Cost-Effectiveness of On-Site Versus Off-Site Collaborative Care for Depression in Rural FQHCs

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Objective: Collaborative care for depression in primary care settings is effective and cost-effective. However, there is minimal evidence to support the choice of on-site versus off-site models. This study examined the cost-effectiveness of on-site practice-based collaborative care (PBCC) versus off-site telemedicine-based collaborative care (TBCC) for depression in federally qualified health centers (FQHCs).

Methods: In a multisite, randomized, pragmatic comparative cost-effectiveness trial, 19,285 patients were screened for depression, 2,863 (14.8%) screened positive, and 364 were enrolled. Telephone interview data were collected at baseline and at six, 12, and 18 months. Base case analysis used Arkansas FQHC health care costs, and secondary analysis used national cost estimates. Effectiveness measures were depression-free days and quality-adjusted life years (QALYs) derived from depression-free days, the 12-Item Short-Form Survey, and the Quality of Well-Being (QWB) Scale. Nonparametric bootstrap with replacement methods were used to generate an empirical joint distribution of incremental costs and QALYs and acceptability curves.

Results: The TBCC intervention resulted in more depression-free days and QALYs but at a greater cost than the PBCC intervention. The disease-specific (depression-free day) and generic (QALY) incremental cost-effectiveness ratios (ICERs) were below their respective ICER thresholds for implementation, suggesting that the TBCC intervention was more cost effective than the PBCC intervention.

Conclusions: These results support the cost-effectiveness of TBCC in medically underserved primary care settings. Information about whether to insource (make) or outsource (buy) depression care management is important, given the current interest in patient-centered medical homes, value-based purchasing, and bundled payments for depression care.

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According to the 2010 U.S. Census, 19.3% of the U.S. population resides in rural areas, which places them at risk of poor detection and treatment of mental disorders (1). Rural areas differ from urban areas in some significant ways that may explain this disparity, for example, longer travel distances, lack of colocation of mental health specialists in primary care settings, weak linkages to off-site mental health specialists, limited mental health insurance coverage, and higher levels of stigma (2).

Collaborative care for depression has been shown to be highly effective (3–6) and cost-effective (7–10) in urban settings, but it is difficult to implement in federally designated mental health professional shortage areas (85% of rural counties) (11). Collaborative care for depression can be adapted successfully for rural primary care settings by using telemedicine technologies (12), but it is critical to also assess the cost-effectiveness of this approach.

Federally qualified health centers (FQHCs) are located in medically underserved areas and are a critical component of the health care safety net. In 2012, FQHCs served approximately 21 million patients, and this number could double by 2015 with the passage of the Patient Protection and Affordable Care Act (13). Three-quarters of FQHC patients live in poverty, half live in rural areas, one-third is uninsured, and two-thirds are members of racial-ethnic minority groups. Mental health problems are the most commonly reported reasons for visits to FQHCs (14), yet only 6.9% of encounters at FQHCs are with on-site mental health specialists (15).

Two recent developments have focused FQHCs' attention and resources on depression recognition and management. First, new federal standards require FQHCs to qualify as patient-centered medical homes (PCMHs) according to the National Committee for Quality Assurance. PCMH recognition requires team-based care that emphasizes care coordination. Second, the Centers for Medicare and Medicaid Services are expected to add depression to the list of clinical condition episodes included in the Bundled Payments for Care Improvement Initiative. The initiative will make clinics eligible to receive bundled payments for depression care.

A common decision facing clinics striving for PCMH recognition and preparing for bundled payments is whether to outsource care management services. To inform this decision, we conducted a cost-effectiveness analysis of two alternative approaches to providing depression care management in FQHCs. The on-site approach, practice-based collaborative care (PBCC), focused on improving depression outcomes by using local providers. The off-site approach, telemedicine-based collaborative care (TBCC), focused on utilizing off-site specialists to support local primary care (PC) providers.

METHODS

Design Overview

This multisite, pragmatic randomized trial employed a comparative-effectiveness design (16). Patients were randomly assigned to either TBCC or PBCC, both of which represented potentially feasible approaches to adapting the evidence-based collaborative depression care model for routine delivery in medically underserved areas. The intervention and evaluation methods are described in detail elsewhere (12) and are summarized here. The base case or main analysis used Arkansas FQHC health care costs, and the secondary analysis used national cost estimates.

