Cost-Effectiveness of Collaborative Care for Depression and PTSD in Military Personnel

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ABSTRACT

OBJECTIVES: Collaborative care is an effective approach for treating posttraumatic stress disorder (PTSD) and depression within the US Military Health System (MHS), but its cost-effectiveness remains unstudied. Our objective was to evaluate the costs and cost-effectiveness of centrally assisted collaborative telecare (CACT) versus optimized usual care (OUC) for PTSD and depression in the MHS.

STUDY DESIGN: A randomized trial compared CACT with OUC. Routine primary care screening identified active-duty service members with PTSD or depression. Eligible participants (N = 666) were randomized to CACT or OUC and assessed at 3, 6, and 12 months. OUC patients could receive care management and increased behavioral health support. CACT patients could receive these services plus stepped psychosocial treatment and routine centralized team monitoring.

METHODS: Quality-adjusted life-years (QALYs) were derived from the 12-Item Short Form Health Survey. Claims and case management data were used to estimate costs. Cost-effectiveness analyses were conducted from a societal perspective.

RESULTS: Data from 629 patients (320 CACT and 309 OUC) with sufficient follow-up were analyzed. CACT patients gained 0.02 QALYs (95% CI, −0.001 to 0.03) relative to OUC patients. Twelve-month costs, including productivity, were $987 (95% CI, −$3056 to $5030) higher for CACT versus OUC. CACT was estimated to cost $49,346 per QALY gained compared with OUC over 12 months. There is a 58% probability that CACT is cost-effective at a $100,000/QALY threshold.

CONCLUSIONS: Despite its higher costs, CACT appears to be a cost-effective strategy relative to OUC for managing PTSD and depression in the MHS.

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Posttraumatic stress disorder (PTSD), anxiety, and depression are common conditions in the US military. Prevalence estimates of postdeployment PTSD and depression range from 13% to 18%, and 28% of service members report severe symptoms of PTSD, anxiety, or depression.[1,2] These problems cause suffering and impairment and contribute to military attrition, absenteeism, misconduct, and sick-call visits.[3,4] Despite this, less than half of the serving military personnel affected receive military mental health services, which are often not timely or adequate.[5,6] The military has attempted to better integrate mental health services into primary care, and the first Army integration approach began in 2007.[7,8] Access to and quality of mental health services for military personnel has remained a recurring public policy concern, however.[1,9] To address this, the Institute of Medicine has called for health system–level interventions to increase access to and continuity of mental health services in military and veteran populations.[10]

Collaborative care is an empirically supported method of extending and improving the reach, quality, and outcomes of care for common health conditions.[11,12] In more than 80 randomized trials, collaborative care models have demonstrated improved outcomes among patients with depression and anxiety,[12-14] depression-related suicidal ideation,[15] depression and other chronic health conditions (eg, diabetes, asthma),[16] and chronic pain.[17,18] As of January 1, 2017, the Medicare fee schedule now reimburses for the delivery of collaborative care.

Recently, the first randomized controlled trial (RCT) of centrally assisted collaborative telecare (CACT) for PTSD and depression within the Military Health System (MHS) was completed.[19,20] The STepped Enhancement of PTSD Services Using Primary Care (STEPS-UP) trial compared CACT with the Army's preexisting program integrating behavioral health in primary care. CACT was effective in reducing the severity of PTSD and depressive symptoms in active military personnel using primary care, adding to the evidence supporting the use of collaborative care treatment models for mental illness in a range of settings and populations.[20] However, no prior research

TAKEAWAY POINTS

Centrally assisted collaborative telecare is a cost-effective strategy relative to usual care for treating posttraumatic stress disorder and depression in the Military Health System (MHS).

