Original Investigation

Collaborative Care for Adolescents With Depression in Primary Care
A Randomized Clinical Trial

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IMPORTANCE Up to 20% of adolescents experience an episode of major depression by age 18 years yet few receive evidence-based treatments for their depression.

OBJECTIVE To determine whether a collaborative care intervention for adolescents with depression improves depressive outcomes compared with usual care.

DESIGN Randomized trial with blinded outcome assessment conducted between April 2010 and April 2013.

SETTING Nine primary care clinics in the Group Health system in Washington State.

PARTICIPANTS Adolescents (aged 13-17 years) who screened positive for depression (Patient Health Questionnaire 9-item [PHQ-9] score ≥10) on 2 occasions or who screened positive and met criteria for major depression, spoke English, and had telephone access were recruited. Exclusions included alcohol/drug misuse, suicidal plan or recent attempt, bipolar disorder, developmental delay, and seeing a psychiatrist.

INTERVENTIONS Twelve-month collaborative care intervention including an initial in-person engagement session and regular follow-up by master's-level clinicians. Usual care control youth received depression screening results and could access mental health services through Group Health.

MAIN OUTCOMES AND MEASURES The primary outcome was change in depressive symptoms on a modified version of the Child Depression Rating Scale–Revised (CDRS-R; score range, 14-94) from baseline to 12 months. Secondary outcomes included change in Columbia Impairment Scale score (CIS), depression response (≥50% decrease on the CDRS-R), and remission (PHQ-9 score <5).

RESULTS Intervention youth (n = 50), compared with those randomized to receive usual care (n = 51), had greater decreases in CDRS-R scores such that by 12 months intervention youth had a mean score of 27.5 (95% CI, 23.8-31.1) compared with 34.6 (95% CI, 30.6-38.6) in control youth (overall intervention effect: $F_{2,747.3} = 7.24$, $P < .001$). Both intervention and control youth experienced improvement on the CIS with no significant differences between groups. At 12 months, intervention youth were more likely than control youth to achieve depression response (67.6% vs 38.6%, OR = 3.3, 95% CI, 1.4-8.2; $P = .009$) and remission (50.4% vs 20.7%, OR = 3.9, 95% CI, 1.5-10.6; $P = .007$).

CONCLUSIONS AND RELEVANCE Among adolescents with depression seen in primary care, a collaborative care intervention resulted in greater improvement in depressive symptoms at 12 months than usual care. These findings suggest that mental health services for adolescents with depression can be integrated into primary care.

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Depressed youth are at greater risk of suicide, substance abuse, early pregnancy, low educational attainment, recurrent depression, and poor long-term health.[1,2] In the 2001-2004 US National Comorbidity Survey-Adolescent Supplement, 14% of 13- to 18-year-olds in the United States met criteria for a mood disorder.[3] However, it was estimated that only 60% of these youth received any treatment.[4] This failure to accurately diagnose and treat adolescents and an inadequate supply of child mental health specialists have led to increasing focus on improving the quality of depression treatment in pediatric primary care.[5-7]

Collaborative care interventions have been shown to enhance receipt of evidence-based depression treatment and improve outcomes for adults in primary care settings across more than 70 randomized clinical trials.[8] In contrast, only 2 studies have evaluated collaborative care for depression among adolescents. In the first study, youth who received collaborative psychotherapy with antidepressants did not have significantly greater improvement than those receiving antidepressants alone.[9] The second study found that collaborative care with the patient's choice of treatment was associated with a small but significant decrease in depressive symptoms; however, only about one-third of intervention adolescents received evidence-based depression treatments.[10]

The US Preventive Services Task Force now recommends depression screening among adolescents, but screening alone is unlikely to improve depression outcomes.[11] The Reaching Out to Adolescents in Distress (ROAD) Study is a randomized clinical trial of a collaborative care intervention designed to improve the delivery of evidence-based treatments for adolescents who screened positive for depression in primary care (trial protocol in Supplement 1). We hypothesized that patients in the intervention group would have greater reductions in depressive symptoms, improvement in functional outcomes, and exposure to evidence-based treatments compared with patients receiving usual care.

Methods

Adolescent participants (aged 13-17 years) were recruited from 9 pediatric and family medicine clinics in the Group Health system between April 2010 and March 2011. Located in 3 urban areas in Washington State, clinics were selected for their greater patient diversity and higher number of adolescent patients.

