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Collaborative care and related interventions in patients with heart disease: an update and new directions

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Abstract

Background—Psychiatric disorders, such as depression, are very common in cardiac patients and are independently linked to adverse cardiac outcomes, including mortality. Collaborative care and other integrated care models have been used successfully to manage psychiatric conditions in patients with heart disease, with beneficial effects on function and other outcomes. Novel programs utilizing remote delivery of mental health interventions and promotion of psychological well-being may play an increasingly large role in supporting cardiovascular health.

Methods—We review prior studies of standard and expanded integrated care programs among patients with cardiac disease, examine contemporary intervention delivery methods (e.g., internet or mobile phone) that could be adapted for these programs, and outline mental-health-related interventions to promote healthy behaviors and overall recovery across all cardiac patients.

Results—Standard integrated care models for mental health disorders are effective at improving mood, anxiety, and function in patients with heart disease. Novel, 'blended' collaborative care models may have even greater promise in improving cardiac outcomes, and interfacing with cardiac patients via mobile applications, text messages, and video visits may provide additional benefit. A variety of newer interventions utilizing stress management, mindfulness, or positive psychology have shown promising effects on mental health, health behaviors, and overall cardiac outcomes.

Conclusions—Further study of novel applications of collaborative care and related interventions is warranted given the potential of these programs to increase the reach and impact of mental health interventions in patients with heart disease.

Keywords

collaborative care; integrated care; mHealth; mindfulness-based stress reduction; positive psychology; heart disease

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Conflicts of Interest

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Collaborative care and related integrated care models to manage mental health disorders have become increasingly well-established in medical settings. However, there are still questions about their effectiveness at improving medical outcomes, their optimal components, and the role that novel interventions and modes of delivery will play in next-step development of these models. These questions may be particularly important for patients who have heart disease, given the high prevalence of heart disease and the clear connections between mental health and cardiac prognosis.

In this narrative overview, we will: (1) discuss prior studies of collaborative care and related programs to manage mental health conditions in patients with cardiovascular illness, (2) describe potential refinements to collaborative care models, including expanded roles of care managers and the use of novel modalities for care delivery within these models, and (3) expand the discussion to innovative approaches that could leverage psychological interventions to improve health behaviors and cardiac outcomes, even in patients without a comorbid psychiatric diagnosis.

Cardiovascular disease and mental health

Depression

Cardiovascular disease is the leading cause of mortality worldwide, responsible for 8 million deaths each year (1). Approximately 15% of patients with stable heart disease have current major depression (2), a rate that is substantially higher than in the general population or primary care medical settings (3, 4). This elevated rate of major depression—15–20%—also applies to patients with more serious cardiac conditions including acute coronary syndrome (ACS; myocardial infarction [MI] or unstable angina), heart failure, those undergoing cardiac surgery, and those with implanted cardioverter defibrillators (2, 5, 6).

Among those with acute heart disease, depression is typically a chronic condition that often precedes an event and persists for a prolonged period. Prior work has found that in at least half of patients experiencing post-MI major depression, such depression preceded the MI by several weeks or months (7). Furthermore, without treatment such symptoms usually do not resolve. One illustrative study found that rates of elevated Beck Depression Inventory (BDI) (8) scores remained stable (20–25%) among MI patients in the hospital and 3, 6, and 12 months later (9). Likewise, in care management research trials, hospitalized cardiac patients with clinical depression getting usual care have had exceedingly low (<15%) rates of spontaneous remission over the subsequent 12–24 weeks (10, 11).

Depression is also associated with the development and progression of heart disease. In individuals without pre-established heart disease, depression is linked to the onset of coronary artery disease (CAD), with those who experience depression earlier in their lives having higher rates of incident CAD and cardiac mortality, independent of traditional risk factors and family history of heart disease (12). Indeed, a pair of meta-analyses found that depressive symptoms are associated with a 60% increased relative risk of developing CAD, compared to those without such symptoms (13, 14). Depression also is linked with CAD progression in those patients with stable heart disease, as depression is independently and

prospectively associated with elevated rates of major cardiac events, independent of sociodemographic factors, initial CAD severity, medical comorbidity, or other factors (15, 16).

Finally, depression is associated with increased mortality in patients with more acute or serious cardiac illness. Following an MI, cardiac surgery, or another major cardiac event, or among those with heart failure (HF), depressed individuals have substantially greater rates of mortality compared to nondepressed persons (17, 18). At this stage, over 50 studies have linked post-ACS depression with adverse medical outcomes, leading the American Heart Association to identify depression as a risk factor for poor cardiac prognosis following an ACS (6), signaling an increased awareness in the cardiology community of the adverse effects of depression.