- These findings are consistent with those of previous studies that have investigated the use of similar models of care in a range of healthcare settings and populations, but this is the first study to demonstrate value in a military healthcare setting.
- Results indicate that investments in behavioral health integration and infrastructure in primary care may provide good value for healthcare systems similar to the MHS, which is a large integrated healthcare system serving approximately 9.5 million eligible beneficiaries.

has shown whether a collaborative care approach to treating PTSD and depression is cost-effective in the MHS, an important question given that the military spends more than $50 billion annually on healthcare for its nearly 10 million beneficiaries.[21] The objective of this study was to evaluate the cost-effectiveness of treating patients with PTSD and depression using CACT compared with optimized usual care (OUC) in the MHS.

METHODS

Trial Design and Treatment Protocol

The RCT study design has been published elsewhere in detail.[19] Briefly, between February 2012 and September 2013, routine clinical screening in 18 Army primary care clinics at 6 military installations identified active-duty service members with 1) PTSD, depression, or both, and 2) access to Internet and email. Patients were excluded if they had current alcohol dependence, active suicidal ideation in the prior 2 months, planned geographic relocation within 6 months, or current duties in the participating clinic.[20]

Eligible participants (N = 666) were randomized to OUC (n = 334) or CACT (n = 332) to treat their symptoms for up to 12 months after enrollment. OUC patients received the standard integrated mental health approach for Army primary care clinics, which included increased access to mental health specialists and follow-up monitoring from a nurse care manager who tracked patients' progress and provided status updates to primary care clinicians.[8] CACT patients received the standard OUC services plus 1) stepped psychosocial treatment and 2) routine monitoring by a central mental health team with a centralized patient symptom registry. Nurse care managers who worked with CACT patients also received additional training in behavioral activation, problem solving, and motivational interviewing to provide additional support to patients.[20] The study was approved by all affiliated institutional research review boards.

Health Outcome Assessment

We used data from patient surveys administered at baseline and 3-, 6-, and 12-month follow-ups to assess the primary outcomes of depression and PTSD, as well as health-related quality of life (QOL) and other secondary health outcomes. We assessed the severity of PTSD and depression symptoms using the PTSD Diagnostic Scale[22,23] (PDS) and the Hopkins Symptom Checklist depression items (HSCL-20).[24] We assessed QOL using the 12-Item Short Form Health Survey (SF-12).[25] We derived quality-adjusted life-years (QALYs) from the Short-Form Six-Dimension utility index (SF-6D).[26] Depression-free days (DFDs) were derived from the scored HSCL-20,[27] and PTSD-free days (PFDs) were derived from the PDS.

Intervention Costs

Both arms of the study followed protocols that instructed the use of weekly caseload review calls between nurse coordinators and staff psychiatrists to review participating patients' progress, as well as regular case management calls between the nurse coordinator and the patient and other phone, email, or text message contacts as needed. An electronic case management system was used to track all contacts and caseload review calls. Nurse coordinators in each intervention arm also underwent training and education sessions.

To estimate the cost of each of these intervention components, we multiplied the estimated hourly wage of each participating staff member (nurse coordinator and/or staff psychiatrist) by the number and average duration of each contact or training session, estimated from case management system data and interviews with nurse coordinators at each site. The CACT arm also included a centralized management team that coordinated intervention activities throughout the 12-month study period, composed of a half-time administrative assistant, a full-time psychologist, and a half-time nurse coordinator. We estimated the cost of these services using the salary of each staff member. All wage estimates were based on the General Schedule pay scale.[20]

Other Costs

We used claims data to assess the other (nonintervention) healthcare resources utilized within and outside of the MHS through the 12-month study period. These data contain information on medications, inpatient stays, emergency department visits, outpatient tests and procedures, outpatient visits, and telephone contacts. Utilization was recorded within the MHS and outside the MHS when reimbursed by TRICARE. For services provided within the MHS, costs were estimated from the given estimated full service cost, which includes resources used and estimated overhead; for services and medications provided outside of the MHS, costs were estimated from the total amount reimbursed by TRICARE. We excluded any services, such as certain telephone contacts, that were recorded in claims data but already accounted for in our analysis as an intervention component. Healthcare costs borne by the patient, including co-pays for services, were not included.