Parents of all adolescents receiving primary care through the study clinics received a letter describing the study with an opt-out telephone number. Research staff subsequently called parents who did not opt out to obtain consent. Adolescent assent was obtained prior to conducting a brief telephone-based screening that included questions from the Patient Health Questionnaire 2-item (PHQ-2)[12,13] screen, followed by the full 9-item screen (PHQ-9)[14,15] among those who scored 2 or higher on the PHQ-2.

Adolescents with a screening PHQ-9 score of 10 or more were contacted to assess eligibility and schedule an in-person interview. Participants were deemed eligible if they met criteria for major depression on the Kiddie-Structured Interview for Affective Disorders and Schizophrenia[16] or had a second positive PHQ-9 with a Child Depression Rating Scale-Revised (CDRS-R)[17] score of 42 or greater. Exclusions included non-English speaking, suicidal plan or recent attempt, bipolar, drug/alcohol misuse (CRAFFT[18] score ≥5), seeing a psychiatrist, and developmental delay. Adolescents taking antidepressants or receiving psychotherapy who were still symptomatic were eligible to participate. The Group Health institutional review board approved the study, all parents gave consent and adolescents gave assent, and safety was monitored by a data and safety monitoring board.

Adolescents were block-randomized to intervention vs control using blocks of 4 within each of 4 strata defined by sex and age (<15 years, ≥15 years). Randomization was based on computer algorithms generated off-site and overseen by the study statistician.

ROAD Intervention

The ROAD intervention was an adapted collaborative care intervention based on the IMPACT Team Care model.[19] Adaptations included developmentally sensitive materials and structured involvement of both the adolescent and parent in the initial education and engagement session, the choice of treatment, and follow-up contacts. Intervention components were delivered by depression care managers (DCMs), master's-level clinicians employed by the study. The education and engagement session[20] included eliciting youth perspectives on symptoms, providing depression education, and encouraging active treatment participation of adolescents and parents. During the session, a DCM helped the youth and parent choose treatment with antidepressant medication, brief cognitive behavioral therapy (CBT), or both.

Brief CBT was delivered by the DCM in clinic using an individual collaborative care CBT protocol developed for adolescents by Clarke and colleagues.[21] The protocol included two 4-session modules dedicated to either increasing positive activities or changing thoughts. Antidepressant medications were selected based on medication protocols informed by the Texas Medication Algorithm Project.[22] Depression care managers followed up with adolescents every 1 to 2 weeks (in person or by telephone) to assess treatment adherence and response to treatment using the PHQ-9 and checked in with parents monthly. Visits and depressive symptoms were tracked using Microsoft Excel. Clinical supervision occurred in weekly team meetings with the DCM, study psychiatrist, psychologist, and pediatrician. Follow-up frequency was decreased to monthly for up to 12 months after participants exhibited a clinical response (≥50% reduction in PHQ-9 score from baseline) or achieved remission (PHQ-9 score <5).

For adolescents with a less than 50% decrease in the PHQ-9 by 4 to 8 weeks, treatment was advanced using a stepped-care algorithm. Adolescents receiving medication alone could increase their medication dosage, change medications, or receive augmentation with CBT. Adolescents receiving CBT alone could receive augmentation with or switch to antidepressant treatment. Adolescents who needed specialty mental health care could be referred at any point during the study.

Prior to starting, DCMs received 2 days of training on adolescent depression, antidepressant medication management, suicide, motivational interviewing skills, and basic CBT principles. They also received training and practice in conducting engagement sessions and the CBT protocol. Audiotapes of each DCM's cases were reviewed by the study psychologist until the DCM was deemed proficient.

Enhanced Usual Care

Adolescents randomized to receive usual care control and their parents received a letter summarizing test results and encouraging follow-up to initiate depression care. Their primary care clinicians received letters summarizing the results and recommending treatment. Group Health coverage includes primary care, mental health care, and medications. All patients could self-refer to mental health care through a centralized behavioral health intake line.

Safety Assessments

Study staff performed safety assessments with all intervention and control youth who endorsed suicidal ideation. Assessments included evaluation of persistence and intrusion of thoughts, intent, means, and resources. Study staff recommended treatment, assisted with resources, and communicated with parents and primary care clinicians for all youth who were found to be at risk.

Blinded Outcomes and Covariates

Baseline data were collected by research assistants in the primary care clinic. Outcomes were assessed via telephone at 6 and 12 months by research assistants who were blinded to intervention status.