Setting and Participants

Six FQHCs were approached and five (83%) agreed to participate. Participating FQHCs employed between 1.3 and 9.7 full-time-equivalent PC physicians, served between 5,362 and 13,050 unique PC patients, and operated one to six clinics across multiple locations. None of the participating clinic locations had an on-site mental health specialist. From 2007 to 2009, a total of 19,285 patients were screened for depression, 2,863 (15%) patients screened positive (Patient Health Questionnaire–9 [PHQ-9] score ≥10), and 364 patients were enrolled. We excluded patients with schizophrenia, bipolar disorder, or acute suicide ideation. Patients (stratified by clinic) were randomly assigned to PBCC or TBCC. Blinded follow-up telephone interviews were completed for 318 (87%) of the 364 patients at six months, 287 (79%) at 12 months, and 283 (78%) at 18 months. This study was approved by the University of Arkansas for Medical Sciences (UAMS) Institutional Review Board. After complete description of the study to the patients, written informed consent was obtained.

Interventions

PBCC involved two types of providers: on-site PC providers and on-site nurse depression care managers (DCMs). Each clinic location employed a half-time DCM funded by the study. All DCMs received one day of training in depression care management, a care manager training manual, and access to a Web-based decision support system (www.netdss.net) (17). Encounters with a DCM were conducted either face to face or by telephone, depending on patient preference. The initial encounter with the DCM included PHQ-9 symptom monitoring, education and self-management behavioral activation, barrier assessment and resolution, and establishment of self-management goals, such as planning physical, rewarding, and social activities. Follow-up encounters included the monitoring of symptoms with the PHQ-9, medication adherence, side effects, and engagement in planned self-management activities. PBCC DCMs received no supervision from a mental health specialist. Patients could be referred to specialists at off-site locations, for example, community mental health centers. Progress notes were entered into the patients' paper medical record. Patients received the intervention for up to 12 months.

TBCC involved five types of providers: on-site PC providers and off-site DCM (a registered nurse), clinical pharmacist (Pharm.D.), psychologist (Ph.D.), and psychiatrist (M.D.). The off-site team was funded by the study and was located at UAMS. All encounters between DCMs and patients were conducted by telephone and followed the protocol described above. The DCM met weekly with the psychiatrist to discuss new patients and patients who were not responding to treatment and prepared progress notes containing stepped-care treatment recommendations. These notes were faxed to the FQHC for implementation by the PC providers. If the patient did not respond to the initial antidepressant, the off-site pharmacist conducted a medication history and provided medication management recommendations as needed. If the patient did not respond to two trials, a psychiatry consultation via interactive video was scheduled. At any time, patients had access to cognitive-behavioral therapy delivered via interactive video.

Depression Outcomes

It has been previously reported that the TBCC group experienced a significantly greater treatment response, significantly higher odds of remission, and significantly greater reductions in severity of depression over time compared with the PBCC group on the basis of the Symptom Checklist–20 (SCL-20) (12).

Cost-Effectiveness Outcomes

Primary effectiveness outcomes for the analysis of cost-effectiveness were depression-free days and quality-adjusted life years (QALYs).

Depression-free days were calculated by using a formula originally developed by Lave and colleagues (18) and adapted for use with the SCL-20 (19). An SCL-20 score of .5 or less was considered depression free, a score of 1.7 or higher was considered fully symptomatic, and scores in between were assigned a linear proportional value. Sensitivity analyses using variations of these scores to define depression free (for example, .25 and .75) and fully symptomatic depression (for example, 1.5 and 2.0) resulted in minimal differences in number of depression-free days, so depression-free day scores using .5 and 1.7 thresholds are reported below.

QALYs were calculated in three ways. One method used a formula to convert incremental changes in depression-free

TABLE 1. Baseline characteristics of recipients of telemedicine-based collaborative care (TBCC) or practice-based collaborative care (PBCC) for depression[a]