We used survey data from 3-, 6-, and 12-month follow-ups to estimate productivity costs over the course of the 12-month study. At each survey time point, we asked participants if they had missed an entire workday or part of a workday "due to a mental or physical health problem" in the previous 28 days. We extrapolated the stated number of lost workdays to cover the full period since the previous survey and estimated productivity costs by multiplying the estimated number of lost workdays by a daily personnel cost. We estimated personnel costs from the salaries reported at the study baseline plus fringe benefits.

Statistical Analysis

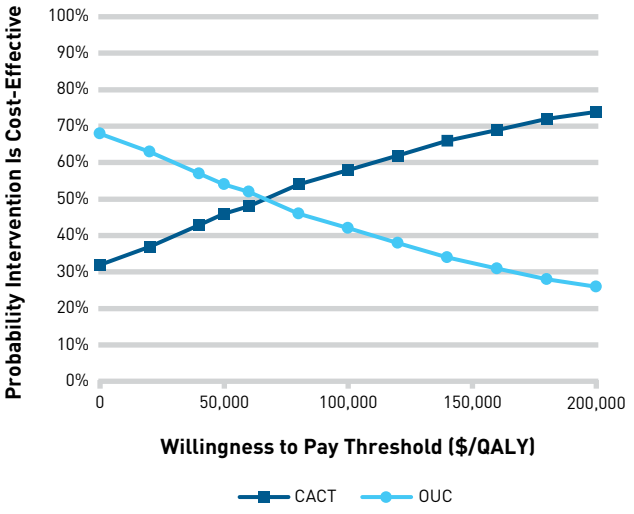
We included patients who received the intervention and had at least 1 follow-up interval of both survey data and cost data in the primary economic evaluation analytic population. We excluded patients who did not receive any intervention or received the intervention but did not have both cost and survey data. For patients included in the analysis, we imputed missing 12-month cumulative QALY, utilization, and cost data using the fully conditional specification approach.[28] Imputation models included available measures of cost and utilization; demographic and social characteristics, including age, race, gender, salary, marital status, and education; and clinical characteristics, including SF-12 scores and depression and/or PTSD status. Imputations were performed within each treatment arm. Five imputations were created, and results from each imputation were pooled using the rules outlined by Rubin.[29] Specifically, we defined point estimates as the average of those from the 5 imputed datasets. The variance of the estimate was derived from both the within-imputation and between-imputation variances, where the former is the average of the variances of point estimates from the 5 imputed datasets.

Categorical data are reported as frequencies and were compared using χ^2 or Fisher's exact test statistics. Continuous demographic variables are reported as means and SDs and were compared with *t* test statistics. Continuous cost and utilization data are reported as means; the statistical significance of the difference in means between the 2 groups was evaluated using a 95% CI. Cost categories also report median values. All analyses were performed in SAS 9.4 (SAS Institute, Inc; Cary, North Carolina).

Cost-Effectiveness Analysis

We examined the cost-effectiveness of CACT versus OUC over the 12-month study period. In our base case analysis, we included all intervention costs, other healthcare costs paid for by the MHS or TRICARE within and outside of the MHS, and productivity costs. The primary outcome assessed was the incremental cost-effectiveness ratio (ICER) in dollars per QALY gained, which was the difference in mean total costs between the 2 treatment arms over the 12-month study period divided by the difference in mean QALYs. We converted all costs to 2014 US dollars for analysis.

FIGURE. Cost-Effectiveness Acceptability Curve[a]



CACT indicates centrally assisted collaborative telecare; CEA, cost-effectiveness analysis; ICER, incremental cost-effectiveness ratio; OUC, optimized usual care; QALY, quality-adjusted life year.

