

An Evaluation of a Care Coaching and Provider Referral Intervention for Behavioral Health Needs

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Among an estimated 1 in 5 Americans (46.6 million in 2017) with behavioral health (BH) conditions, only about 43% will receive BH care each year.¹ During the COVID-19 pandemic, prevalence of BH conditions such as anxiety, depression, and substance use doubled,² and care for these conditions became more fragmented.³ Stigma, lack of access, cost, lack of clinical incentives to diagnose and treat BH, and a shortage of qualified providers all contribute to this care gap.⁴ BH conditions, including depression, anxiety, and substance use disorders (SUDs), are major drivers of cost in the US health care system and are associated with a doubling or tripling of total cost of care.⁵

The use of telehealth interventions for the treatment of BH conditions has expanded substantially over the last decade, with even more rapid change to this landscape occurring because of the COVID-19 pandemic.⁶ Several recent reports summarize the adaptation of practice and suggest that remote delivery is likely to remain common after the pandemic subsides.⁷⁻¹⁰ Evidence supporting these telehealth interventions lags behind the growth of the sector, and there have been very few formal evaluations of the cost impacts of these interventions.¹¹⁻¹³ This report summarizes an evaluation of a BH intervention that combines telephonic-based care coaching with connecting members to BH providers to address behavioral issues that are associated with high health care costs.

METHODS

Description of Program

Ontrak is a national organization that offers an integrated provider-led intervention for individuals with unaddressed BH conditions and chronic diseases. Ontrak contracts with health plans, including commercial and Medicare Advantage lines of business, to serve clinically complex, high-cost members who have anxiety, depression, and/or SUD and comorbid acute and chronic physical conditions such as hypertension, chronic obstructive pulmonary disease, and chronic pain. Eligible members enroll in a 52-week BH telephonic care coaching program designed to improve health outcomes. Trained care coaches work with members to establish care treatment

ABSTRACT

OBJECTIVES: To evaluate changes in health care spending and utilization associated with a telehealth-based care coach-supported and behavioral health (BH) provider referral intervention in the United States.

STUDY DESIGN: Observational retrospective cohort study with propensity score matching of treated and control groups.

METHODS: Difference-in-differences (DID) analysis was used to calculate per-member per-month (PMPM) savings and changes in utilization in a treated group relative to matched controls over 36 months. The study included 1800 adults with substance use disorder (SUD), anxiety, or depression who were eligible for the intervention. Treated members (n = 900) graduated from the program. Matched control members (n = 900) were eligible but never enrolled. Primary outcomes included all-cause and disease-attributable health care cost and utilization PMPM, categorized by place of service.

RESULTS: There were statistically significant reductions in total all-cause medical costs of \$485 PMPM ($P < .001$) and a 66% pre-post reduction in inpatient encounters, with \$488 PMPM DID savings for inpatient admissions ($P < .001$) among the treated cohort compared with the control cohort over 36 months. Conversely, there were statistically significant cost increases (\$110 PMPM; $P < .001$) for all-cause office visits in the treated cohort compared with the control cohort. Similar results were seen in SUD-attributable and BH-attributable costs.

CONCLUSIONS: Although the results could be affected by unmeasured confounding, they suggest that care coaching interventions that offer BH provider referrals may produce long-term savings, reductions in avoidable utilization, and increases in targeted services to treat BH conditions. Rigorous evaluations are needed to confirm these findings.

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pathways, activate durable health-seeking behavior by setting personal health goals, and drive toward durable behavior change to prevent large but avoidable costs associated with health care utilization. The approach is based on evidence-based coaching standards such as motivational interviewing,¹⁴ self-determination theory,¹⁵ and person-centered care.¹⁶ Health coaches connect individuals to BH providers (virtual or in person) for therapy and/or medication management. Program completion was defined as (1) 365 days of enrollment; (2) primary care provider visit completed; (3) at least 1 behavior changed related to self-identified goal, including decreased substance use, improved diet, or social risk resolution, among others; and (4) member-specific adherence to provider follow-ups and physician recommendations.

In this article, we test the hypothesis that care coaching and provider referral models improve health-related outcomes while lowering costs.