Characteristic	Total (N=332) N	Total %	TBCC (N=163) N	TBCC %	PBCC (N=169) N	PBCC %	p
Age (M±SD)	47.9±12.4		48.3±12.2		47.6±12.6		.60
Male	62	19	30	18	32	19	.90
Race-ethnicity							.88
Caucasian	237	71	118	72	119	70	
African American	69	21	33	20	36	21	
Native American	17	5	7	4	10	6	
Other	9	3	5	3	4	2	
Income							.67
<$10,000	95	30	52	33	43	27	
$10,000–$14,999	76	24	38	24	38	24	
$15,000–$19,999	51	16	28	18	23	14	
$20,000–$29,999	56	18	24	15	32	20	
$30,000–$39,999	23	7	9	6	14	9	
$40,000–$49,999	12	4	6	4	6	4	
≥$50,000	8	3	3	2	5	3	
Married	151	46	74	45	77	46	.98
High school graduate	245	74	117	72	128	76	.47
Employed	122	37	52	32	70	42	.07
Insurance							.29
Public	100	30	57	35	43	25	
Private	50	15	24	15	26	15	
Public and private	12	4	5	3	7	4	
Uninsured	170	51	77	47	93	55	
Rural residence	229	70	110	68	119	70	.56
Social support (M±SD score)[b]	.4±.2		.4±.2		.4±.2		.77
Perceived barriers (M±SD score)[c]	3.7±2.0		4.0±2.1		3.4±2.0		.01
Perceived need (M±SD score)[d]	3.0±1.5		3.1±1.4		2.9±1.5		.15
Perceived treatment effectiveness (M±SD score)[e]	1.3±.7		1.4±.7		1.3±.7		.42
SCL-20 (M±SD score)[f]	1.9±.8		1.9±.8		1.9±.7		.79
SF-12 PCS (M±SD score)[g]	36.7±13.4		35.8±13.2		37.7±13.5		.20
SF-12 MCS (M±SD score)[h]	31.3±11.3		32.4±11.4		30.2±11.2		.08
QWB (M±SD score)[i]	.4±.1		.4±.1		.4±.1		.43
N of chronic general medical illnesses	4.6±2.6		4.8±2.5		4.4±2.7		.21
Family history of depression	191	58	102	64	89	53	.06
Age <18 at depression onset	129	40	61	39	68	42	.70
Number of prior depression episodes (M±SD)	4.2±1.6		4.2±1.6		4.2±1.6		.87
Prior depression treatment	251	76	120	74	131	78	.41
Current depression treatment	160	48	76	47	84	50	.57
Antidepressants acceptable	276	85	136	85	140	85	.93
Counseling acceptable	248	77	125	78	123	75	.51
Current disorder							
Major depressive disorder	276	83	130	80	146	86	.11
Dysthymia	10	3	6	4	4	2	.54
Panic disorder	28	8	13	8	15	9	.77
Generalized anxiety disorder	211	64	107	66	104	62	.44
PTSD	54	16	29	18	25	15	.46
Current at-risk drinking	14	4	8	5	6	4	.54

[a] Numbers for some items do not add up to total number of patients because of missing data, and some percentages do not add up to 100 because of rounding.
[b] Scores are from the Duke Social Support Scale. Possible scores range from 0 to 1, with higher scores indicating greater social support.
[c] Scores are from the Depression Beliefs Inventory Perceived Barriers Subscale. Possible scores range from 0 to 9, with higher scores indicating greater perceived barriers to receiving depression treatment.
[d] Scores are from the Depression Beliefs Inventory Perceived Need Subscale. Possible scores range from 0 to 6, with higher scores indicating greater perceived need for depression treatment.
[e] Scores are from the Depression Beliefs Inventory Perceived Treatment Effectiveness Subscale. Possible scores range from 0 to 2, with higher scores indicating greater perceived depression treatment effectiveness.
[f] SCL-20, Symptom Checklist–20. Possible scores range from 0 to 4, with higher scores indicating more severe depression.
[g] SF-12 PCS, 12-Item Short-Form Survey (SF-12) Physical Component score. Possible scores range from 0 to 100, with higher scores indicating better physical health functioning.
[h] SF-12 MCS, SF-12 Mental Component score. Possible scores range from 0 to 100, with higher scores indicating better mental health functioning.
[i] QWB, Quality of Well-Being Scale. Possible scores range from 0 to 1, with higher scores indicating better health-related quality of life.