[a]To create the acceptability curves, we created 1000 bootstrapped replications of each of our multiply imputed datasets. We re-ran the CEA in each of these datasets and calculated the proportion of ICERs (CACT vs OUC) that fell below commonly cited cost-effectiveness thresholds between $0/QALY and $200,000/QALY. At each threshold, proportions from each of our multiply imputed datasets were combined using Rubin's rules.[29] The proportion of ICERs (CACT vs OUC) that fell below each benchmark CEA threshold represented the probability that CACT would be considered cost-effective compared with OUC at that threshold and would be considered the preferred intervention. In all remaining cases, we considered OUC to be the preferred intervention at each threshold.

We ran 6 sensitivity analyses to examine the impact of assumptions used in our base case analysis. We generated cost-effectiveness acceptability curves to show the probability that either CACT or OUC would be considered the preferred intervention at a range of cost-effectiveness thresholds (**Figure**).[29]

RESULTS

Study Sample

Among the 666 patients enrolled in the study, 629 patients were assigned to an intervention arm (320 CACT and 309 OUC) and had at least 1 follow-up interval each of cost data and health outcome data. A total of 553 patients answered the survey at all 4 time points. Full 12-month cost and health outcome data were available for 459 patients, and multiple imputation was used to generate full QALY and cost data for the remaining 170 patients (27% of full analytic sample). Patients were well matched between study arms, with no statistically significant differences among them. The majority of patients in each arm were male (~80%) and married (63%), and mean ages were 31 and 32 years in the CACT and OUC arms, respectively (**Table 1**).[26,30,31]

TABLE 1. Sociodemographic Characteristics

Baseline Characteristics	CACT (n = 320)	OUC (n = 309)	*P* for Difference
Age (years), mean ± SD (n)	31.03 ± 7.48 (320)	31.76 ± 7.79 (309)	.23
Male, n (%)	255 (79.69)	254 (82.20)	.42
Married, n (%)	202 (63.13)	195 (63.11)	.85
Highest level of education, n (%)			.58
High school or GED	106 (33.13)	104 (33.66)	
Some college	150 (46.88)	134 (43.37)	
College or graduate degree	64 (20.00)	71 (22.98)	
Race, n (%)			.92
White, non-Hispanic	154 (48.13)	148 (47.90)	
African American, non-Hispanic	78 (24.38)	70 (22.65)	
Hispanic	55 (17.19)	55 (17.80)	
Other, non-Hispanic	33 (10.31)	36 (11.65)	
Annual salary (individual), n (%)			.64
<$30,000	107 (33.44)	90 (29.13)	
$30,000-$59,999	175 (54.69)	181 (58.58)	
$60,000-$99,999	35 (10.94)	35 (11.32)	
≥$100,000	2 (0.63)	1 (0.32)	
Workdays missed in previous month due to a mental or physical health problem, mean days ± SD (n)[a]			
Entire workdays	1.58 ± 3.25 (315)	1.99 ± 4.91 (305)	.23
Partial workdays	2.95 ± 4.20 (315)	3.45 ± 5.29 (305)	.19
Quality of life (SF-12), mean summary scores ± SD (n)			
Mental health	31.12 ± 9.34 (317)	32.58 ± 10.22 (309)	.06
Physical health	40.16 ± 11.05 (317)	38.90 ± 11.52 (309)	.16
SF-6D utility scores[26]	0.56 ± 0.10 (315)	0.56 ± 0.11 (308)	.88
Baseline screening, n (%)			
PTSD[30]	276 (86.25)	261 (84.47)	.53
Depression[31]	215 (67.19)	194 (62.78)	.25
PTSD and depression	186 (58.13)	165 (53.40)	.23

CACT indicates centrally assisted collaborative telecare; GED, General Educational Development; OUC, optimized usual care; PTSD, posttraumatic stress disorder; SF-6D, Short-Form Six-Dimension utility index; SF-12, 12-Item Short Form Health Survey.
[a]Baseline survey asked participants if they had missed an entire workday or part of a workday in past 4 weeks due to a physical or mental health problem.