Study Design

This longitudinal, retrospective observational study compared cost and utilization between an enrolled group of members who completed the Ontrak program (treatment cohort) and a propensity score-matched control cohort of members who were eligible for the Ontrak program but never enrolled. The preindex period was the 12 months preceding the enrollment month. The postindex period began with the enrollment day (simulated for control members) and continued thereafter for 24 months post enrollment (Figure 1).

Data Source

We used a proprietary administrative claims data set containing health plan eligibility history and longitudinal member data from regional and national health plans contracted with Ontrak, representing commercial and Medicare Advantage plans in the Northeastern, Southern, Midwestern, and Western regions of the United States.

Study Population

Inclusion criteria were (1) continuous health plan eligibility for 36 months; (2) diagnosis of SUD, depression, or anxiety; (3) being at least 18 and younger than 85 years on the date of enrollment; and (4) meeting a cost threshold of \$7500 in health care-related costs during the 12-month preindex period. Exclusion criteria included specific clinical conditions or procedures and facility and professional claims exceeding \$100,000 within the last 12 months. Inclusion and exclusion criteria are described in [eAppendix Table 1](#) (eAppendix available at ajmc.com); clinical *International*

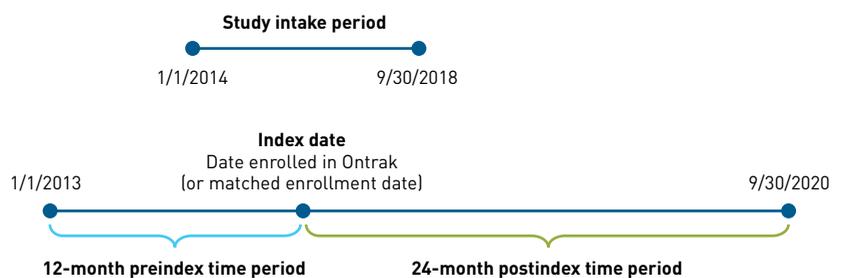
TAKEAWAY POINTS

A care coaching intervention that offers behavioral health (BH) provider referrals produced significant long-term savings, reductions in avoidable inpatient utilization, and increases in office visits and targeted services to treat BH conditions.

- ▶ All-cause medical savings were driven by reductions in inpatient cost and utilization. Conversely, there were increases in all-cause office visits and BH-attributable costs.
- ▶ Savings were sustained throughout the 24-month postindex time period, indicating the durability of the program.

These results provide support for a shift toward clinical integration of BH interventions to achieve long-term savings, which is crucial as the US health care system moves toward value-based care with an increased focus on BH interventions.

FIGURE 1. Study Design



Classification of Diseases, Ninth Revision (ICD-9) and Tenth Revision (ICD-10) exclusion codes are available upon request. Except for continuous health plan coverage, these inclusion and exclusion criteria also reflect Ontrak program eligibility.

Individuals in the treatment cohort were members who enrolled in the Ontrak program between January 1, 2014, and September 30, 2018, and graduated from the program (n=900), allowing for continuous eligibility requirements (Figure 1). For treated members, the index date was the date that they enrolled in the program. For each control group member, a simulated enrollment date was set to the date they were first eligible to enroll plus 119 days, the mean time to enrollment for individuals in the program. Individuals in the control cohort were propensity score matched to members meeting Ontrak program and study eligibility criteria who never enrolled in the program.

Primary End Points

Primary end points were health care resource utilization and plan-paid costs for enrolled and nonenrolled members during preindex and postindex periods. All-cause health care costs included the sum of all medical costs associated with the utilization of health care paid by the health plan during the preindex and postindex periods and were adjusted to 2020 US\$ based on US Census Bureau inflation ratios. Disease-attributable costs were defined as the medical costs associated with claims identified as SUD, anxiety, or depression

CLINICAL

TABLE 1. Baseline Sociodemographic and Clinical Characteristics of Study Population (N = 1800)^{17,18}