TABLE 2. Unadjusted costs per patient of telemedicine-based collaborative care (TBCC) and practice-based collaborative care (PBCC) for depression, in 2009 dollars[a]

Cost	PBCC (N=169)	TBCC (N=163)	Difference	p
Intervention				
Fixed				
Total	13.19	389.51	376.32	<.001
Education	2.31	.40	−1.91	
Training	10.88	4.75	−6.13	
Equipment	.00	384.36	384.36	
Variable				
Total	78.44	834.46	756.02	<.001
Depression care manager	78.44	338.70	260.26	
Psychologist	.00	119.63	119.63	
Pharmacist	.00	56.76	56.76	
T1-line charge (40%)	.00	222.33	222.33	
Psychiatrist	.00	97.04	97.04	
Outpatient				
Total	6,559.42	7,178.72	619.3	.29
General medical emergency	2,701.73	2,805.35	103.62	
Mental health emergency	233.44	491.60	258.16	
General medical primary care	958.31	1,066.91	108.60	
Mental health primary care	779.97	709.22	−70.75	
Psychiatrist	320.14	526.63	206.49	
Other medical specialist	718.79	683.27	−35.52	
General medical medication	712.61	749.29	36.68	
Mental health medication	16.02	14.95	−1.07	
Antidepressant medication	1,18.41	131.50	13.09	
Mental health inpatient	45.36	188.13	142.77	.19
Patient	354.90	340.40	−14.50	.69
General medical				
Gas	125.71	117.29	−8.42	
Travel and waiting	127.69	127.93	.24	
Mental health				
Gas	46.07	42.03	−4.04	
Travel and waiting	55.43	53.15	−2.28	
Total excluding mental health inpatient costs				
T1-line charge				
0%	7,005.94	8,136.39	1,130.44	.054
40%[b]	7,005.94	8,512.46	1,506.52	.01
100%	7,005.94	9,076.57	2,070.63	<.001
Total with 40% T-1 line charge plus mental health inpatient costs	7,051.30	8,700.59	1,649.29	<.007

[a] Data were collected between baseline and 18 months.
[b] The base case cost analysis assumed that 40% of T-1 line charges were attributable to TBCC.

days to QALYs (20). We divided the difference in depression-free days over 18 months by 365 and then multiplied by the lower (.2) and upper (.4) bounds of the QALY increase associated with going from fully symptomatic to depression free (20). In addition, previously published standard gamble utility weights were used to convert results of the Medical Outcomes Study 12-Item Short-Form Survey (SF-12) (21) to QALYs. A third method used the Quality of Well-Being Scale (QWB) (22) to calculate QALYs. Generic QALYs from the SF-12 and QWB are reported because generic QALYs are the recommended unit of effectiveness for the base case cost-effectiveness analysis (23).

QALYs derived from the SF-12 used standard gamble preference weights (21) that transformed SF-12 data into a preference-weighted index score that varied from .0 (death) to 1.0 (perfect health). Similarly, the QWB subscales represented preference-weighted scores that were subtracted from 1.0 (perfect health) to determine the QWB index score, which ranged from 0 (death) to 1.0 (perfect health) (24).

Intervention costs and health care costs were collected by using a societal perspective (health care utilization and patient costs) and were adjusted to reflect 2009 dollars. The societal perspective was recommended by the U.S. Public Health Service Panel on Cost-Effectiveness in Health and Medicine. Fixed costs of the interventions included the cost of education materials for the DCM, DCM training, and interactive video equipment (TBCC only). There was one DCM for TBCC and six DCMs for PBCC. Costs of DCM training (eight hours) used 2009 Bureau of Labor Statistics median hourly wage for registered nurses plus 25% for fringe benefits (www.bls.gov/oes/2009/may/oes_nat.htm#29-0000). Equipment costs included the purchase and installation of interactive video stations and routers, which depreciated in value over the course of the study. The annual depreciation rate was 18.33% (from the U.S. Bureau of Economic Analysis of depreciation of medical equipment) over four years (total duration of recruitment and intervention).

Variable costs of the interventions included the time spent by personnel delivering the intervention. Time costs for intervention personnel were estimated by using 2009 Bureau of Labor Statistics hourly wage data plus 25% for fringe benefits (www.bls.gov/oes/2009/may/oes_nat.htm#29-0000). The DCM's time was estimated by counting the number of encounters from chart review and estimating that an initial encounter would last 1.5 hours and follow-up encounters would last 1.0 hour (including time to reach the patient by phone, conduct the interview, and chart the encounter). For TBCC, variable intervention costs also included the time of the pharmacist, psychologist, and psychiatrist and monthly charges for the T1 line necessary for telemental health encounters. (A T1 line can carry about 192,000 bytes per second, roughly 60 times more data than a normal residential modem.) Intervention clinician time was estimated by the number of progress notes written by each provider and the time spent in team meetings. For the base case analysis, we assumed that 40% of T1 charges were attributable to TBCC, on the basis of reports in the literature that 40% of patients seen at a university-based telepsychiatry service had a primary depression diagnosis (25). Sensitivity analyses varied T1-cost assumptions from 0% to 100%.