Anxiety

The links between anxiety and cardiovascular health are less clear, though studies suggest that—in some cases—anxiety is associated with the development and progression of CAD. Among individuals with no history of heart disease, a large meta-analysis found that anxiety led to a 26% increased risk of CAD development (19). Regarding patients with established CAD, a recent meta-analysis revealed significant associations between anxiety and adverse cardiac outcomes, controlling for potential confounding variables, when anxiety was measured during a period of clinical stability but not when measured in the post-ACS period (20). These findings suggest that while post-ACS anxiety may be transient and normative, anxiety in the absence of an acute stressor predicts future cardiovascular problems. In patients with HF, the relationships between anxiety and cardiovascular health are significantly weaker than in CAD (21–24). This suggests that in patients with HF, anxiety may be more of a marker of current medical illness than an independent risk factor for subsequent cardiac events.

While the relationship between anxiety in general and cardiovascular outcomes is mixed, anxiety disorders are more clearly linked to the development and progression of cardiovascular disease. Generalized anxiety disorder has been found in numerous studies to be associated with the development of acute cardiac events in patients with heart disease (25–27), independent of the effects of depression, though at least one study has found a protective effect (28). Likewise, panic disorder has been associated with incident cardiac disease and major adverse cardiac events (29) and overall mortality (30). Finally, post-traumatic stress disorder is linked to increased incidence of CAD and HF (31, 32), though its relationship to cardiac outcomes among individuals with established heart disease is more mixed (33–37).

Challenges managing depression and anxiety disorders

Discovering effective real-world treatment for depression and anxiety disorders in patients with heart disease has been a challenge. Evidence-based psychotherapy interventions, such as cognitive behavioral therapy, have largely had beneficial effects on depressive symptoms among patients with heart disease (38–41), and they can be individualized for each patient based on their specific needs. However, in formal trials among heart disease patients, these

interventions have led to limited or no improvements in objective medical outcomes (such as hospitalizations or mortality) (39, 40). Furthermore, well-trained therapists who can deliver evidence-based treatment are difficult to access in clinical settings, especially in rural areas. While medication treatments are much more accessible, and might have bigger effects on cardiac outcomes (42), trials of antidepressant monotherapy have only been modestly successful for depression in cardiac patients (43–45), and two large randomized controlled trials found sertraline and escitalopram to be no better than placebo at improving depression in patients with HF (46, 47).

In real world clinical care, effective depression treatment requires frequent monitoring and stepwise adjustments, and trials of single treatments have found low rates of depression remission (48). In contrast, stepped care with dose adjustments, addition of new medications or psychotherapy, coordination of care and communication of outcomes, and consideration of patient preferences, appears to be more effective (49). However, in traditional, dyadic, fee-for service models, such care can only be delivered to a small number of patients and often requires comprehensive work by a single practitioner. Furthermore, efforts, outcomes, and prescriptions from a mental health clinician are not always relayed to other medical providers.

Collaborative care in patients with heart disease

Collaborative care and related integrated care models may represent an important departure from prior models in terms of managing larger numbers of patients, providing specialist-level care, and integrating such care into the rest of patients' medical treatment. These models utilize a non-physician care manager to identify depression or other psychiatric conditions, obtain recommendations from a team psychiatrist, and convey these recommendations to the patient and his or her primary medical provider, who prescribes all medication. The care manager then longitudinally follows patients, providing ongoing assessment and therapeutic interventions, monitoring treatment response, and coordinating care between the supervising psychiatrist and primary medical provider. Such an approach allows patients to receive high-quality, longitudinal mental health care with all prescriptions remaining within patients' medical homes (50). Collaborative care programs for depression in general outpatient settings have been studied for many years and found to improve mental health and be cost-effective (51–53).

Collaborative care has also been specifically studied in patients with heart disease (54; see Table 1 for details of each study). Rollman and colleagues completed the first collaborative care study in patients with heart disease, the Bypassing the Blues trial (55). In this trial, 302 patients who had elevated depressive symptoms following coronary artery bypass graft surgery were randomized to receive treatment as usual or an 8-month telephone-delivered collaborative care intervention for depression. Collaborative care was associated with significantly greater improvements in mental health-related quality of life (HRQoL; primary outcome measure), depression, and function, though there were no between-group differences in rehospitalization (56). The intervention was also associated with lower overall estimated median costs over a twelve-month period (57). Of note, higher levels of optimism at study enrollment were associated with lower rates of subsequent rehospitalization,

independent of initial depression severity or other factors potentially associated with readmissions (58).

Davidson and colleagues completed a pair of integrated care interventions in post-ACS patients; this model was highly similar to collaborative care, but study psychiatrists prescribed all medication. First, in the Coronary Psychosocial Evaluation Study (COPES) randomized controlled trial of phone-based integrated care in 157 post-ACS patients with 3 months of persistent depressive symptoms (59), patients were randomized to receive centralized depression care (patient preference for problem-solving therapy [PST] via telephone or in person, pharmacotherapy, both, or neither, stepped every 8 weeks), or usual care. Following the 6-month intervention, the integrated care program was associated with greater depression improvements and lower rates of major adverse cardiac events, compared to treatment as usual.