	Treated	Matched controls	P		Treated	Matched controls	P
No. of members	900	900		Physical comorbidities, ^f n (%)			
Age group in years on index date, n (%)				Asthma	224 (25)	237 (26)	.52
18-34	51 (6)	51 (6)	>.99	COPD	262 (29)	245 (27)	.40
35-44	71 (8)	71 (8)		Chronic pain	375 (42)	337 (37)	.07
45-54	148 (16)	148 (16)		CHF	150 (17)	128 (14)	.17
55-64	342 (38)	342 (38)		CAD	258 (29)	250 (28)	.71
≥65	288 (32)	288 (32)		Diabetes	332 (37)	287 (32)	.03
Age in years, mean (SD)	58.32 (12.98)	58.29 (13.27)	.85	Gallbladder disease	102 (11)	96 (11)	.71
Gender, n (%)				Hepatitis C	27 (3)	22 (2)	.56
Female	578 (64)	586 (65)	.73	Hypertension	693 (77)	660 (73)	.08
Male	322 (36)	314 (35)		Hypertriglyceridemia	221 (25)	199 (22)	.24
Geographic region, ^a n (%)				Injury/poisoning	85 (9)	91 (10)	.69
West	0 (0)	0 (0)	.05	Multiple sclerosis	14 (2)	10 (1)	.54
Midwest	373 (41)	393 (44)		Pneumonia	184 (20)	166 (18)	.31
South	432 (48)	387 (43)		Rheumatoid arthritis	84 (9)	73 (8)	.40
Northeast	95 (11)	120 (13)		Mental health comorbidities, ^g n (%)			
Plan type, n (%)				Anxiety	638 (71)	638 (71)	>.99
Commercial ^b	450 (50)	450 (50)	>.99	Attention deficit	51 (6)	74 (8)	.04
Medicare ^c	450 (50)	450 (50)		Bipolar	101 (11)	88 (10)	.36
Rural type, ^d n (%)				Depression	614 (68)	614 (68)	>.99
Rural	230 (26)	180 (20)	>.99	Developmental disorders	3 (0)	4 (0)	>.99
Not rural	670 (74)	720 (80)		Nicotine dependence	421 (47)	409 (45)	.60
Elixhauser comorbidity index score, ^e mean (SD)	2.08 (12.01)	2.01 (11.2)	.72	Other psych	212 (24)	185 (21)	.14
				Personality disorder	14 (2)	14 (2)	>.99
				SUD	562 (62)	562 (62)	>.99
				Suicide	2 (0)	6 (1)	.29

CAD, coronary artery disease; CHF, chronic heart failure; COPD, chronic obstructive pulmonary disease; SUD, substance use disorder.

^aGeographic regions are the following: West (Colorado, Wyoming, Montana, Idaho, Washington, Oregon, Utah, Nevada, California, Alaska, Hawaii), Midwest (Ohio, Indiana, Michigan, Illinois, Missouri, Wisconsin, Minnesota, Iowa, Kansas, Nebraska, South Dakota, North Dakota), Northeast (Maine, Massachusetts, Rhode Island, Connecticut, New Hampshire, Vermont, New York, Pennsylvania, New Jersey, Delaware, Maryland), and South (West Virginia, Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Arkansas, Louisiana, Florida, Texas, Oklahoma, New Mexico, Arizona).

^bCommercial: subscriber and dependents with health care insurance that is provided by subscriber's employer.

^cMedicare: subscriber who is 65 years or older and/or has disability pension and/or has amyotrophic lateral sclerosis and/or permanent kidney failure.

^dRurality is defined by zip code using Federal Office of Rural Health Policy definition.¹⁷

^eThe Elixhauser comorbidity index categorizes and weights comorbidities to provide a score related to the likelihood of mortality in 6 months.¹⁸

^fPhysical comorbidities indicate comorbidities that are nonpsychiatric. Flags originate from diagnosis codes in administrative claims data.

^gMental health comorbidities indicate comorbidities that are behavioral. Flags originate from diagnosis codes in administrative claims data.

based on ICD-9 or ICD-10 diagnosis codes; BH-attributable costs were defined as costs associated with BH services identified by a list of Current Procedural Terminology and Healthcare Common Procedure Coding System codes (code lists available upon request). Costs included claims categorized by place of service codes as inpatient hospitalizations, emergency department (ED) visits, physician office visits, and outpatient visits (utilization that occurs in a hospital outpatient location, which could include blood work, diagnostic test workups, or other nonemergency procedures). Cost savings are reported as gross savings.