Twelve-Month Health Outcomes

As reported in Engel et al, the primary PTSD and depression outcomes examined as part of the overall RCT showed small to moderate, but statistically significant, improvements over 12 months in the CACT group compared with the OUC group.[20] These improvements were measured by the PDS (–2.53 lower scores for CACT vs OUC; 95% CI,–4.47 to –0.59) and HSCL-20 scores (–0.26; 95% CI, –0.41 to –0.11).[20] Significant improvements were also observed in the CACT group versus OUC for the 12-month secondary RCT outcomes of physical symptom severity and mental health–related QOL, but not for other secondary health outcomes of suicidality, pain intensity and interference, alcohol misuse, and physical QOL.[20]

We found that over the 12-month follow-up, QALYs, as derived from the SF-6D, were 0.60 for CACT versus 0.59 for OUC, with a nonsignificant 0.02 QALY (95% CI, –0.001 to 0.03) gain for CACT relative to OUC. DFDs and PFDs also did not differ significantly between groups (**Table 2**).

Twelve-Month Costs

Compared with patients randomized to OUC, patients in the CACT arm of the study received significantly more intervention resources, including care management contacts (7.25 vs 3.74) and other "as needed" contacts (3.97 vs 1.06) during the study period ($P < .05$ for difference in both) (Table 2). Patients in CACT were also reviewed more frequently in caseload review calls (9.9 times over the 12-month study period vs 1.5 times for OUC patients; $P < .05$), and CACT nurse coordinators received more training and education (Table 2). These resources, plus 12 months of central assistance, resulted in $1754 higher intervention costs for patients in the CACT arm compared with the OUC arm over the 12-month study period ($2743 vs $989; $P < .05$).

The utilization of other healthcare resources did not differ significantly between study arms, with the exception of nonintervention-related telephone contacts, which were significantly more common in the CACT intervention arm (6.0 vs 4.3 in the OUC arm) (Table 2). However, patients in the CACT arm had 3.0 fewer lost workdays (95% CI, –13.1 to 7.0) compared with patients in OUC, equating to a $1255 (95% CI, –$3961 to $1451) productivity gain for CACT versus OUC. Adding up intervention costs, other healthcare costs, and productivity costs across both CACT and OUC, total 12-month costs were $987 (95% CI, –$3056 to $5030) higher in CACT compared with OUC over the study period ($23,125 vs $22,138) (**Table 3**).

Cost-Effectiveness

In the primary cost-effectiveness analysis, CACT was estimated to cost $49,346 per QALY gained compared with OUC (**Table 4**). At a US willingness to pay (WTP) cost-effectiveness threshold of $100,000/

QALY, there is a 58% probability that CACT is the preferred intervention (Figure). This likelihood increases at higher WTP thresholds (74% at $200,000/QALY) and decreases at lower WTP thresholds (46% at $50,000/QALY).

Excluding productivity costs increased the cost of CACT relative to OUC, resulting in a ratio of $112,081/QALY (Table 4). Similarly, halving the number of patients followed by centralized management increased the ratio to $110,089/QALY. Other sensitivity analyses resulted in more favorable ICERs for CACT relative to OUC (Table 4).

DISCUSSION

The MHS is a sizable federal health system with a budget nearly as large as that of the Veterans Health Administration. The MHS invests heavily in behavioral health integration and infrastructure in primary care,[32] ensuring that this study is timely. We have estimated that CACT costs $49,346/QALY gained and has a 58% probability of being cost-effective at a $100,000/QALY WTP threshold compared with OUC. These results were based on 12-month improvements in the PTSD and depression outcomes observed as part of the overall RCT for CACT versus OUC and a 0.02 (95% CI, −0.001 to 0.03) gain in QALYs. CACT had significantly higher intervention costs ($1754) over the 12-month period of intervention and follow-up. Total 12-month costs were $987 (95% CI, −$3056 to $5030) higher in the CACT versus the OUC arm of the study when intervention costs, other healthcare costs, and productivity costs were considered. Cost-effectiveness estimates appear robust to assumptions regarding the imputation of missing data, high-cost outliers, and OUC intervention costs.