The Comparison of Depression Interventions after Acute Coronary Syndrome (CODIACS) study was a follow-up study to COPES. In this study, patients with elevated depressive symptoms 2 to 6 months after an ACS were randomized to receive 6 months of centralized depression care (similar to the COPES program plus an option for internet-delivered PST) or locally determined depression care after physician notification (60). Depressive symptoms decreased more in the active treatment group, and overall health care estimated costs were not significantly different but were lower (−$325); data on major adverse cardiac events was not reported.

Collaborative care has also been initiated in cardiac inpatients. The Screening Utilization and Collaborative Care for more Effective and Efficient treatment of Depression (SUCCEED) study (N=175) was a randomized controlled trial of collaborative care in cardiac inpatients with pre-existing clinical depression for at least 2 weeks preceding hospitalization. Patients admitted for ACS, HF, or arrhythmia were assessed in the hospital, and those with clinical depression were randomized to receive collaborative care or enhanced usual care. Participants in the collaborative care group met with a care manager, who evaluated their symptoms and discussed their care with a supervising psychiatrist, with a goal of initiating mental health treatment prior to discharge. Post-discharge, participants in collaborative care received 12 weeks of phone-delivered collaborative care in a standard model, with ongoing support, therapeutic interventions, and stepped care recommendations from the study psychiatrist (61). At the end of the 12-week study period, collaborative care recipients had significantly greater improvements in mental HRQoL (main study outcome), depression, and anxiety. There were no between-group differences in readmissions at 6 months (62). An analysis of predictors of intervention non-response found that baseline level of anxiety—which was not addressed in this model—was a significant predictor of non-response to collaborative care at 6 months (63).

This team then completed the Management Of Sadness and Anxiety In Cardiology (MOSAIC) trial (N=183), which examined a similar collaborative care intervention for patients hospitalized for ACS, HF, or arrhythmia, but expanded inclusion to patients with depression, GAD, or panic disorder and extended the duration of the intervention to 24 weeks (64). At the end of the 24-week study period, the intervention was associated with

significant improvements in mental HRQoL, depression, and function. The collaborative care intervention was associated with significantly fewer cardiac rehospitalizations at 90 days, though not at the primary assessment point at 24 weeks (11), and it was found to be cost-effective, though not cost-saving (65).

The TrueBlue study (N=400) was a two-arm, randomized, cluster trial that used practice nurses as case managers in a collaborative care model to treat depression in primary care patients with elevated depressive symptoms (PHQ-9≥5) and comorbid diabetes or heart disease. Patients were randomized to receive 6 months of collaborative care or treatment as usual. The intervention included an in-person visit every 3 months for 45 minutes of nursing coordination followed by a 15-minute consult with the primary care physician, during which stepped care was offered if clinically indicated. Practice nurses encouraged patients to set goals related to depression self-management, identify barriers to reaching goals, and develop plans to overcome those barriers. At 6 months, depression scores had greater improvements in the intervention condition compared to usual care (66).

Blended collaborative care

Overall, across these seven studies, traditional collaborative care models for mental health conditions were feasible and effective in improving mood symptoms, anxiety, mental HRQoL, and function. In many cases, such models were also cost-effective and/or cost-saving. At the same time, the interventions generally had limited effects on major health outcomes, such as cardiac readmissions. This suggested that modifications to this approach were necessary.

Such a modified approach was prompted by the results of a traditional collaborative care trial. The Pathways study was a randomized trial by Katon and colleagues of standard collaborative care for primary care patients with diabetes and comorbid major depression or dysthymia. As with prior studies, standard collaborative care was linked to greater improvements in mood and overall self-rated health compared to usual care, but there were no between-group differences in objective health outcomes, in this case hemoglobin A1c (67). These findings prompted the study team to modify the collaborative care model to more fully address health behaviors and medical outcomes by developing a “blended collaborative care” model (68).

In this newly developed model, nurse care managers would use a treat-to-target approach for not only depression but also medication adherence and disease parameters (e.g., blood pressure). The care managers would focus on depression symptoms and treatment, use motivational interviewing to prompt health behavior change, and inquire about disease self-monitoring (e.g., self-monitored blood pressure or blood glucose) and medication adherence. This could allow the care manager to take a much more holistic approach to patient care management rather than a siloed approach to mental health symptoms only. In this case the care manager also would have medical specialists (e.g., diabetologist and/or cardiologist) as part of the study teams in addition to the psychiatrist, to provide support, recommendations, and guidance around all aspects of care at weekly case review meetings and on an as-needed basis.