Health care costs were based on the Quality Improvement for Depression collaboration's service utilization instrument, which measures service utilization on the basis of patients' self-report. Patients are asked about service utilization for general medical problems and mental health problems ("personal or emotional problems such as feeling down or anxious, or for alcohol or drug problems").

The base case analysis used FQHC costs and the secondary analysis used national costs. Outpatient FQHC visit costs were estimated by using the FQHC prospective payment system rates for Arkansas. Costs for outpatient visits to other facilities were estimated by using Arkansas Blue Cross Blue Shield data. Emergency room (ER) and inpatient costs were estimated by using data from the academic medical center and affiliated hospitals, including safety net providers, in the University HealthSystem Consortium Southern Region. Medication costs approximated the discounts provided to FQHCs by the 340B Drug Pricing Program by applying the average discount for the top ten medications prescribed in this study for general medical and mental (76% and 86%, respectively) conditions to the lowest average wholesale price listed in the *Red Book*. Patients' time and mileage associated with health care utilization were collected from patients' self-report. Patients' time costs were estimated by using 2009 U.S. Census Bureau wage estimates related to age, gender, and education (for employed patients) or minimum wage ($7.25) (for unemployed patients). Patients' mileage costs were estimated by using the 2009 General Services Administration reimbursement rate of 59 cents per mile.

For the secondary analysis, health care costs were estimated from LifeLink Health Plan Claims Data, which comprise data from 70 million enrollees from 80 managed care organizations and are nationally representative of the commercially insured U.S. population. Per diem costs for inpatient treatment of general medical conditions were estimated from the median allowed per diem cost of the top ten most frequent *ICD-9* diagnoses other than mental health diagnoses. Per diem costs for inpatient treatment of mental health conditions and ER costs for general medical and mental health visits were estimated from their respective Clinical Classifications Software codes. Outpatient costs were estimated on the basis of their respective CPT codes. Medication costs were estimated by using the *Red Book* lowest average wholesale price.

Incremental cost-effectiveness ratios (ICERs) are the ratio of the difference in total costs between TBCC and PBCC divided by the difference in effectiveness (depression-free days or QALYs), as shown in the following formula: [cost (TBCC) – cost (PBCC)]/[QALY (TBCC) – QALY (PBCC)]. The base case analysis included the SF-12–derived QALYs and outpatient, ER, pharmacy, patient (travel and time), intervention, and 40% of monthly T1 costs. Sensitivity analyses included 0% or 100% of the T1 costs, QALYs derived from conversion of depression-free days (using the lower [.2] and upper [.4] bounds of the QALY increase) and the QWB, and mental health inpatient costs. Secondary analyses included cost estimates from the nationally representative LifeLink claims data.

TABLE 3. Mean incremental cost-effectiveness ratios (ICERs) comparing outpatient costs of TBCC and PBCC for depression per quality-adjusted life year (QALY), in 2009 dollars[a]

Data source and QALY measure	ICER	Interquartile range
FQHC[b]		
SF-12[c]	33,217	18,744–39,298
QWB[d]	35,762	20,336–44,299
Depression-free day (QALY .2)[e]	29,428	21,588–36,740
Depression-free day (QALY .4)[f]	14,714	10,794–18,370
National[g]		
SF-12[c]	25,728	14,684–30,045
QWB[d]	28,017	16,044–34,418
Depression-free day (QALY .2)[e]	23,158	16,418–29,326
Depression-free day (QALY .4)[f]	11,579	8,209–14,663

[a] TBCC, telemedicine-based collaborative care; PBCC, practice-based collaborative care. ICERs were calculated based on a nonparametric bootstrap-with-replacement method. The final model for depression-free days included intervention dummy variable and the following covariates: barriers to treatment, perceived need for treatment, the 12-Item Short-Form Survey (SF-12) Physical Health Component score, the SF-12 Mental Health Component score, employment, family history of depression, and Symptom Checklist–20 (SCL-20). The QALY and cost models included the same covariates, except the SCL-20 was replaced by the baseline QALY measure or the baseline cost measure, respectively.