These results are sensitive to the size of the patient caseload handled by the central assistance team used to support CACT. In contrast to patient-level treatments (eg, the cost-effectiveness analysis [CEA] of a medication or psychotherapy), CACT is a systems-level intervention requiring a multidisciplinary team with centralized administrative and clinical support. Significant research suggests that depression and anxiety outcomes improve when a primary care–based collaborative care

TABLE 2. 12-Month Health Service Use, Lost Workdays, and Health Outcomes, by Intervention Arm

	CACT (n = 320)	OUC (n = 309)	Difference in Means (95% CI)
Intervention service utilization, mean per patient (95% CI)			
Caseload review calls (n)	9.9 (9.4-10.4)	1.5 (1.4-1.6)	8.4 (7.8-8.9)[a]
Case management contacts (n)	7.3 (6.8-7.7)	3.7 (3.4-4.1)	3.5 (2.9-4.1)[a]
Other email, text, or phone contacts, as needed (n)	4.0 (3.5-4.4)	1.1 (0.8-1.3)	2.9 (2.4-3.4)[a]
Training and education of nurse coordinators, minutes	52	12	40
Total healthcare utilization, mean n (95% CI)			
Inpatient hospitalization (all)	0.2 (0.2-0.3)	0.2 (0.1-0.2)	0.1 (−0.002 to 0.2)
Emergency department visit (all)	1.2 (1.0-1.5)	1.0 (0.8-1.2)	0.3 (−0.1 to 0.6)
Outpatient procedure, imaging, or test (all)	37.7 (33.9-41.6)	40.6 (35.3-45.9)	−2.9 (−9.4 to 3.6)
Outpatient visit (all)	38.1 (34.5-41.7)	38.8 (34.9-42.7)	−0.7 (−6.0 to 4.5)
Outpatient visit (mental health specialist)	13.6 (11.7-15.4)	12.9 (11.0-14.7)	0.7 (−1.9 to 3.3)
Other telephone contacts[b]	6.0 (5.4-6.6)	4.3 (3.8-4.9)	1.7 (0.9-2.4)[a]
Medications (all, including refills)	28.4 (25.9-30.9)	27.2 (23.8-30.6)	1.2 (−3.0 to 5.4)
Medications (mental health, including refills)	11.4 (10.0-12.9)	10.6 (8.8-12.5)	0.8 (−1.5 to 3.2)
Lost workdays, mean (95% CI)			
Total lost workdays	39.4 (32.8-46.1)	42.5 (35.0-49.9)	−3.1 (−13.1 to 7.0)
Health outcomes, mean (95% CI)			
QALYs	0.60 (0.59-0.61)	0.59 (0.57-0.60)	0.02 (−0.001 to 0.03)
Depression-free days	0.31 (0.27-0.34)	0.29 (0.26-0.32)	0.02 (−0.03 to 0.07)
PTSD-free days[c]	0.34 (0.32-0.37)	0.32 (0.29-0.35)	0.03 (−0.01 to 0.07)

CACT indicates centrally assisted collaborative telecare; OUC, optimized usual care; PDS, PTSD Diagnostic Scale; PTSD, posttraumatic stress disorder; QALY, quality-adjusted life-year.
[a]Utilization is statistically significantly higher for CACT versus OUC at the $P = .05$ level.
[b]Nonintervention-related telephone contacts, including specialty care phone calls, or primary care phone calls when made by someone other than a nurse.
[c]PTSD-free days were derived from the PDS assessments at each of the baseline and follow-up time points, using 2 thresholds. At the lower bound, a PDS score of 0 (indicating no symptoms of PTSD) was used to identify patients who were completely free of PTSD at that time point (proportion of PTSD-free days = 1). A score of 36 or higher (indicating severe symptoms of PTSD) was used to identify patients who had no days free of PTSD at that time point (proportion of PTSD-free days = 0). A linear interpolation between these 2 extremes was used to estimate the proportion of days that were free of PTSD at each time point. PTSD-free days during the year were estimated for each patient as the time-weighted average of these proportions applied to the number of days between time points, using the midway point as the transition between health states, starting at baseline.