The primary outcome was change from baseline to 12 months on the modified clinician-rated CDRS-R,[17] excluding 3 of 17 items that require in-person observations (modified range, 14-94). A score of 40 or greater on the full scale (range, 17-113) is indicative of depression and a score of 28 or less is often used to define remission.[23]

Secondary outcomes included treatment response (≥50% reduction in CDRS-R score from baseline), treatment remission (score of <5 on the PHQ-9), and functional status as measured by the Columbia Impairment Scale (CIS). The PHQ-9 is a 9-item depression symptom assessment with scores ranging from 0 to 27; a PHQ-9 score of less than 5 is frequently used as a measure of depression remission.[24] The CIS is a 13-item self-report scale of functional impairment with scores ranging from 0 to 52; a score of 15 or greater is indicative of "clinical impairment."[25]

Quality of care was assessed using administrative data on antidepressant fills (adequacy defined as receipt of at least 90 consecutive days of treatment with no gap >7 days at a minimally effective dose defined based on the Texas Medication Algorithms[22]) and counseling frequency (including both administrative and DCM tracking data) for each 6-month period. Youth were asked to report satisfaction with treatment on a 7-point Likert scale. We also estimated intervention costs using a formula recently developed for costing collaborative care interventions (eAppendix in Supplement 2).[26,27]

To describe the sample, we asked parents to categorize the child's race and ethnicity using prespecified categories, as well as adolescent age and sex and parental education. Race was collected using the following categories: American Indian or Alaskan Native, Asian, black or African American, Native Hawaiian or other Pacific Islander, white, or other (with a free-text field for the parent to provide more details). Hispanic ethnicity was assessed in a separate yes/no question. We also gathered information on depression treatment in the prior 6 months, anxiety symptoms (brief Screen for Child Anxiety and Related Emotional Disorders[28]), externalizing disorder symptoms (17-item Pediatric Symptom Checklist externalizing subscale[29]), family history of depression, and depressive symptoms in the surveyed parent (PHQ-9[14]).