[b] Cost estimates were based on prospective payment system rates at Arkansas federally qualified health centers (FQHCs) for community health center (CHC) visits as well as Arkansas Blue Cross Blue Shield data for non-CHC outpatient visits, University HealthSystem Consortium Southern Region per diem rates for emergency room (ER) and inpatient visits, estimated 340B Drug Pricing Program costs for medication, and 40% of monthly T1-line charges.

[c] Base case analysis

[d] Quality of Well-Being Scale

[e] Change in depression-free days was converted to QALYs by assuming that a change from fully symptomatic to depression free would result in an expected increase in QALYs of .2.

[f] Change in depression-free days was converted to QALYs by assuming that a change from fully symptomatic to depression free would result in an expected increase in QALYs of .4.

[g] Cost estimates were based on Lifelink Health Plans Claims Data for outpatient, ER, and inpatient visits, lowest average wholesale price for medication from *Red Book*, and 40% of monthly T1-line charges.

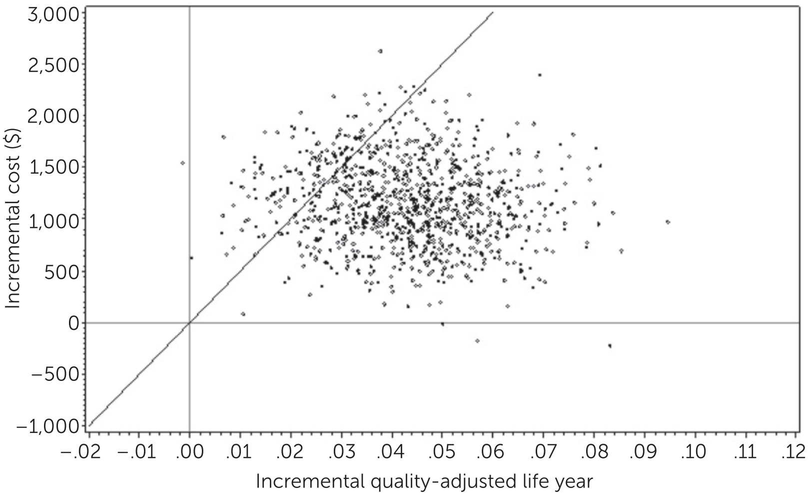
Case Mix Variables

At baseline, information about sociodemographic and clinical case mix factors were collected by using the Depression Outcomes Module (26), the Mini International Neuropsychiatric Interview (27), the Duke Social Support and Stress Scale (28), the Quality Improvement for Depression Treatment Acceptability Scale (5), and the Depression Beliefs Inventory (29). Zip codes were used to categorize patients' residence as rural or urban according to Rural-Urban Commuting Area codes.

Statistical Analysis

Patients were the unit of the intent-to-treat analysis. Only patients with at least one research follow-up visit were included in the analyses. All models specified clinic as a random effect to control for intraclass correlation. Data were missing for four cost variables and two demographic variables (.3% each) and for the SF-12 at 18 months (15.7%). Variables with

FIGURE 1. Joint distribution (scatter plot) of incremental costs of telemedicine-based collaborative care (TBCC) versus practice-based collaborative care (PBCC) for depression and quality-adjusted life years (QALYs)[a]



[a] The scatter plot analysis used 1,000 bootstrapped samples with replacement. Incremental cost was the cost difference between TBCC and PBCC (using federally qualified health center cost data), and incremental QALY was the QALY difference between TBCC and PBCC derived from the 12-Item Short-Form Survey (base case). The proportion of bootstrapped samples below (to the right of) the $50,000 per QALY threshold line (through the origin) was 85.6%.

missing data were imputed by using multiple imputation methods. Because of the large number of available covariates, only those with significant differences between TBCC and PBCC ($p<.20$) were included in multivariate analyses. After model specification was finalized, prebaseline health care utilization costs were added to cost models as a covariate.

The depression-free day and cost outcomes were non-normally distributed, so generalized linear models (GLMs) were used. The GLMs with a gamma distribution and identity link were the best fit for the cost data. The depression-free day and QALY data were normally distributed, so the normal distribution with identity link was used. To determine the incremental effect of treatment on QALYs, we used the regression coefficient for the intervention variable.

We used a nonparametric bootstrap-with-replacement method and 1,000 replications to generate an empirical joint distribution of incremental costs and QALYs (30) and acceptability curves representing the probability of falling below cost-effectiveness ratio thresholds ranging from $0 to $100,000 per QALY (31).