TABLE 3. 12-Month Cost Outcomes

	CACT (n = 320)	OUC (n = 309)	Difference in Means (95% CI)
Costs			
Centralized management intervention costs			
Mean	$1005	$0	$1005
Other intervention costs (without central management)			
Mean (95% CI)	$1738 ($1707-$1767)	$989 ($974-$1004)	$749 ($715-$783)[a]
Median	$1681	$942	
Outpatient costs			
Mean (95% CI)	$9322 ($8351-$10,293)	$9007 ($7948-$10,066)	$315 (–$1117 to $1746)
Median	$6225	$5747	
Inpatient costs			
Mean (95% CI)	$1675 ($939-$2412)	$1288 ($633-$1942)	$388 (–$598 to $1373)
Median	$0	$0	
Medication costs			
Mean (95% CI)	$1083 ($875-$1292)	$1298 ($1001-$1594)	–$215 (–$590 to $161)
Median	$529	$471	
Productivity costs			
Mean (95% CI)	$8302 ($6631-$9974)	$9557 ($7431-$11,682)	–$1255 (–$3961 to $1451)
Median	$3200	$3034	
Total costs			
Mean (95% CI)	$23,125 ($20,574-$25,675)	$22,138 ($18,986-$25,290)	$987 (–$3056 to $5030)
Median	$15,971	$12,794	

CACT indicates centrally assisted collaborative telecare; OUC, optimized usual care; PDS, PTSD Diagnostic Scale; PTSD, posttraumatic stress disorder; QALY, quality-adjusted life-year.
[a]Cost is statistically significantly higher for CACT versus OUC at the $P = .05$ level.

systems approach is utilized to maximize adherence to existing clinical practice guidelines by using a care manager, valid and feasible measures of clinical status, and improved access to mental health specialist consultation.[12] The STEPS-UP trial results have now shown that when a central assistance capability is used to improve clinics' capacity to implement, monitor, and sustain collaborative care,[20] patient outcomes improve. However, to utilize collaborative care resources most efficiently, a critical mass of patients is required to make the intervention economically feasible. Using a hypothetical scenario, we show that if the patient population in our study were reduced by half, the per patient cost of CACT relative to OUC would increase substantially due to the additional per-patient costs of centralized care, and the ICER of CACT versus OUC would increase from $49,346 to $110,089/QALY. Thus, a system planning to implement CACT would need to carefully project the size of the patient population and plan central resources accordingly.

In addition, the results were sensitive to our decision to include the monetary value of lost workdays due to health problems as a cost input, as recommended by the Second Panel on Cost-Effectiveness in Health and Medicine.[33] We found that the higher costs in the CACT arm due to the higher costs of the intervention were diminished somewhat once the smaller number of days of missed work was taken into account. Excluding these productivity costs increased the ICER to $112,081/QALY, showing the importance of including all relevant costs in a CEA from a societal perspective.

The evidence for collaborative care is robust. Collaborative care has been demonstrated to be effective in more than 80 RCTs in various settings, which now include the MHS.[20] Health economics studies have also consistently reported the model to be either cost saving or cost-effective. Although no previous studies have investigated collaborative care for mental illness in the MHS, several have investigated the use of similar models of care in a variety of civilian and Veterans Affairs healthcare settings and populations. These studies produced a range of estimates, which are generally consistent with our results. A systematic review[34] of 11 cost-effectiveness studies accompanying RCTs of enhanced primary care for depression found that interventions based upon collaborative care/case management resulted in improved outcomes at a greater cost, but they were generally considered to be cost-effective (range, $15,463 to $36,467/QALY). Another study[35] that reviewed existing cost-effectiveness studies of primary care depression treatments also found that collaborative care interventions are generally considered to be cost-effective (range, cost-saving to $105,819/QALY gained). Varying results are due to different forms of collaborative care interventions, different comparators, and different study populations.