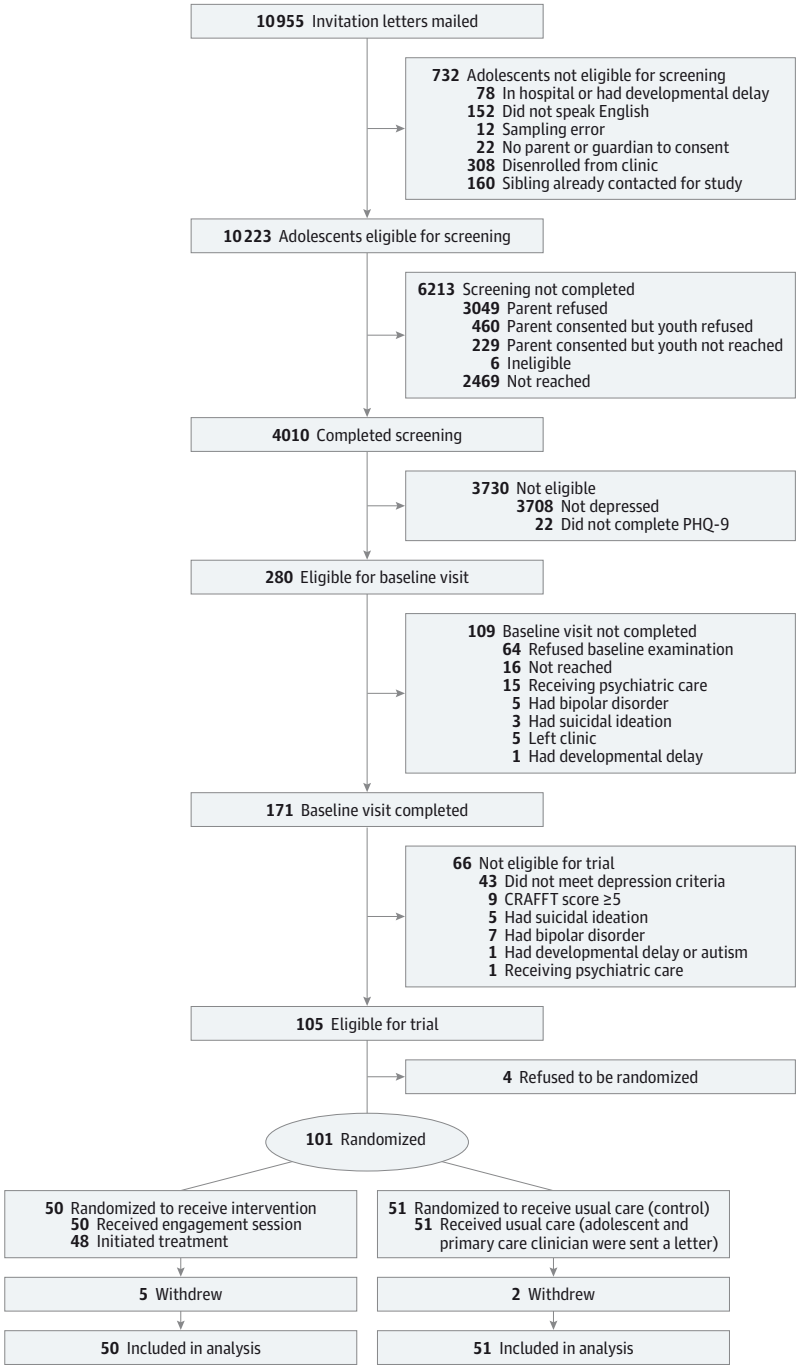
Power and Statistical Analyses

The original target sample size (n = 160) was reduced to n = 100 secondary to reductions in grant funding. Using data from the Treatment of Adolescents with Depression Study[30] as a benchmark, we estimated that a sample of 80 per study group (n = 160) would have 83% power at a 5% significance level to detect a Cohen D effect size for the CDRS-R of 0.145 at 12 months and 89% power to detect a 25% difference in dichotomous outcomes. Using the same assumptions, we estimated that a sample of 50 per study group (n = 100) would have 87% power to detect a 12-month Cohen D effect size of 0.194 and 87.6% power to detect a 30% difference in dichotomous outcomes.

Analyses were conducted using Stata SE (StataCorp) with intent-to-treat principles. All analyses were 2-sided with a significance level of $P \leq .05$ for the primary outcome and $P \leq .01$ for secondary outcomes. Descriptive statistics were generated for all variables. For dichotomous variables that represented change from baseline (eg, 50% decrease in CDRS-R scores, interval treatment), logistic regression models were used to examine the effect of intervention status on outcomes at both 6 and 12 months. For continuous variables with measurement at baseline and 6 and 12 months, generalized estimating equation models (GEEs) with robust standard errors were used to examine the intervention's effect across time accounting for within-subject correlation. Generalized estimating equation models included the main effects of group and time and a group × time interaction. As baseline characteristics were balanced between the randomized groups, no additional covariates were included in study regression models.

Administrative treatment data were complete for all youth and did not require imputation. Survey follow-up data on depressive symptoms, functional impairment, and satisfaction were missing for 18 patients at 6 months (8 intervention, 10 control) and 20 patients at 12 months (12 intervention, 8 control) with 13 patients missing at both times. Missingness was evaluated and assumed to be missing at random. The Stata MI module for multiple imputation with chained equations was used to impute missing CDRS-R, CIS, PHQ-9, and satisfaction variables. Imputation models included baseline CDRS-R, CIS, PHQ-9, child age, sex, race, and parent education. We generated 20 imputed data sets, which were used for all GEE and logistic regression analyses and to complete tables related to these data.

Figure 1. Reaching Out to Adolescents in Distress (ROAD) Study Enrollment Flowchart



CRAFFT is a behavioral health screening tool developed to screen adolescents for alcohol and other drug use disorders; its acronym is constructed from key words in the 6 screening questions (car, relax, alone, forget, friends, trouble). PHQ-9 indicates Patient Health Questionnaire 9-item scale.

Results

Of 10 223 eligible youth who were invited to participate, screening surveys were obtained from 4010 youth (**Figure 1**). Seven percent of screened youth (n = 280) had a PHQ-9 of 10 or greater and were invited to participate in a baseline interview. One hundred seventy-one youth completed the baseline interview, 105 were found to be eligible for study participation, and 101 were randomized.

There were no major baseline differences between groups (**Table 1**). The mean (SD) age of participants was 15.3 (1.3) years, 72% were female, and 31% were nonwhite. The mean (SD) baseline PHQ-9 score was 14.96 (4.12), and 60% of youth met criteria for major depression.