RESULTS

In general, study patients were middle-aged, low-income, Caucasian women with moderate depression who were unemployed and uninsured (Table 1). The only statistically significant differences between the intervention groups was a higher level of perceived barriers to depression treatment in the TBCC group (4.0) compared with the PBCC group (3.4) ($p=.01$).

Although there were no statistically significant group differences in terms of health care costs, the total cost per patient was significantly greater for TBCC than for PBCC because of the higher fixed and variable costs of TBCC (Table 2). The unadjusted average incremental intervention cost (fixed plus variable intervention cost difference between TBCC and PBCC) was $1,132 ($376+$756). For the base case analysis, the adjusted total cost was significantly greater for TBCC compared with PBCC (β=1,146, 95% confidence interval [CI]= 396–1,897, $p=.003$). The adjusted incremental cost ranged from $794 (CI=56–1,533, $p=.03$) for 0% monthly charges for a T1 line to $1,663 (CI=884–2,442, $p<.001$) for 100% monthly charges for a T1 line.

The adjusted incremental effectiveness on depression-free days was significant (β=109.6, CI=79.7–139.5, $p<.001$), as was the incremental effectiveness on depression-free day QALYs at both the lower (.2) and upper (.4) bounds of QALY increases associated with improving from fully symptomatic to depression free (β=.04, CI=.03–.05, and β=.078, CI=.06–.10, respectively; both p values $<.001$). The adjusted incremental effectiveness for generic QALYs was also significant (SF-12 QALY, β=.04, CI=.02–.07, $p=.003$; QWB QALY, β=.04, CI=.01–.07, $p=.01$).

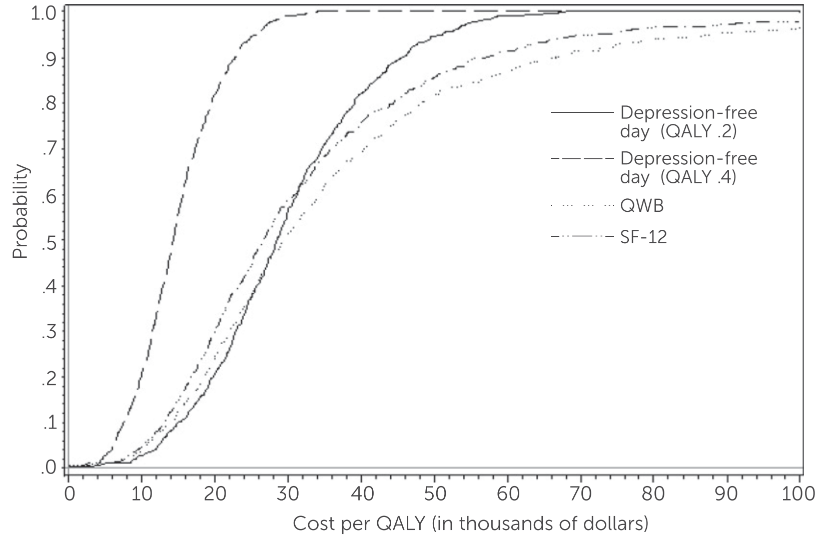
When mental health inpatient costs were excluded, the bootstrapped mean ICER calculated by using FQHC costs and depression-free days was $10.75 per depression-free day; in the sensitivity analyses, it ranged from $7.49 (0% of T1 charges) to $15.49 (100% of T1 charges). The mean ICER calculated by using FQHC costs and SF-12 QALYs was $33,217 per QALY (Table 3). The sensitivity analyses for the QALY estimates ranged from $14,714 (depression-free days and upper [.4] bound of the QALY increase) to $35,762 (QWB) per QALY. The T1-charge sensitivity analyses that used FQHC costs and SF-12 QALYs ranged from $22,548 per QALY (0% of T1 charges) to $48,789 per QALY (100% of T1 charges). Adding inpatient mental health costs to the SF-12 QALY base case analysis resulted in an ICER of $36,033 per QALY. Figure 1 depicts a scatter plot analysis of incremental costs associated with increased QALYs derived from the SF-12. Figure 2 depicts an acceptability curve illustrating the probability of falling below cost-effectiveness ratio thresholds for QALYs associated with a range of costs.