The team then studied this blended care approach ("TEAMCare"), compared to usual care, in a randomized trial of 214 patients with poorly controlled diabetes, coronary heart disease, or both, and co-existing depression (Table 1). At the end of the 12-month intervention period, the intervention was associated with significantly greater improvement in depression. Furthermore, unlike standard collaborative care trials (69), the intervention was associated with greater improvements in hemoglobin A1c, systolic blood pressure, and LDL cholesterol, suggesting that this multi-pronged approach had substantially greater effects on key medical outcomes. Patients in the intervention group were also more likely to have had an adjustment in insulin, antihypertensive medications, and antidepressant medications, and they reported better overall quality of life. Also notable is that the effects on depression were more than twice as great as in the Pathways study (67), suggesting that this holistic approach may have effects on depression that are even greater than models with a singular mental health focus.

The Care of Mental, Physical and Substance-use Syndromes (COMPASS) initiative then looked to implement the blended TEAMCare model in 18 health centers and 172 clinics in 8 states to assess whether this blended care approach could be translated effectively to real-world settings (70, 71). The main pre-defined goals of this implementation in patients with diabetes mellitus or CAD who had poorly controlled glucose or blood pressure, along with co-existing depression, were: (1) depression response in 40% of participants, (2) achievement of glucose control (hemoglobin A1c <8.0) in 20%, and (3) blood pressure control in 20%. These seemingly modest goals, if achieved in these complex patients, could eventually lead to savings of hundreds of thousands of dollars, with substantially reduced risk of many major medical events, and possibly lower rates of mortality, when viewed from a population health lens.

The COMPASS project was successfully implemented, enrolling more than 3,600 patients nationwide. Over an 11.5-month mean follow-up, the project's goals were realized, with 40% of patients having a depression response, 23% reaching glucose control, and 58% achieving blood pressure control (72). Satisfaction with care was high, with over half of participants reporting being "very satisfied" with their care. There was substantial variability in outcomes across sites, with sites that consistently completed systematic case reviews and spent more time on care management tasks having superior outcomes (71). In sum, when well-implemented, it appears that blended care management programs can lead to meaningful improvements in both mental and physical health in complicated patients with comorbid psychiatric and medical illnesses.

Novel intervention modalities in collaborative care

Traditional collaborative care has been delivered in person or by phone, but new methods of communicating and intervening with patients could provide additional means to support patients in these programs. Indeed, as collaborative care has evolved, so has the way that patients receive health information. Currently, 95% of American adults (including 97% of 50–64 year-olds) own a cellular phone (73), and half of smartphone owners have downloaded at least one mobile application ("app") related to health (74), suggesting that people are eager to utilize these devices to manage their health. This data suggests that

collaborative care management programs could make use of Internet-based ‘eHealth’ tools and mobile device-based ‘mHealth’ tools to offer to participants, wherever they are. Such automated programs are often low-cost, very low-burden for patients and providers, and match patients’ desire to use remote tools, including their mobile devices, for health purposes.

The key issue, at this stage, is to determine whether available tools that can be delivered remotely are truly effective. Computerized CBT (cCBT) has been effective in developer-led efficacy trials (75, 76) but in a recent large pragmatic trial of cCBT for depression (77), patients did not engage well with the intervention, and it did not result in superior outcomes. Phone support in a follow-up trial of cCBT somewhat improved engagement and sped recovery compared to cCBT alone, but the magnitude of the effect was still small (78), and overall there is some question about the impact of this approach alone (79). In contrast, Rollman and colleagues found that cCBT alone or with an internet support group led to greater improvements in depression and anxiety than usual care in a large primary care study (80).

mHealth interventions may be even more promising, given their portability and ease of use. Mobile health apps are widely available, though the majority have exceedingly little evidence supporting their use; numerous trials have recently been completed or are ongoing to assess the impact of specific programs on mood and health behaviors (81–83), and evidence-based mobile apps may soon be widely available. Text message interventions (TMIs)—even simpler and more broadly available—are more well-studied and indeed appear to provide benefit in patients with mental illness (84) and lead to health behavior change (85). TMIs have been successfully used in health promotion (86), including several studies in patients with heart disease that have found generally positive effects on health behaviors and cardiac outcomes (85, 87), with effect sizes on health behaviors similar to that seen for standard health behavior interventions (86). Finally, video-based virtual visits with patients are growing in popularity and confer some of the benefits of in-person sessions with a far reduced burden on both patients and providers compared to meeting in a shared location. It seems clear that these modalities will be a key part of next-wave collaborative models in the years to come.

Beyond disorders: Tools for cardiac and mental health in those without psychiatric conditions

Overall, collaborative care models to treat mental health conditions in cardiac patients are effective and can be implemented in clinical care. At the same time, most patients with heart disease do not have an active psychiatric diagnosis yet still can benefit greatly from psychosomatic medicine interventions to gather coping skills, manage stress, enhance well-being, and promote health behavior change. And each of these skills, in turn, could improve recovery and prognosis related to heart disease. In this section, we will outline selected psychological, psychiatric, and behavioral interventions that have been studied to promote health in patients with cardiovascular conditions.