All intervention youth had at least 1 in-person visit with a DCM. Intervention youth had a mean (SD) of 14 (8.2) in-person visits and 7 (5.1) telephone visits. Nineteen youth (38%) received psychotherapy alone, 2 (4%) received antidepressants alone, 27 (54%) received both, and 2 (4%) withdrew prior

Table 1. Baseline Patient Characteristics[a]

	Intervention (n = 50)	Control (n = 51)	Full Sample (N = 101)
Age, mean (SD), y	15.1 (1.3)	15.5 (1.3)	15.3 (1.3)
Female sex, No. (%)	36 (72)	37 (72)	73 (72)
Race, No. (%)			
White	36 (72)	34 (67)	70 (69)
Black	4 (8)	1 (2)	5 (5)
Asian/Pacific Islander	1 (2)	1 (2)	2 (2)
Other/multiracial	9 (18)	15 (30)	24 (24)
Parental education ≥1 y of college, No. (%)	41 (82)	44 (86)	85 (84)
CDRS-R score, mean (SD)[b]	48.25 (10.00)	46.00 (10.46)	47.1 (10.25)
Depression in the surveyed parent (parent score on PHQ-9 ≥10), No. (%)[c]	5 (10)	6 (12)	11 (11)
Family history of depression, No. (%)	37 (74)	39 (76)	76 (75)
Baseline PHQ-9 score for the adolescent, mean (SD)[c]	15.65 (3.79)	14.28 (4.34)	14.96 (4.12)
Baseline CIS score, mean (SD)[d]	22.76 (6.63)	21.31 (7.01)	21.94 (6.80)
Major depression K-SADS scale, No. (%)	31 (62)	30 (58)	61 (60)
Brief SCARED score ≥3, No. (%)	33 (66)	40 (78)	73 (72)
PSC externalizing score ≥7, No. (%)	12 (24)	10 (19)	22 (22)
Treatment for depression/anxiety in prior 6 mo, No. (%)	21 (42)	18 (36)	39 (39)
Antidepressants in 6 mo prior to baseline, No. (%)	14 (28)	11 (22)	25 (25)
Counseling for depression/anxiety in prior 6 mo, No. (%)	20 (40)	18 (35)	38 (38)
Undergoing active treatment at start of study, No. (%)	9 (18)	8 (16)	17 (17)

Abbreviations: CDRS-R: Child Depression Rating Scale–Revised; CIS, Columbia Impairment Scale; K-SADS, Kiddie Schedule for Affective Disorders and Schizophrenia; PHQ-9, Patient Health Questionnaire 9-item scale; PSC, Pediatric Symptom Checklist; SCARED, Screen for Child Anxiety and Related Emotional Disorders.

[a] No major differences were noted between intervention and control youth.

[b] CDRS-R modified range, 14-94; higher scores indicate greater severity.

[c] Range, 0-27; higher scores indicate greater severity.

[d] Range, 0-52; higher scores indicate greater impairment.

to selecting a treatment. The estimated cost of intervention delivery was $1403 per patient (eAppendix in Supplement 2).

Primary Outcome

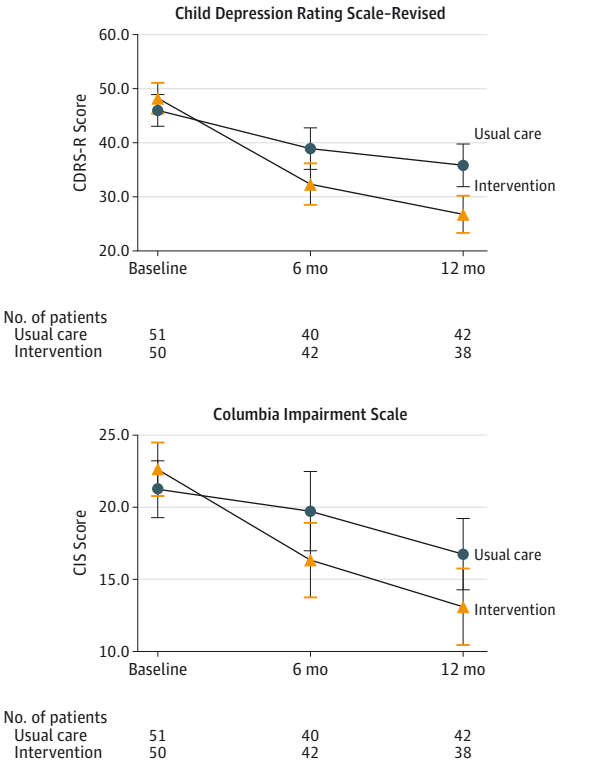
The mean CDRS-R score decreased from 48.3 (95% CI, 45.5 to 51.0) to 27.5 (95% CI 23.8 to 31.1) among patients in the intervention group compared with a decrease from 46.0 (95% CI, 43.1 to 48.9) to 34.6 (95% CI, 30.6 to 38.6) among the control group (**Figure 2**). In regression models using CDRS-R data at all time points (**Table 2**), intervention youth had an 8.5-point greater decrease in mean CDRS-R from baseline than control youth (95% CI, −13.4 to −3.6; P = .001) at 6 months and a 9.4-point greater decrease from baseline at 12 months (95% CI, −15.0 to −3.8; P = .001). The overall group × time interaction term was consistent with more improvement in CDRS-R over time among intervention than control youth (Wald χ^2_2 = 7.24, P < .001).