All-cause utilization was defined as the sum of encounters for each member associated with inpatient hospitalization, ED visits,

physician office visits, or outpatient visits. Disease-attributable utilization applied the same diagnosis code criteria as the cost variables. Costs and utilization were normalized to per-member per-month (PMPM) values for the preindex and postindex periods (12 months and 24 months, respectively). We report outcomes among individuals with at least 1 utilization in the preindex or postindex time periods, as well as for all members (eAppendix Table 2 [A-D]).

Covariates

Patient demographic and clinical characteristics are shown in Table 1.^{17,18} Clinical characteristics were further quantified using the Elixhauser comorbidity index, which categorizes and weights

comorbidities to provide a score related to the likelihood of mortality in 6 months.¹⁸ The mean Elixhauser score was calculated for members during their preindex time period to assess level of comorbidity within the population. Distributions of preindex and postindex all-cause medical costs are shown in the [eAppendix Figure](#).

Statistical Analysis

One-to-one propensity score matching (PSM) was used to identify a matched control cohort of individuals who were eligible but did not enroll in the program. Although PSM is widely used and acknowledged,^{19,20} it is an imperfect method for controlling selection bias. Only randomization can control for unobserved differences that may be present when similar individuals make different decisions about program enrollment. The outcome of the propensity model was propensity for enrollment in the Ontrak program. Features included in the forced match (line of business, age category, health plan, SUD/anxiety/depression diagnosis) are shown in [eAppendix Table 3](#). Features included in the PSM model are listed in [eAppendix Table 3](#) and included date first identified, sociodemographic/clinical characteristics, health plan, line of business, and slope of 1-month pre-enrollment costs (we identified costs 1 month prior to enrollment, subtracted PMPM value for the 12-month preindex time period, and matched treated and control members who had the same directionality of slope to match on trend of 1-month preindex costs relative to 12-month preindex period).

Pairwise propensity score distances were identified between each treated member and every control member, and couplings were sorted in ascending order by propensity score distance. The first time a control member was assigned to a treated member, based on having the smallest propensity score distance, all later couplings involving that control member were removed. Similarly, once any treated member attained a matched control, all later couplings involving that treated member were removed.

The quality of the match was assessed using a standardized differences threshold of 0.2 across the treatment and control groups on all variables used in the PSM model. Statistical differences between groups were determined using χ^2 tests for categorical variables and Mann-Whitney tests for non-normally distributed continuous variables.²¹ We conducted sensitivity analyses on the balance of the PSM-matched cohorts by assessing additional comparison groups including a never-enrolled (but eligible to enroll) cohort, unmatched controls, and a random sample of unmatched controls ([eAppendix Table 4](#)).

Difference-in-differences (DID) calculations were applied to the matched treated and control groups to estimate the average treatment effect for the outcomes of interest, including all-cause and disease-attributable cost and utilization outcome variables. Following DID methods, the pre-post change in PMPM cost and utilization was derived for both the treated cohort and the matched controls (ie, for each cohort, the postindex values for cost and utilization were subtracted from the preindex values to create the within-member

differences used in the analysis). Thus, $DID = (\text{postindex cost} - \text{preindex cost})_{\text{Treatment}} - (\text{postindex cost} - \text{preindex cost})_{\text{Control}}$.

Two-sample *t* tests were applied to assess the statistical significance of the DID values because the variables used in the DID statistics were continuous and our sample size was sufficiently large. Difference statistics between preindex and postindex periods were reported as the mean value with a 95% CI and SD for the treatment and control cohorts separately, as well as for the DID across the cohorts. CIs were calculated using the simple bootstrap method.²² To investigate the sensitivity of the findings to outlier values, we took the logarithmic value of the larger of cost and \$1 and ran a standard DID regression. We also winsorized using thresholds from 0% to 40% on member-level DID.

