to 0.22; P=0.081).

Similarly, regarding depression response on the PHQ-9, intervention subjects had greater rates of depression response at 6 weeks (59.7% collaborative care versus 33.7% usual care; odds ratio [OR] 2.91; P=0.003) and 12 weeks (51.5% versus 34.4%; OR 2.02; P=0.042), but with no significant difference at 6 months (48.7% versus 43.9%; OR, 1.21; P=0.57; Figure 2).

Mental HRQoL
Collaborative care subjects had greater improvements of mental HRQoL (as measured via SF-12 MCS) than usual care subjects at all time points (Table 2), with greater magnitude
of improvement at 6 weeks (7.32 points greater improvement in intervention group; \(P<0.001\)) and 12 weeks (5.92 points; \(P=0.003\)) than 6 months, when the between-group differences were below threshold for statistical significance (3.92 points; \(P=0.072\)).

**Anxiety, Cognitive Symptoms, and Global Improvement**

Anxiety (HADS-A) and cognitive symptoms of depression (CPFQ) both improved significantly more in the collaborative care arm at 6 and 12 weeks compared with usual care, with reduced effects at 6 months (Table 2). Finally, subjects in the collaborative care arm reported significantly greater improvement in mental health over the 6-month study period (54.6% gave a rating of 4 or 5 [out of 5] in collaborative care versus 30.4% in usual care, \(\chi^2=7.34; \text{df}=1; P=0.007\); Table 3).

**Clinical Outcomes: Medical Outcomes**

**Cardiac Symptoms**

Collaborative care was not associated with significantly greater improvements in either number or intensity of cardiac symptoms at 6 or 12 weeks. However, by 6 months, collaborative care subjects had significantly greater improvements in number of cardiac symptoms (improvement greater by 0.80 symptoms in collaborative care; \(P=0.047\)) and intensity of symptoms (2.15 points; \(P=0.011\); Table 2).

**Adherence to Medical Recommendations**

Self-reported adherence (Medical Outcomes Study Specific Adherence Scale, MOS) was significantly greater in the collaborative care arm at 6 months (mean adherence score, 15.9 in collaborative care subjects versus 14.6 in usual care; \(P=0.027\)) (Table 3). No significant difference was observed at 6 weeks (16.0 versus 15.0; \(P=0.06\)) or 12 weeks (15.6 versus 15.1; \(P=0.44\)).

**Physical HRQoL and Cardiac Readmissions**

Finally, there were no between-group differences in physical HRQoL (SF-12 PCS), and no significant differences in rates of cardiac readmissions (39.5% collaborative care versus 40.5% usual care; \(\chi^2=0.016; \text{df}=1; P=0.88\)) in the 6 months after enrollment.

**Discussion**

In this randomized trial of a 12-week, low-intensity collaborative care program, we found that systematic depression evaluation in hospitalized cardiac patients—linked with care management during and after admission—was associated with improvement in mental health and other clinical metrics, compared with usual care. Patients randomly assigned to collaborative care had significantly greater improvement of depressive symptoms, less anxiety, better mental HRQoL,
and lower scores for cognitive symptoms of depression and showed higher rates of depression response, at 6 and 12 weeks, though these effects waned to some degree by 6 months. There was no effect of collaborative care on medical outcomes during the 12-week intervention period. However, at 6-month follow-up, collaborative care subjects had significant reduction in the number and intensity of cardiac symptoms and greater self-reported adherence to specific

Table 1. Baseline Sociodemographic and Clinical Characteristics by Randomization Status