Secondary Outcomes

For functional status at 12 months, mean CIS score decreased from 21.3 (95% CI, 19.3 to 23.2) to 16.3 (95% CI, 13.8 to 18.8) among intervention youth and from 22.6 (95% CI, 20.8 to 24.5) to 13.4 (95% CI, 10.8 to 15.9) for control youth (Figure 2). Based on the GEE model (Table 2), CIS differences between intervention and control youth were not significant at $P \le .01$ at 6 months (mean difference, −4.4; 95% CI, −8.4 to −0.5; P = .03) or 12 months (mean difference, −4.3; 95% CI, −8.3 to −0.3; P = .04).

The percentage of youth with a clinically important depression response (≥50 reduction in CDRS-R from baseline) at 12 months was 67.6% (95% CI, 52.2%-83.0%) among intervention youth and 38.6% (95% CI, 23.7%-53.5%) among control youth (**Table 3**). In regression analyses, intervention youth were

Figure 2. Mean CDRS-R and CIS Scores Over Time in Intervention vs Control Youth



Mean Child Depression Rating Scale–Revised (CDRS-R) and Columbia Impairment Scale (CIS) scores for intervention vs usual care control based on youth survey response data. Error bars indicate 95% confidence intervals.

Table 2. Intervention vs Control Differences in Depressive Symptoms and Functional Impairment on 20 Multiple Imputation Samples (N=101)

	CDRS-R Score		CIS Score	
	β (95% CI)	*P* Value	β (95% CI)	*P* Value
Group				
Usual care	1 [Reference]		1 [Reference]	
Intervention	2.2 (−1.7 to 6.2)	.27	1.4 (−1.3 to 4.0)	.30
Time				
Baseline	1 [Reference]		1 [Reference]	
6 mo	−7.1 (−10.4 to −3.9)	<.001	−1.7 (−4.6 to 1.2)	.24
12 mo	−11.4 (−15.2 to −7.5)	<.001	−5.0 (−7.8 to −2.1)	.001
Group × month				
Intervention × 6 mo	−8.5 (−13.4 to −3.6)	.001	−4.4 (−8.4 to −0.5)	.03
Intervention × 12 mo	−9.4 (−15.0 to −3.8)	.001	−4.3 (−8.3 to −0.3)	.04

Abbreviations: CDRS-R, Child Depression Rating Scale–Revised; CIS, Columbia Impairment Scale.

Table 3. Intervention vs Control Differences in Categorical Secondary Outcomes Based on 20 Multiple Imputation Samples (N=101)

	Raw Data, No./Total No. (%)		Imputed Data, % (95% CI)		Estimated Intervention Effect Based on Logistic Regression Models	
Variable	Intervention (n = 50)	Control (n = 51)	Intervention (n = 50)	Control (n = 51)	OR (95% CI)	*P* Value
Response (≥50% Decrease in CDRS-R)[a]						
6 mo	21/42 (50)	6/40 (15)	48.4 (33.5-63.3)	23.4 (10.2-36.7)	3.1 (1.2-7.9)	.02
12 mo	27/38 (71)	12/42 (29)	67.6 (52.2-83.0)	38.6 (23.7-53.5)	3.3 (1.4-8.2)	.009
Remission of Depressive Symptoms (PHQ-9 <5)[b]						
6 mo	16/42 (38)	3/40 (8)	36.6 (21.9-51.3)	10.2 (0.5-19.9)	5.2 (1.6-17.3)	.007
12 mo	21/38 (55)	7/42 (17)	50.4 (34.7-66.1)	20.7 (8.2-33.2)	3.9 (1.5-10.6)	.007
Satisfaction With Care (Moderately to Very Satisfied)						
6 mo	36/42 (86)	20/38 (53)	85.8 (75.3-96.3)	52.2 (36.0-68.3)	5.6 (1.9-16.0)	.001
12 mo	32/38 (84)	27/41 (66)	82.2 (70.0-94.4)	68.5 (54.7-82.4)	2.1 (0.7-6.1)	.16