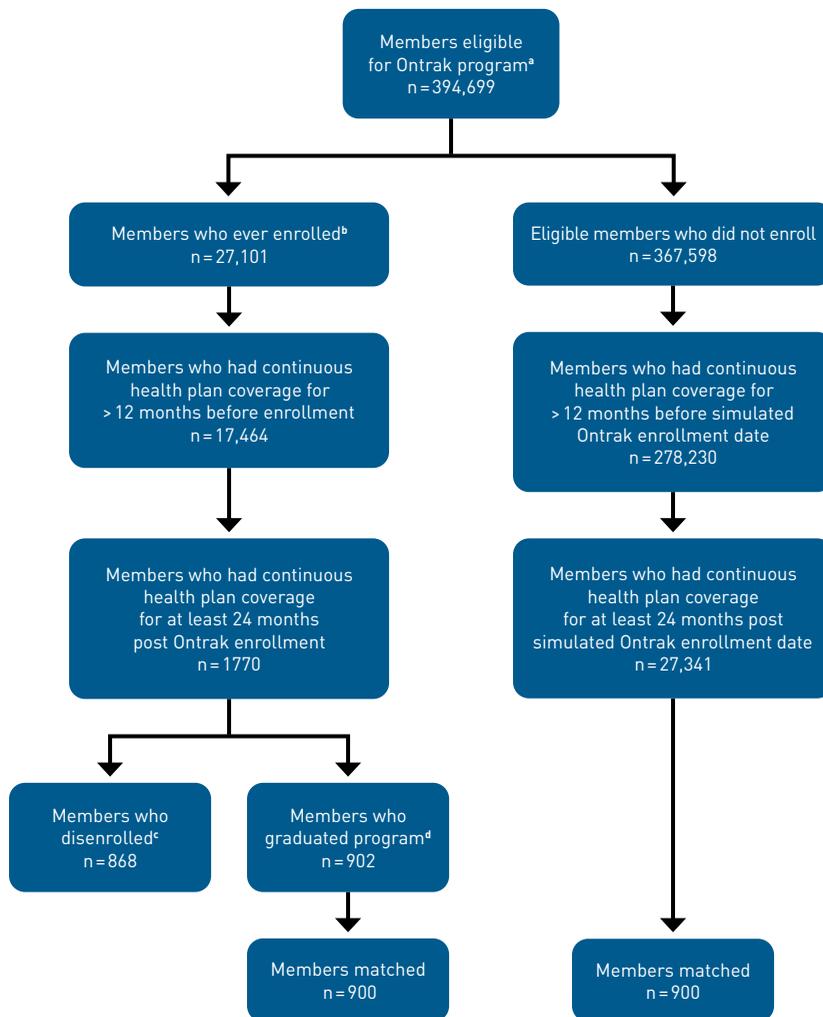
RESULTS

The final sample that met all predefined study eligibility criteria included 1800 individuals (900 treated, 900 matched controls; this even number of treated and control cohorts was arrived at by chance following application of our study eligibility criteria and exact matching criteria) ([Figure 2](#)), with a mean age of 58 years, 50% in Medicare Advantage and 50% in commercial plans, and 64% to 65% female ([Table 1](#)). Mean Elixhauser comorbidity scores were 2.08 and 2.01 in the treated and control cohorts, respectively ($P = .72$). The 3 most common medical comorbidities were hypertension, diabetes, and chronic pain. Among psychiatric comorbidities, anxiety, SUD, and depression were most common ([Table 1](#)). Many individuals had multiple, overlapping psychiatric and clinical comorbidities.

Descriptive statistics of all measured clinical and sociodemographic variables for the treated and control cohorts and members included or excluded from matching are provided in [Table 1](#) and [eAppendix Table 4](#). Differences across clinical or sociodemographic characteristics between the 2 cohorts were nonsignificant ([Table 1](#)) and below our threshold of less than 0.2 standard units across these variables, indicating a well-balanced matched control cohort ([eAppendix Table 5](#)). After matching, preindex period inpatient-related costs differed between treatment and control cohorts by 19%; all-cause costs differed by 11% ([Table 2](#)).

Over 24 months, all-cause costs were statistically significantly lower in the treated vs control cohort, by \$485 PMPM (95% CI, \$170-\$780; $P < .001$). This was largely driven by a reduction in inpatient utilization; we found a 66% pre-post reduction in inpatient encounters among the treated cohort, with \$488 PMPM DID savings for inpatient admissions (95% CI, \$183-\$683; $P < .001$) compared with the control cohort ([Table 2](#)). Results from our sensitivity analyses ([eAppendix Table 6](#)) indicated a DID savings of \$426 (all-cause costs) and the magnitude of savings was smallest when 15% of upper and lower bounds were winsorized ([eAppendix Table 6](#); \$384 PMPM). These values both fall within the 95% CIs described for the main effects (\$170-\$780), indicating a change in magnitude of savings, but no change in directionality.