<table>
<thead>
<tr>
<th></th>
<th>Intervention (n=90)</th>
<th>Usual Care (n=85)</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Demographic/psychosocial characteristics</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>Age, mean (SD)</td>
<td>62.1 (12.8)</td>
<td>62.6 (12.2)</td>
<td>0.81</td>
</tr>
<tr>
<td>Male sex</td>
<td>52 (58)</td>
<td>38 (45)</td>
<td>0.08</td>
</tr>
<tr>
<td>Married</td>
<td>41 (46)</td>
<td>35 (42)</td>
<td>0.56</td>
</tr>
<tr>
<td>White</td>
<td>83 (92)</td>
<td>77 (91)</td>
<td>0.70</td>
</tr>
<tr>
<td>Employed</td>
<td>18 (20)</td>
<td>24 (28)</td>
<td>0.20</td>
</tr>
<tr>
<td>Living alone</td>
<td>27 (30)</td>
<td>31 (36)</td>
<td>0.36</td>
</tr>
<tr>
<td>Medical history</td>
<td></td>
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<tr>
<td>Hypertension</td>
<td>56 (62)</td>
<td>46 (54)</td>
<td>0.28</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>34 (38)</td>
<td>25 (29)</td>
<td>0.24</td>
</tr>
<tr>
<td>Hyperlipidemia</td>
<td>51 (57)</td>
<td>51 (60)</td>
<td>0.65</td>
</tr>
<tr>
<td>Current smoking</td>
<td>17 (19)</td>
<td>18 (21)</td>
<td>0.71</td>
</tr>
<tr>
<td>Prior MI</td>
<td>33 (37)</td>
<td>21 (25)</td>
<td>0.08</td>
</tr>
<tr>
<td>Peripheral arterial disease</td>
<td>10 (11)</td>
<td>10 (12)</td>
<td>0.89</td>
</tr>
<tr>
<td>Prior depression</td>
<td>60 (67)</td>
<td>64 (75)</td>
<td>0.21</td>
</tr>
<tr>
<td>Taking antidepressant on admission</td>
<td>38 (42)</td>
<td>39 (46)</td>
<td>0.63</td>
</tr>
<tr>
<td>Duration of current depression &gt;1 month</td>
<td>67 (74)</td>
<td>67 (79)</td>
<td>0.50</td>
</tr>
<tr>
<td>Duration of admission, median (25th to 75th percentiles)</td>
<td>5.0 (3.0–10.0)</td>
<td>5.0 (2.0–9.0)</td>
<td>. . .</td>
</tr>
<tr>
<td>Admission diagnosis</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Arrhythmia:</td>
<td>16 (18)</td>
<td>20 (24)</td>
<td></td>
</tr>
<tr>
<td>CHF:</td>
<td>32 (36)</td>
<td>25 (29)</td>
<td>0.71</td>
</tr>
<tr>
<td>MI:</td>
<td>15 (17)</td>
<td>26 (31)</td>
<td></td>
</tr>
<tr>
<td>UA:</td>
<td>27 (30)</td>
<td>24 (35)</td>
<td></td>
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<tr>
<td>Medications at discharge</td>
<td></td>
<td></td>
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<tr>
<td>β-blocker</td>
<td>65 (75)</td>
<td>68 (81)</td>
<td>0.33</td>
</tr>
<tr>
<td>ACE inhibitor</td>
<td>46 (53)</td>
<td>40 (48)</td>
<td>0.49</td>
</tr>
<tr>
<td>Lipid-lowering agent</td>
<td>59 (68)</td>
<td>67 (80)</td>
<td>0.08</td>
</tr>
<tr>
<td>Aspirin</td>
<td>65 (75)</td>
<td>68 (81)</td>
<td>0.33</td>
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<tr>
<td>Clopidogrel</td>
<td>21 (24)</td>
<td>30 (36)</td>
<td>0.10</td>
</tr>
<tr>
<td>Diuretic</td>
<td>49 (56)</td>
<td>38 (45)</td>
<td>0.15</td>
</tr>
<tr>
<td>Antidepressant</td>
<td>73 (83)</td>
<td>47 (56)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Anxiolytic</td>
<td>22 (25)</td>
<td>15 (18)</td>
<td>0.25</td>
</tr>
<tr>
<td>Baseline symptom/functional measures</td>
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<td></td>
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</tr>
<tr>
<td>PHQ-9 score, mean (SD)</td>
<td>17.9 (3.8)</td>
<td>17.3 (3.1)</td>
<td>0.30</td>
</tr>
<tr>
<td>Cardiac symptoms (n, of 10), mean (SD)</td>
<td>6.0 (2.2)</td>
<td>6.1 (2.0)</td>
<td>0.68</td>
</tr>
<tr>
<td>Cardiac symptoms (total score), mean (SD)</td>
<td>12.1 (5.5)</td>
<td>11.7 (4.6)</td>
<td>0.51</td>
</tr>
<tr>
<td>SF-12 MCS, mean (SD)</td>
<td>30.9 (8.0)</td>
<td>32.5 (7.8)</td>
<td>0.19</td>
</tr>
<tr>
<td>SF-12 PCS, mean (SD)</td>
<td>32.2 (10.4)</td>
<td>31.3 (9.4)</td>
<td>0.47</td>
</tr>
<tr>
<td>HADS-A, mean (SD)</td>
<td>10.8 (4.5)</td>
<td>9.7 (4.0)</td>
<td>0.10</td>
</tr>
<tr>
<td>CPFQ total score, mean (SD)</td>
<td>26.1 (5.2)</td>
<td>25.4 (4.4)</td>
<td>0.36</td>
</tr>
<tr>
<td>CPFQ, cognitive items, mean (SD)</td>
<td>16.3 (4.2)</td>
<td>16.7 (3.7)</td>
<td>0.73</td>
</tr>
</tbody>
</table>