Abbreviations: CDRS-R, Child Depression Rating Scale–Revised; OR, odds ratio; PHQ, Patient Health Questionnaire 9-item scale.

[a] CDRS-R modified range, 14-94; higher scores indicate greater severity.

[b] PHQ-9 range, 0-27; higher scores indicate greater severity.

significantly more likely to achieve depression response by 12 months (OR = 3.3, 95% CI, 1.4-8.2; *P* = .009) but not by 6 months (OR = 3.1, 95% CI, 1.2-7.9; *P* = .02).

The overall rate of depression remission at 12 months was 50.4% (95% CI, 34.7%-66.1%) for intervention youth compared with 20.7% (95% CI, 8.2%-33.2%) for control youth. In regression analyses, intervention youth were significantly more likely to achieve depression remission at both 6 months (OR = 5.2, 95% CI, 1.6-17.3; *P* = .007) and 12 months (OR = 3.9, 95% CI, 1.5-10.6; *P* = .007).

When patients were asked to report their satisfaction with the treatment, those in the intervention group were significantly more likely to be "moderately to very satisfied" with care at 6 months (85.8% vs 52.2%; OR = 5.6, 95% CI, 1.9-16.0; *P* = .001) but not at 12 months (82.2% vs 68.5%; OR = 2.1, 95% CI, 0.7-6.1; *P* = .16) (Table 3).

Overall, 86% of patients in the intervention group received either psychotherapy or medications that met study quality standards, compared with 27% of the control group. Intervention youth were significantly more likely than control youth to receive 4 or more psychotherapy sessions in the first 6 months of the study (84.0% vs 15.7%; OR = 28.2; 95% CI, 9.7-82.1; *P* < .001), but differences were nonsignificant during months 6 through 12 (20.0% vs 15.7%; OR = 1.3, 95% CI, 0.5-3.7; *P* = .57). Although intervention youth were significantly more likely than control youth to have received antidepressants in the first 6 months of the study (44.0% vs 17.7%; OR = 3.7, 95% CI, 1.5-9.1; *P* = .005), there were no significant differences between intervention and control youth in receipt of 90 days or more of antidepressants at either 6 or 12 months. There were also no significant differences between the groups in use of specialty mental health care through Group Health (**Table 4**).

On follow-up surveys, youth-reported use of non-Group Health psychotherapy was 8% for both intervention and control youth from baseline to month 6 and 11% for intervention and 10% for control youth during months 6 through 12.

Adverse Events

Based on administrative data over the 12-month trial, psychiatric hospitalization occurred for 3 patients in the intervention (6%) and 2 in the control group (4%). Emergency department visits with a primary psychiatric diagnosis occurred for 1 intervention patient (2%) and 5 control patients (10%).

Table 4. Intervention vs Control Differences in Quality of Treatment Delivered (N=101)

Variable	Patients, No. (%)		Estimated Intervention Effect Based on Logistic Regression Models	
	Intervention (n = 50)	Control (n = 51)	OR (95% CI)	*P* Value
≥4 Psychotherapy Visits[a]				
First 6 mo	42 (84.0)	8 (15.7)	28.2 (9.7-82.1)	<.001
6-12 mo	10 (20.0)	8 (15.7)	1.3 (0.5-3.7)	.57
Any Antidepressant Medication (Administrative Data)				
First 6 mo	22 (44.0)	9 (17.7)	3.7 (1.5-9.1)	.005
6-12 mo	24 (48.0)	14 (27.5)	2.4 (1.1-5.6)	.04
≥90 Days of Antidepressants at a Minimally Effective Dose[b]				
First 6 mo	11 (22.0)	3 (5.9)	4.5 (1.2-17.3)	.03
6-12 mo	12 (24.0)	6 (11.8)	2.4 (0.8-6.9)	.12
Any Specialty Mental Health Visits (Administrative Data)				
First 6 mo	14 (28.0)	14 (27.5)	1.0 (0.4-2.5)	.95
6-12 mo	13 (26.0)	13 (25.5)	1.0 (0.4-2.5)	.95

Abbreviation: OR, odds ratio.