Coping skills and stress management

Blumenthal and colleagues have developed and studied psychological interventions targeting coping and behavior changes in cardiac patients in two recent trials (88, 89). They first studied an intervention called coping skills training—CST—in HF patients. CST combines individually tailored cognitive behavioral techniques to enhance coping, with motivational interviewing to enhance adherence to prescribed medical therapies. In a 16-week randomized trial, the authors found that weekly phone delivery of CST, compared to delivery of HF education, led to greater improvements in health-related quality of life (p=.009), depression (p=.027), and function (6 minute walk test; p=.012) at the end of the trial, though there were no between-group differences in biomarkers and no changes in readmissions/death at 3-year followup (88).

A similar intervention, Stress Management Training (SMT), was used as an adjunctive treatment in cardiac rehabilitation (CR) patients in a recent trial involving 151 patients with coronary heart disease. SMT is based upon a cognitive-behavioral model in which stress is conceptualized as an imbalance between high demands and more limited coping resources. Methods included brief lectures, group discussion, role playing, instruction in specific behavioral skills, and weekly ‘homework’. Participants were randomized to SMT plus CR or CR alone; a no-CR control group was also utilized. Both CR groups achieved similar, statistically significant improvements in heart disease biomarkers. However, participants in the CR+SMT group exhibited lower rates of major clinical cardiac events compared with those in the CR-alone group (18% versus 33%; p=0.03) (89).

Mindfulness-based programs

Mindfulness-based interventions have also shown promise in patients with heart disease. Mindfulness-based programs appear to improve anxiety and depression across healthy and medically ill populations (90), but there have been fewer specific studies in cardiac patients. A single-arm proof of concept study examining the initial effectiveness of a brief acceptance-based behavior therapy for modifying diet and physical activity among cardiac patients found high rates of satisfaction and improvement in health behaviors (91), and mindfulness training has been linked to weight loss and lower blood pressure in patients with hypertension (92). A systematic review among individuals with CAD or other risk factors (e.g., hypertension and diabetes patients) found significant improvements in stress, depression, anxiety, and quality of life following mindfulness interventions; however, similar to studies of cognitive behavioral therapy, effects on physical health outcomes were less consistent (93). Among CAD patients specifically, a systematic review of 11 randomized trials of mind-body practices found significant improvements in depression, anxiety, and quality of life, though these studies were found to be of low quality overall (94).

Mindfulness-based stress reduction (MBSR) is an intensive mindfulness-based intervention combining weekly group meetings, a retreat, and regular homework, with training on specific techniques, including mindfulness meditation, body scanning, and simple yoga postures. MBSR has not been well-studied in cardiac patients, but a pair of small randomized studies in patients with coronary heart disease found that MBSR was linked to improved mental health outcomes and reductions in blood pressure (95, 96). Mindfulness-

based cognitive therapy (MBCT), a related intervention that combines elements of mindfulness and CBT, has also been used in cardiac settings; one trial of MBCT integrated into cardiac rehabilitation found that the program was well accepted (97), but otherwise there has been limited study of this modality in heart disease patients. One potential limitation of MBSR and MBCT is the intensive nature of these programs, both for practitioners to become certified trainers and for patients to complete multiple prolonged sessions and substantial home practice.

Positive psychological interventions

Finally, programs focused more broadly on positive psychological states and traits—including optimism, gratitude, and positive affect (e.g., happiness, enthusiasm, vitality)—may also be relevant for patients with heart disease. Importantly, the experience of positive states is not simply the opposite of depression; for example, prior studies have found only a weak inverse correlation between optimism and depression (98). Indeed, most clinicians have experienced medically ill patients who are depressed yet hopeful about recovery, and, conversely, patients who are not depressed but distinctly lacking in optimism.

Positive psychological constructs—whether optimism, positive affect, or overall psychological-well-being measured multiple different ways—have been prospectively associated with lower rates of cardiac mortality, lower rates of heart disease, and lower rates of overall mortality (99–101). Such connections between positive constructs and health outcomes have been independent of sociodemographic variables and medical comorbidity, and also above and beyond the adverse effects of depression (101). In patients with heart disease, a pair of recent studies found optimism immediately following ACS to be associated with improved health behaviors (e.g., objectively measured physical activity), independent of baseline adherence and multiple relevant covariates (102, 103). Furthermore, a systematic review that looked specifically at studies in patients with heart disease likewise found health benefits—including less mortality—associated with psychological well-being (104).

Though these positive constructs are linked to beneficial cardiac effects, a critical question is whether such constructs are modifiable: is positive psychological well-being intrinsic or can it be cultivated? There is an extensive literature on so-called positive psychology (PP) interventions that utilize deliberate activities to promote gratitude, optimism, efficacy, and positive affect; these have been used in over 6,000 healthy persons and consistently found to improve well-being and reduce depression and anxiety (105). One benefit of these programs is that they involve activities, such as appreciating positive life events, performing kind acts, using personal strengths, and expressing gratitude, that are simple, have minimal burden on patients and providers, and are experienced by many patients as enjoyable.