FIGURE 2. Attrition Table Among Ever-Enrolled and Never-Enrolled Members



^aOntrak eligibility criteria were (1) diagnosis of substance use disorder, depression, or anxiety; (2) being aged at least 18 and younger than 85 years on the date of enrollment, and (3) meeting a cost threshold of \$7500 of health care–related costs during 12-month preindex period. Exclusion criteria included (1) diagnoses of end-stage renal disease, HIV/AIDS, cancer, hemophilia, transplant, chronic paranoid schizophrenia, or excludable dementia in past 12 months, (2) receiving hospice care in past 12 months, or (3) having facility and professional claims exceeding \$100,000 in past 12 months.

^bEnrollment definition: eligible health plan members who agreed to participate in Ontrak program.

^cDisenrollment definition: members who do not complete the program because a care coach loses touch with them for at least 90 days or the member decides they do not want to continue.

^dGraduation: completion of the Ontrak program required meeting specific criteria, including 365 days of enrollment; primary care provider visit completed during enrollment; at least 1 behavior changed related to self-identified goal, such as decreased substance use, improved diet, or social risk resolution, among others; and member-specific adherence to provider follow-ups and physician recommendations.

We identified statistically significant cost increases for all-cause office visits in the treated cohort (\$110 PMPM; $P < .001$) (Table 2). All-cause outpatient costs and utilization decreased modestly for both the treated and control cohorts, with \$74 PMPM DID savings ($P = .06$) for the treated cohort compared with the control cohort. ED cost and utilization also decreased slightly for both cohorts, with a small but significant reduction in ED visits for the treated cohort

compared with the control cohort (0.02 visits PMPM; $P < .05$).

Similar trends were found in disease-attributable costs (Table 3). There were statistically significant savings for SUD-attributable total medical costs (\$224 PMPM; $P < .05$) among the treated cohort compared with the control cohort. These savings are likely driven by statistically significant inpatient cost savings (\$630 PMPM; $P < .01$) and a small but significant reduction in utilization (0.07 hospitalizations PMPM; $P < .01$). Office visit costs and utilization attributable to anxiety, depression, and BH increased significantly ($P < .001$) for the treated cohort between the preindex and postindex periods compared with the control cohort (by \$69 and 0.109 visits; \$61 and 0.133 visits; and \$75 and 0.124 visits PMPM, respectively).

DISCUSSION

Completing a telephonic care coaching and BH provider referral program was associated with a significant reduction in all-cause medical costs for high-cost individuals with BH conditions and complex acute and chronic clinical comorbidities. The cost differences were largely driven by a reduction in all-cause inpatient utilization. Conversely, we identified statistically significant cost increases for all-cause office visits in the treated cohort compared with the control cohort, suggesting that enrolled individuals had fewer inpatient encounters but more office visits.

Mean PMPM costs declined in both the control and the treatment cohorts. This was not unexpected: Eligibility criteria favored individuals with high health care spending. Greater cost decrease in the treatment cohort may reflect a shift away from more costly inpatient treatment and ED services to more efficient, appropriate outpatient care. Individuals who enrolled in the Ontrak program had statistically significant decreases in inpatient encounters and increases in costs related to office

visits, driven predominantly by increases in SUD-attributable and BH-attributable care.

Well-established longitudinal methodologies identifying linear clinical care pathways to establish causality and measure treatment effect of BH interventions are still in development. However, consistent with our findings, investigators assessing Medicaid administrative claims described cost differences between a cohort

TABLE 2. All-Cause Health Care Utilization and Cost by Place of Service During 12-Month Preindex and 24-Month Postindex Periods (N = 1800)