ACE indicates angiotensin-converting enzyme; MI, myocardial infarction; CHF, congestive heart failure; and UA, unstable angina. Data are reported as n (%) unless otherwise specified.
improved treatment rates by discharge13,28—suggest the potential promise of a care management program in hospitalized cardiac units and that the collaborative care program vastly increased adherence at 6 months associated with collaborative care is more intense follow-up intervention than most successful collaborative care programs.

These results—taken together with our in-hospital results that found systematic depression screening to be feasible on cardiac units and that the collaborative care program vastly improved treatment rates by discharge13,28—suggest the potential promise of a care management program in hospitalized cardiac patients, and we found that even a limited such program may affect key clinical outcomes. Although we demonstrated significant improvements in mood-related end points, benefit on psychiatric outcomes waned by 6 months. This is not surprising, given that subjects received at most 3 phone contacts from a care manager over the 12-week postdischarge period and no contacts thereafter—a much less intense follow-up intervention than most successful collaborative care programs.

The observed improvement of cardiac symptoms and adherence at 6 months associated with collaborative care is intriguing and suggests that sequential improvement may occur: Depressed patients may need improvement of their mental health condition before they are able to take on improvement of their cardiac health behaviors. Indeed, studies in other medical populations have found that treatment of depression improves subsequent adherence to recommended medical treatment28 and is further supported by a study of depressed patients with acute coronary syndrome, finding that improvement in depressive symptoms in the month after acute coronary syndrome was associated with improvements in aspirin adherence rates in the following 2 months.30 However, this remains only a hypothesis, and further investigation of this connection between depression improvement and adherence is warranted. Finally, the study of this short-term intervention did not find between-group differences in mortality rates.