When mental health inpatient costs were excluded, the bootstrapped mean ICER calculated by using national costs and depression-free days was $8.46 per depression-free day. The mean ICER calculated by using national costs and QALYs derived from the SF-12 was $25,728 per QALY. The sensitivity analyses for the QALY estimates ranged from $11,579 (depression-free day and upper [.4] bound of the QALY increase) to $28,017 (QWB) per QALY. Adding inpatient mental health costs to the analysis of national costs and SF-12–derived QALYs resulted in costs per QALY of $28,126.

DISCUSSION

For primary care clinics lacking on-site mental health resources, there are increasing calls for collaborative care models in which off-site specialists support primary care providers by using telemedicine technologies (32). To our knowledge, this is the first cost-effectiveness analysis to compare the value of outsourced TBCC with PBCC. The adjusted incremental cost (base case) of TBCC was $1,146, which is consistent with the incremental cost reported for other collaborative care interventions for depression ($389 to $1,772 per capita adjusted to 2009 dollars) (7,10,19,20,33). Televideo equipment and T1-line charges accounted for 50% of the per capita direct costs of TBCC. However, results clearly demonstrated that TBCC was both more effective and more cost-effective compared with PBCC. The incremental cost-effectiveness of TBCC was $10.78 per depression-free day, which is less than what depressed patients report being willing to pay for an additional depression-free day ($14.40, adjusted to 2009 dollars) (34). Other studies that have estimated the cost-effectiveness of collaborative care versus usual care for depression have reported ICERs ranging from $3.64 to $85.54 per depression-free day (2009 dollars) (20,35).

FIGURE 2. Acceptability curves representing the probability that incremental cost-effectiveness ratios comparing TBCC and PBCC will fall below $0 to $100,000 per QALY, by QALY measure[a]



[a] TBCC, telemedicine-based collaborative care; PBCC, practice-based collaborative care; QALY, quality-adjusted life year; depression-free day (QALY .2), conversion from depression-free days by using .2 as the improvement in QALYs associated with improving from fully symptomatic depression to depression free; depression-free day (QALY .4), conversion from depression-free days by using .4 as the improvement in QALYs associated with improving from fully symptomatic depression to depression free; QWB, derived from Quality of Well-Being Scale; SF-12, derived from the 12-Item Short-Form Survey by using standard gamble preference weights

The mean ICERs for all methods of calculating QALYs were below the commonly used threshold of $50,000 per QALY for intervention adoption. The cost-effectiveness ratios calculated by using depression-free days and the upper (.4) bound of the QALY increase (which is the most commonly reported QALY measure for collaborative care interventions for depression) were less than $20,000 per QALY, which is considered the threshold for recommending immediate adoption (23). In other studies, estimates of mean ICERs for collaborative care versus usual care for depression ranged from $3,325 to $99,335 per depression-free-day QALY, adjusted to 2009 dollars (20,35).

The TBCC intervention is a cost-effective model for delivering accessible and high-quality depression care to settings lacking on-site mental health resources. Thus, TBCC presents a viable option for organizations weighing whether to "make or buy" depression care management in order to achieve PCMH recognition. Telemedicine capability in primary care clinics is increasing within (http://aims.uw.edu) and outside (www.accesspsych.com) university research programs. Estimates from previous collaborative-care interventions indicate that approximately one DCM is needed for every 10,000 primary care patients and that TBCC could feasibly cover more than one site (36). Adaptations of TBCC to enhance value and sustainability could be tested within specific settings and will be required within the changing health care environment (37).

This study had the following limitations. Electronic health record systems were not in place at the FQHCs during this study, which limits the generalizability of the findings. However, electronic health records would likely improve communication between the TBCC intervention team and FQHC providers. The demographic characteristics of FQHC patients (typically poor, rural, and uninsured members of racial-ethnic minority groups) differ from private sector patients, which limited the generalizability of the findings to the private sector.

CONCLUSIONS

This pragmatic comparative cost-effectiveness study provides evidence to support the cost-effectiveness of TBCC in medically underserved areas. These results can help FQHCs and other health care delivery systems decide whether to provide on-site versus off-site depression care management as they work toward achieving PCMH recognition, utilize value-based purchasing, and prepare for bundled depression care payments.

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- John Boronow, M.D., reviews *Difficult Psychiatric Consultations: An Integrated Approach,* by Sergio V. Delgado and Jeffrey R. Strawn