Activities to induce positive affect and well-being have been studied in cardiac patients. Peterson and colleagues (106) completed a multi-component positive affect induction program in patients with CAD in a randomized trial, finding the intervention to be associated with increased physical activity. Several smaller studies in patients with heart disease have been completed in a variety of populations, including post-CABG patients, post-ACS patients, and cardiac patients hospitalized for HF or ACS; all have found benefits in well-being, depression, and anxiety, and most have been delivered remotely via phone

(107–109), increasing their reach and feasibility. Larger trials will test these interventions more fully, both as stand-alone treatments and combined with behavioral treatments (110).

These interventions could also be delivered through internet or mHealth modalities. A recent meta-analysis found that PP interventions can be effectively delivered via mHealth modalities, with improvements in both well-being and mood symptoms (111), and mHealth interventions that promote well-being—delivered via mobile app or TMIs—could easily be applied as adjuncts to clinical care or to traditional or blended collaborative care programs.

Conclusion

In sum, collaborative care is effective in patients with heart disease, with traditional collaborative models consistently leading to improvements in mental health, HRQoL, and function. Blended care management programs may represent an even more effective new model with the potential to have even greater effects on medical outcomes and a larger public health impact. These models can be challenging to implement, but, as seen in the COMPASS program and numerous implementations of standard collaborative care, it is possible to successfully translate them to clinical practice.

Successfully implementing collaborative care programs requires a systematic and persistent approach (112). Fortunately, guides for implementation have been developed by the University of Washington's Advancing Integrated Mental Health Solutions (AIMS) center (http://aims.uw.edu/collaborative-care/principles-collaborative-care) and http://aims.uw.edu/collaborative-care/implementation-guide). In short, steps for implementation include the following: (1) securing buy-in from senior leaders (typically involving a needs assessment and presentations regarding the cost effectiveness and benefits of collaborative care from a literature review), (2) making decisions about which conditions/patients/clinics to be included, (3) determining the components of treatment (medications, therapy, outside mental health services) offered in the program, (4) developing role descriptions for collaborative care team staff and strategically hiring such staff, (5) setting up procedures from symptom monitoring via a centralized database and regular team meetings, (6) training staff and setting up procedures to ensure quality of care and safety of patients, and (7) developing plans to assess outcomes and to present those outcomes to stakeholders. These implementation steps will invariably vary locally based on staffing, patient needs, senior leader buy-in, and existing familiarity with the collaborative care model, but nearly all settings initiating collaborative care will need to consider these steps in developing such programs.

Novel methods of delivering additional health and mental health content and interventions, via internet, mobile devices, and video sessions, may extend the reach and effectiveness of these programs. Beyond collaborative care, there are a growing number of programs that can be applied to all patients with heart disease—not just those with a mental health diagnosis—to promote well-being, healthy behaviors, and overall health. CST, mindfulness-based interventions, and PP interventions have all shown some promise in heart disease patients, and evolution of these programs will likely involve further refinement of the content of the

programs and the use of novel delivery systems to reduce costs, increase reach, and match patients' use of their mobile devices for health purposes.