Limitations

The claims data we used included all services provided within the MHS and those reimbursed by TRICARE outside of the MHS. We were not able to track other services paid for by non-TRICARE third-party payers or by the patient. Previous study findings indicate that more than one-fifth of depression treatment expenses are paid for

TABLE 4. Overall and Sensitivity Cost-Effectiveness Analyses

	Difference in Cost (95% CI)	Difference in QALY (95% CI)	ICER ($/QALY)	% Cost-Effective at $100,000/QALY
Overall (n = 629)	$987 (–$3056 to $5030)	0.02 (–0.001 to 0.03)	$49,346	58%
Sensitivity				
Truncating costs at 99th percentile[a]	$678 (–$2920 to $4275)	0.02 (–0.001 to 0.03)	$33,880	65%
Excluding productivity costs	$2242 ($151-$4332)	0.02 (–0.001 to 0.03)	$112,081	33%
Half number patients in centralized management[b]	$2202 (–$1841 to $6245)	0.02 (–0.001 to 0.03)	$110,089	40%
Alternative assumptions regarding OUC intervention costs[c]	$796 (–$3248 to $4839)	0.02 (–0.001 to 0.03)	$39,780	61%
Available case (n = 661)[d]	$726 (–$3865 to $5317)	0.02 (–0.001 to 0.03)	$36,289	N/A
Complete case (n = 459)[e]	$480 (–$4518 to $5478)	0.02 (–0.001 to 0.04)	$24,001	68%

ICER indicates incremental cost-effectiveness ratio; N/A, not applicable; OUC, optimized usual care; QALY, quality-adjusted life-year.
[a]Truncated all cost data at the 99th percentile within treatment arm by cost category and set higher costs equal to that threshold.
[b]Halved the number of patients we assumed would be followed by our set number of centralized management staff.
[c]Used data from nurse coordinator interviews instead of the electronic case management system to estimate intervention costs for OUC patients.
[d]Restricted our analyses to only patients with data at each time point.
[e]Restricted our analyses to only patients with complete data through 12 months.

out-of-pocket in the civilian population,[36] but no estimates are available regarding the expected extent of these expenditures in the military population. In addition, some study participants left the military and became ineligible for services before the end of the 12-month study.[37] However, loss of MHS services did not differ significantly between the 2 treatment arms,[37] and we used multiple imputation to include all patients who had minimal cost and health outcome follow-up data.

We were limited to a 12-month follow-up period and were not able to track cost or health outcomes beyond this time. Previous study results have suggested that higher up-front intervention costs associated with collaborative care may produce longer-term savings[38] and that health effects may continue to be realized beyond the 12-month mark,[39] indicating that our relatively short follow-up time period may have produced conservative cost-effectiveness estimates. Our RCT results found that the relative effectiveness of CACT improved over the 12-month period of follow-up.[20]

We used the SF-6D conversion of the SF-12 instrument to estimate QALY values. This utility conversion includes only 1 mental health question and may be limited in its sensitivity to changes in mental health functioning over time.[40] In addition, our evaluation did not incorporate the impact the intervention may have had on the health of patients' family members. Previous research has shown that mental health conditions, including depression, can have measurable impacts on other family members.[41] Excluding spillover gains in family health that may result from treatment may lead to underestimation of the true value of interventions.[42]

CONCLUSIONS

Compared with OUC, use of the CACT costs $49,346/QALY gained for decreasing symptoms of PTSD and depression in active-duty service members in the MHS, with a 58% probability of being cost-effective at a $100,000/QALY threshold. The results of this study are timely and show that a stepped collaborative care approach may offer an economically sustainable way of improving the quality and outcomes of care for patients with PTSD and depression in the military. ■

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