<table>
<thead>
<tr>
<th>Variable</th>
<th>Usual Care</th>
<th>Collaborative Care</th>
<th>Between-Group Difference</th>
<th>P Value</th>
</tr>
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<tbody>
<tr>
<td><strong>6-Week outcomes</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Depressive symptoms, PHQ-9</td>
<td>−5.95</td>
<td>−8.98</td>
<td>−3.03</td>
<td>0.002</td>
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<td>Mental HRQoL, SF-12 MCS</td>
<td>6.69</td>
<td>14.01</td>
<td>7.32</td>
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<td>Anxiety, HADS-A</td>
<td>−2.63</td>
<td>−4.17</td>
<td>−1.55</td>
<td>0.047</td>
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<td>Cognitive symptoms, CPFQ</td>
<td>−5.92</td>
<td>−8.36</td>
<td>−2.43</td>
<td>0.03</td>
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<tr>
<td>Physical HRQoL, SF-12 PCS</td>
<td>2.41</td>
<td>0.59</td>
<td>−1.82</td>
<td>0.19</td>
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<tr>
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<td>−1.51</td>
<td>−1.79</td>
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<tr>
<td>Cardiac symptoms, total score</td>
<td>−3.66</td>
<td>−5.26</td>
<td>−1.60</td>
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<td><strong>12-Week outcomes</strong></td>
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<tr>
<td>Depressive symptoms, PHQ-9</td>
<td>−5.30</td>
<td>−8.73</td>
<td>−3.43</td>
<td>&lt;0.001</td>
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<td>Mental HRQoL, SF-12 MCS</td>
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<td>13.19</td>
<td>5.92</td>
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<td>−8.92</td>
<td>−3.95</td>
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<tr>
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<td>2.51</td>
<td>1.11</td>
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<td>−0.46</td>
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<tr>
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<td>−3.81</td>
<td>−5.20</td>
<td>−1.39</td>
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<tr>
<td><strong>6-Month outcomes</strong></td>
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<td></td>
<td></td>
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<tr>
<td>Depressive symptoms, PHQ-9</td>
<td>−6.90</td>
<td>−8.67</td>
<td>−1.77</td>
<td>0.081</td>
</tr>
<tr>
<td>Mental HRQoL, SF-12 MCS</td>
<td>8.26</td>
<td>12.18</td>
<td>3.92</td>
<td>0.072</td>
</tr>
<tr>
<td>Anxiety, HADS-A</td>
<td>−2.83</td>
<td>−4.16</td>
<td>−1.33</td>
<td>0.099</td>
</tr>
<tr>
<td>Cognitive symptoms, CPFQ</td>
<td>−6.44</td>
<td>−8.27</td>
<td>−1.83</td>
<td>0.12</td>
</tr>
<tr>
<td>Physical HRQoL, SF-12 PCS</td>
<td>3.88</td>
<td>2.14</td>
<td>−1.75</td>
<td>0.35</td>
</tr>
<tr>
<td>Cardiac symptoms, n</td>
<td>−1.66</td>
<td>−2.46</td>
<td>−0.80</td>
<td>0.047</td>
</tr>
<tr>
<td>Cardiac symptoms, total score</td>
<td>−4.15</td>
<td>−6.29</td>
<td>−2.15</td>
<td>0.011</td>
</tr>
</tbody>
</table>

All values are reported as change in score from baseline value with 95% confidence intervals.

Figure 2. Rates of depression response as measured by PHQ-9 scores.
Our results are consistent with collaborative care studies performed in outpatient settings, including the few involving patients with cardiovascular disease.\textsuperscript{9,10,14} The Pathways study\textsuperscript{14} of depressed patients with diabetes found that collaborative care was associated with improvement of depression and improved patient-rated global improvement over the 2-year trial, though diabetes outcomes were not affected. Similarly, the Bypassing the Blues study\textsuperscript{10} of postcoronary artery bypass graft depression, which recruited patients in the hospital but did not initiate care management until 2 weeks after discharge, found collaborative care to improve depression and mental HRQoL but not physical HRQoL, in the overall sample. Finally, a recent study of enhanced care for depressed patients with prior acute coronary syndrome led to improvement in satisfaction in care and depression at 9 months along with a suggestion of reduced subsequent cardiac events.\textsuperscript{31} Overall, our odds ratios for depression response in the collaborative care arm during the active intervention period (OR, 2.0 to 2.9 at 6 and 12 weeks) were consistent with, or better than, the ORs for depression response seen in the Pathways (OR, 1.4 to 1.9) and Bypassing the Blues (OR, 2.4) studies.\textsuperscript{10,14} That patients were easily identified and effective treatment begun before discharge is a crucial aspect of our study—with a minimal amount of effort, those patients most in need for treatment received effective therapy before discharge, when the likelihood for missed opportunity to apply effective treatment rises.

Our study extends prior work in several ways. First, we treated depressed patients who had multiple cardiac conditions, including those with decompensated heart failure and arrhythmia, common and disabling cardiac conditions for which collaborative care depression models have not been used. Second, we examined a wide range of psychological outcomes, including anxiety and cognitive symptoms (not well-examined in prior collaborative care depression trials), and we found our intervention to provide benefit in these domains as well. Third, our program used phone-based interventions rather than requiring in-person visits, allowing the intervention to be feasible for more patients, especially those with functional limitations. Finally, we used social workers (rather than nurses or nurse practitioners) as care managers to improve real-world applicability of the intervention. Social workers have the requisite skill and experience to diagnose depression and provide psychoeducation, allocation of a social worker is less costly than a trained nurse or physician, and most cardiac units already have full- or part-time social work staff.