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Table 1

Study	Lead Author	Intervention	Control condition	Population	Psychiatric condition	Psychiatric Outcomes	Cardiac Outcomes	N	Findings
Bypassing the Blues (56)	Rollman	Phone-delivered collaborative care for 8 months. Treatment options included workbook, antidepressant, watchful waiting, or referral to mental health provider.	Enhanced usual care (notified participants and PCP of depression diagnosis)	Post-CABG	Depression (PHQ-9 score ≥10 at 2 weeks post-CABG)	Health-related quality of life (HRQoL; SF-36 MCS [primary study outcome measure] and PCS), function (DASI), depression (HRS-D)	Rehospitalization rates at 8 months	302 (150 intervention, 152 usual care)	At 8-month follow-up, intervention led to significant improvements in SF-36 MCS (between-group difference 3.2 points; 95% CI=0.5–6.0; p=.02) but not PCS (1.6 points; 95% CI=−0.5–3.8; p=.14). It also led to significant improvements in DASI (4.6 points; 95% CI=1.9–7.3; p=.001) and HRS-D (3.1 points; 95% CI=1.3–4.9; p=.001). Intervention led to greater rates of depression response (50% reduction in depressive symptoms) (effect size 0.42; 95% CI=0.19–0.65; p<.001) No significant difference was seen between the two groups in rates of rehospitalization (33% intervention vs. 32% usual care).
The Coronary Psychosocial Evaluation Study (COPES) (59)	Davidson	Stepped care consisting of pharmacotherapy and/or problem-solving therapy delivered in-person or by telephone.	Enhanced usual care (notified physicians of elevated depressive symptoms and presence of depressive episode)	Post-ACS	Depression (BDI ≥10 within 1 week of hospitalization for ACS and 3 months later)	Satisfaction with depression care, depressive symptoms (BDI)	Major adverse cardiac events (nonfatal myocardial infarction, unstable angina hospitalization, or mortality), other adverse events	157 (80 intervention, 77 usual care)	Intervention led to higher rates of satisfaction at 9 months (54% [intervention] vs. 19% [usual care]; odds ratio 5.4, 95% CI=2.2–12.9, p<0.001), but not 3 months. Intervention led to significantly greater reductions in BDI score than usual care (5.7 vs. 1.9 points, t=2.85, p=0.005), and patients in the intervention group had fewer MACE than those in usual care 4% vs. 13%, χ^2=3.93, p=.047).
The Comparison of Depression Interventions after Acute Coronary Syndrome Study (CODIAC S) (60)	Davidson	Stepped care consisting of pharmacotherapy and/or problem-solving therapy delivered in-person or by internet/phone for 6 months.	Enhanced usual care (notified physicians of elevated depressive symptoms)	Post-ACS	Depression (BDI ≥10 on two occasions or ≥15 on one occasion, administered 2–6 months post-ACS)	Depressive symptoms (BDI), health-related Quality of life (SF-12), anxiety (PROMIS anxiety short form)	Health care costs	150 (73 intervention, 77 usual care)	Intervention was associated with greater improvement in depressive symptoms (10.1 vs. 6.6-point reduction, p=.01) and greater rates of depression remission (47% vs. 28%, p=.04) at 6 months. There were no significant between-group differences in change in anxiety or health-related quality of life. Mental health costs were significantly higher in the intervention group $687, p<.001). Average hospital costs and total healthcare costs were not significantly different between the two groups.
The Screening Utilization and Collaborative Care for more Effective and Efficient treatment of Depression (SUCCEE D) trial (61)	Huffman	Telephone-delivered collaborative care program consisting of pharmacotherapy or CBT over 12 weeks	Enhanced usual care (notified physicians of elevated depressive symptoms)	Cardiac inpatient s (HF, ACS, arrhythmia)	Depression (PHQ-9 ≥10, with 5 or more symptoms [including depressed mood or anhedonia] present for more than half the days over the previous 2 weeks)	Depressive symptoms (PHQ-9), health-related quality of life (SF-12), anxiety (HADS-A), cognitive symptoms of depression (CPFQ)	Cardiac symptoms, self-reported adherence (MOS), cardiac readmissions	175 (90 intervention, 85 usual care)	At 6 and 12 weeks, the intervention led to significantly greater improvement s in depression (PHQ-9) (6 weeks: between-group difference 3.03 points, 95% CI=1.1o to 4.97, p=.002; 12 weeks: between-group difference 3.43 points, 95% CI=1.45 to 5.41, p<.001), mental health-related quality of life (6 weeks: between-group difference 7.32 points, p<.001; 12 weeks: between-group difference 5.92 points, p=.003), anxiety (6 weeks: between-group difference 1.55 points, p=.047; 12 weeks: between-group difference 1.86 points, p=.02), and cognitive symptoms of depression (6 weeks: between-group difference 2.43 points, p=.03; 12 weeks: between-group difference 3.95 points, p=.002). At 6 months, the intervention led to significantly greater reductions