[a] Includes psychotherapy visits with the depression care manager (intervention only) as well as administrative data identified specialty mental health visits with a *Current Procedural Terminology* code for therapy.

[b] Minimally effective dosing based on the Texas Medication Algorithm.[36]

Discussion

Although depression is a highly treatable condition, few youth receive evidence-based psychotherapy or medications.[4] This has ramifications for adolescents in terms of both acute morbidity and long-term outcomes.[1,2,31-35] Youth who received the ROAD collaborative care intervention demonstrated significantly improved receipt of and adherence to evidence-based treatments for depression. They also showed improvement in depressive symptoms and satisfaction with care compared with control patients. These results suggest that collaborative care interventions for youth with depression are both feasible and effective in improving outcomes.

Our study demonstrated higher rates of evidence-based depression treatment and greater improvements in outcomes than the only prior evaluation of collaborative care that included adolescent choice of treatment, the Youth Partners in Care Study (YPIC).[10] In our study, 86% of intervention youth met quality standards for either medications or psychotherapy, compared with 32% in the YPIC trial. Several features of our study may account for these differences in adherence. First, our study focused on youth with major depression or higher levels of depressive symptom impairment, while the YPIC study included youth with subsyndromal depression. Second, our DCM training emphasized active outreach efforts and frequent contacts during the acute treatment phase, which helped to engage youth. Third, our intervention included innovations to involve parents as active supports. Fourth, youth in our study were recruited from a single health plan, allowing for more uniformity of resources compared with the YPIC study. Fifth, the duration of our intervention was 12 months compared with YPIC's 6 months.

In our study, patients in the control group had good access to mental health services, including having "carved-in" mental health benefits through a centralized self-referral line and relatively easy access to mental health professionals. In addition, all control youth, parents, and primary care clinicians were provided with baseline assessment results and encouraged to initiate care. Even so, few control adolescents received evidence-based psychotherapy or antidepressant medication. These findings suggest that screening alone is unlikely to result in increased mental health treatment, even when benefits are available to cover the costs of mental health care. To increase receipt of evidence-based treatments, resources are needed to identify and engage youth.

This study's strengths include the randomized design, high adherence, implementation in multiple clinics, and developmental adaptations to engage youth and parents in care. Limitations include the smaller than originally intended sample size, which may have resulted in decreased statistical power. In addition, the sample selection of English speakers who were mostly white and female from a single integrated care system in the Pacific Northwest may limit generalizability. Furthermore, the individual-based rather than clinic-based randomization scheme may have increased the likelihood for "spillover" such that primary care clinicians might apply skills obtained from working with intervention youth to control youth. To the extent that this occurred, it would have weakened statistical power to detect differences between groups.

Conclusions

Among adolescents with depression seen in primary care, a collaborative care intervention resulted in significantly greater improvement in depressive symptoms at 12 months than usual care. These findings suggest that mental health services for adolescents with depression can be integrated into primary care.

ARTICLE INFORMATION

Author Contributions: Dr Richardson had full access to all of the data in the study and takes responsibility for the integrity of the data and the accuracy of the data analysis.
Study concept and design: Richardson, Ludman, McCauley, Lindenbaum, Zhou, Clarke, Brent, Katon.
Acquisition, analysis, or interpretation of data: Richardson, Ludman, Lindenbaum, Larison, Zhou, Katon.
Drafting of the manuscript: Richardson.

Critical revision of the manuscript for important intellectual content: Richardson, Ludman, McCauley, Lindenbaum, Zhou, Clarke, Brent, Katon.
Statistical analysis: Richardson, Larison, Zhou.
Obtained funding: Richardson, Ludman, McCauley, Katon.
Administrative, technical, or material support: Richardson, Ludman, McCauley, Lindenbaum, Clarke, Katon.
Study supervision: Richardson, Ludman, McCauley, Lindenbaum, Katon.

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Disclaimer: The authors of this report are responsible for its content.

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