As noted, an important aspect of our study was that we chose to identify and treat depression in the hospital for several reasons. Intervening during hospitalization allowed us to address depression at a teachable moment during hospitalization, provide comprehensive face-to-face patient education at the outset of the intervention, promptly initiate treatment (given data that even short-term medical outcomes may be impaired by depression in cardiac patients\textsuperscript{12}), and closely monitor/adjust for medication side effects early in treatment, when patients are most likely to stop medication.

We were aware of the possibility of spontaneously resolving depression in the context of cardiac admission. However, by using more stringent criteria for depression than a simple PHQ-9 cutoff score, we aimed to identify patients with substantial depression rather than transient mood symptoms. Indeed, >70% of subjects had a prior episode of depression and had ongoing symptoms for >1 month before enrollment. Furthermore, in-hospital identification of depression did not appear to be associated with high rates of spontaneous recovery, as rates of depression response at 6 and 12 weeks in the usual care arm (<35%) were similar to those seen in the placebo arm of depression studies of outpatients with cardiac disease.\textsuperscript{20,33}

Limitations of this study were that it was performed in a single academic medical center in a largely white population. Furthermore, unit staff members were aware that a depression study was ongoing, and usual care subjects’ physicians were informed of the subjects’ depression; both of these factors may have increased rates of treatment (and improved outcomes) in the usual care arm. We also did not assess whether the duration and intensity of depression treatment were different between groups. Finally, we tested outcomes at multiple time points, and performing these multiple comparisons may have biased our study toward finding significant outcomes.

In sum, these results may represent a substantial first step in the systematic treatment of depression in hospitalized cardiac patients, a population for whom depression is independently associated with cardiac morbidity and mortality, and effective therapy remains greatly underrealized. Future collaborative care studies in this population should include

<table>
<thead>
<tr>
<th>Variable</th>
<th>Time Point</th>
<th>Usual Care</th>
<th>Collaborative Care</th>
<th>Estimated Effect</th>
<th>P Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depression response</td>
<td>6 Weeks (n=127)</td>
<td>33.7%</td>
<td>59.7%</td>
<td>OR=2.91</td>
<td>0.003</td>
</tr>
<tr>
<td></td>
<td>12 Weeks (n=138)</td>
<td>34.4%</td>
<td>51.5%</td>
<td>OR=2.02</td>
<td>0.042</td>
</tr>
<tr>
<td></td>
<td>6 Months (n=137)</td>
<td>43.9%</td>
<td>48.7%</td>
<td>OR=1.21</td>
<td>0.57</td>
</tr>
<tr>
<td>Adherence (MOS score)</td>
<td>6 Weeks</td>
<td>15.0</td>
<td>16.1</td>
<td>Δ=1.00</td>
<td>0.060</td>
</tr>
<tr>
<td></td>
<td>12 Weeks</td>
<td>15.2</td>
<td>15.6</td>
<td>Δ=0.49</td>
<td>0.44</td>
</tr>
<tr>
<td></td>
<td>6 Months</td>
<td>14.6</td>
<td>16.0</td>
<td>Δ=1.30</td>
<td>0.027</td>
</tr>
<tr>
<td>Self-reported improvement/satisfaction</td>
<td>6 Months</td>
<td>30.4%</td>
<td>54.6%</td>
<td>OR=2.60</td>
<td>0.007</td>
</tr>
<tr>
<td>Cardiac readmissions</td>
<td>6 Months</td>
<td>40.5%</td>
<td>39.5%</td>
<td>OR=0.96</td>
<td>0.90</td>
</tr>
</tbody>
</table>
larger cohorts and longer follow-up, provide greater intensity and duration of care manager interventions and an evidence-  
based psychotherapy option, and may consider specific inter-  
ventions for health behaviors and physical symptoms, to  
allow a greater chance of reducing major cardiac events and  
mortality in this vulnerable population.

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None.

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