Study	Lead Author	Intervention	Control condition	Population	Psychiatric condition	Psychiatric Outcomes	Cardiac Outcomes	N	Findings
									in cardiac symptoms than enhanced usual care. However, there were no between-group differences in rates of readmission.
Management Of Sadness and Anxiety In Cardiology (MOSAIC) trial (11)	Huffman	Telephone-delivered collaborative care program consisting of pharmacotherapy or CBT over 24 weeks	Enhanced usual care (notified physicians of elevated depressive or anxiety symptoms)	Cardiac inpatients (HF, ACS, arrhythmia)	Depression (PHQ-9 ≥10, with 5 or more symptoms [including depressed mood or anhedonia] present for more than half the days over the previous 2 weeks), GAD, or PD (PRIME-MD anxiety modules)	Mental health-related quality of life (SF-12 MCS), depressive symptoms (PHQ-9), anxiety (HADS-A)	Self-reported adherence (MOS), physical health-related quality of life (SF-12 PCS), functional status (DASI), overall health-related quality of life (EQ5D), cardiac readmissions	183 (92 intervention, 91 control)	Intervention led to greater improvements in mental health-related quality of life (SF-12 MCS change: 11.21 vs. 5.53, p=.002), depressive symptoms (PHQ-9 change: −8.06 vs. −6.01, p=.045), functional status (DASI change: 12.17 vs. 6.59, p=.005), and overall health-related quality of life (EQ5D change: 0.22 vs. 0.10, p=.03). However, the intervention did not lead to greater improvements in anxiety, self-reported adherence, physical health-related quality of life, or cardiac readmissions.).
TrueBlue (66)	Morgan	In-person, nurse-led collaborative care program consisting of pharmacotherapy or referral for psychotherapy over 12 months	Wait-list control group (treatment as usual)	Diabetes, CAD, or both	Elevated depressive symptoms (PHQ-9 ≥5)	Depressive symptoms (PHQ-9), health-related quality of life (SF-36 MCS and PCS), antidepressant prescriptions, referral/attendance to mental health worker	BMI, waist circumference, SBP, cholesterol, LDL, HDL, triglycerides, HbA1c, 10-year CVD risk, smoking, alcohol use, regular exercise, referral to/ attendance at exercise program	400 (206 intervention, 194 control)	At 6 months, the intervention was associated with significantly greater improvements in depressive symptoms (between-group difference=1. 0 points, p=.012), regular exercise (p<.001), referral to an exercise program (p<.001), referral to a mental health worker (p<.001), and attendance at mental health worker appointments (p=.044) than the control group. At 12 months, the intervention led to significant improvements in depression (PHQ-9: 10.6 vs. 6.6, p<.001), mental and physical health-related quality of life (MCS: 36.0 vs. 41.3, p<.001; PCS: 40.6 vs. 44.3, p<.001), BMI (31.4 vs. 31.1 kg/m^2, p=.006), SBP (135.2 vs. 130.2 mm Hg, p=.016), HDL (1.22 vs. 1.36 mmol/l, p<.001), triglycerides (1.73 vs. 1.63 mmol/l, p=.004), 10-year cardiac risk score (27.4% vs. 24.9%, p=.015), regular exercise (40% vs. 58%, p<.001), referral to an exercise program (18% vs. 37%, p<.001), antidepressant use (15% vs. 23%, p=. 001), referral to a mental health worker (28% vs. 42%, p<.001), and attendance at mental health worker appointments (6% vs. 18%, p<.001), compared to baseline.
TEAMcare (52)	Katon	In-person and phone-delivered ‘blended’ collaborative care program focused on improvement of depression, physical health targets (e.g., blood pressure), and illness self-management over 12 months.	Enhanced usual care (PCPs were notified about depression and poor disease control at baseline and received study laboratory test results [e.g., A1C] at baseline,6, and 12 months)	Diabetes, CAD, or both	Depression (PHQ-9 ≥10)	Depressive symptoms (SCL-20, Patient Global rating of depression Improvement), Quality of life (0–10 Likert)	HbA1c, LDL cholesterol, SBP, medication adjustments	214 (106 intervention, 108 control)	At 12 months, the intervention group had significantly greater overall improvement in HbA1c (between-group difference −0.56; 95% CI= −0.85 to −0.27; p<.05), LDL (between-group difference −9.1; 95% CI= −17.5 to −0.8; p<.05), and SCL-20 scores (between-group difference −0.41; 95% CI= −0.56 to −0.26; p<.001). Intervention participants also had SBP improvements (between-group difference −3.4; 95% CI= −6.9 to 0.1) that approached significance. Patients in the intervention group also had greater improvement in quality of life (intervention group 6.0 +/−2.2, 5.2 +/−1.9, p<0.001) and higher rates of care satisfaction for depression (intervention group 81/90 (90), usual care group 46/84 (55), p<0.001)

Study	Lead Author	Intervention	Control condition	Population	Psychiatric condition	Psychiatric Outcomes	Cardiac Outcomes	N	Findings
									and diabetes/cardiac disease (intervention group 79/92 (86), usual care 62/88 (70) p<0.001). Intervention participants also had higher rates of having one or more adjustments of antidepressants (88% vs. 30%; p<.001), antihypertensives (79% vs. 49%; p<.001), and insulin (53% vs. 33%; p=.006), though no significantly greater rates of oral hypoglycemic or lipid lowering agent adjustments.
Care of Mental, Physical, and Substance use Syndrome s (COMPA SS) initiative (71)	Rossum	In-person and phone-delivered 'blended' collaborative care program focused on improvement of depression, physical health targets (e.g., blood pressure), and illness self-management over 12 months.	None (implementation study)	Diabetes, CAD, or both.	Depression (PHQ-9≥10)	Depression response (50% decrease on PHQ-9), care satisfaction	HbA1c, blood pressure	3,609	Over a mean follow-up of 11 months (range 1–26 months), 40% achieved depression response, with 24% reaching remission (PHQ-9<5). 23% of patients with initial A1C>8 had achieved the pre-defined HbA1c goal (AIC<8.0) at follow-up, and 58% with hypertension at baseline achieved blood pressure control (systolic blood pressure<140 and diastolic blood pressure<90). Patients were significantly more likely to rate their depression care as "excellent" at follow-up compared to baseline (OR=1.87 95% CI=1.42–2.46). Patients also rated their overall care as "excellent" more often after experiencing COMPASS care (44.6% at 1 year vs. 38.6% at baseline), although this did not reach statistical significance (OR=1.20, 95% CI=0.99–1.67).