	Treated			Matched controls			DID	
	Pre-	Post	Mean difference (95% CI)	Pre-	Post	Mean difference (95% CI)	Mean difference (95% CI)	P
Total No. of members	900			900				
All-cause inpatient admissions (PMPM)								
Members with ≥ 1 pre- or postindex hospitalization, n (%)	393 (44)			393 (44)				
Number of hospitalizations for all members, mean	0.14	0.05	0.09 (0.07-0.1)	0.13	0.08	0.05 (0.03-0.07)	0.04	<.001
Number of hospitalizations for members with ≥ 1 hospitalization, mean	0.21	0.07	0.13 (0.11-0.16)	0.22	0.14	0.08 (0.04-0.12)	0.05	.001
Cost in \$ among all members, mean	1089	384	705 (557-853)	888	538	350 (202-499)	355 (143-556)	<.001
Cost in \$ among members with ≥ 1 hospitalization, mean	1655	583	1072 (853-1291)	1481	897	584 (338-830)	488 (183-683)	<.001
All-cause ED visits (PMPM)								
Members with ≥ 1 pre- or postindex ED visit, n (%)	480 (53)			480 (53)				
Number of ED visits for all members, mean	0.13	0.09	0.05 (0.03-0.06)	0.13	0.09	0.03 (0.02-0.05)	0.01	.04
Number of ED visits for members with ≥ 1 ED visit, mean	0.18	0.12	0.06 (0.05-0.08)	0.18	0.13	0.05 (0.03-0.06)	0.02	.06
Cost in \$ among all members, mean	277	187	91 (47-134)	241	160	81 (42-120)	9	.16
Cost in \$ among members with ≥ 1 ED visit, mean	371	250	121 (64-179)	342	227	115 (60-170)	6	.27
All-cause office visits (PMPM)								
Members with ≥ 1 pre- or postindex physician office visit, n (%)	870 (97)			870 (97)				
Number of office visits for all members, mean	1.56	1.55	0.01 (-0.06 to 0.08)	1.34	1.21	0.14 (0.07-0.2)	-0.12	.04
Number of office visits for members with ≥ 1 office visit, mean	1.58	1.56	0.01 (-0.06 to 0.08)	1.38	1.24	0.14 (0.07-0.2)	-0.13	.04
Cost in \$ among all members, mean	270	341	-72 (-98 to -45)	270	233	37 (12-62)	-109 (-145 to -71)	<.001
Cost among members with ≥ 1 office visit, mean	272	344	-72 (-99 to -45)	277	239	38 (12-64)	-110 (-145 to -71)	<.001
All-cause outpatient visits (PMPM)								
Members with ≥ 1 pre- or postindex outpatient visit, n (%)	698 (78)			698 (78)				
Number of outpatient visits for all members, mean	0.63	0.42	0.20 (0.15-0.26)	0.58	0.4	0.18 (0.13-0.23)	0.018	.87
Number of outpatient visits for members with ≥ 1 outpatient visit, mean	0.72	0.49	0.23 (0.17-0.30)	0.69	0.47	0.22 (0.16-0.27)	0.017	.86
Cost in \$ among all members, mean	510	315	195 (135-255)	498	369	128 (47-210)	66	.04
Cost in \$ among members with ≥ 1 outpatient service, mean	589	364	225 (156-294)	586	435	151 (55-247)	74	.06
Total medical costs (PMPM)								
Total medical costs in \$, mean	2779	1551	1228 (1010-1446)	2480	1738	743 (530-955)	485 (170-780)	<.001
Members with ≥ 1 pre- or postindex medical encounter, n (%)	900 (100)			900 (100)				
Total medical costs in \$ for members with ≥ 1 pre- or postindex medical encounter, mean	2779	1551	1228 (1010-1446)	2480	1738	743 (530-955)	485 (170-780)	<.001

DID, difference in differences; ED, emergency department; PMPM, per member per month.

who enrolled in a BH self-care digital tool and those who did not and found a DID cost reduction of \$382 per user and return on investment between 142% and 695%.¹¹ The point estimates described in these results are substantially higher than in other published results^{11,23,24}; however, direct comparison is difficult because of differences in study population and postenrollment follow-up time. A strength

of our study is the 24-month postindex follow-up period, which is considerably longer than those found in other published reports.¹¹

Patients with BH conditions have reported a low preference for involvement in their medical decision-making, even when they preferred to have higher involvement in their BH care,²⁵⁻²⁷ and BH conditions have been identified as a risk factor for lower adherence

TABLE 3. Disease-Attributable Utilization and Cost by Place of Service During 12-Month Preindex and 24-Month Postindex Periods Among Members With at Least 1 Encounter^a

	SUD attributable			Anxiety attributable			Depression attributable			BH attributable		
	Treated	Matched controls	DID	Treated	Matched controls	DID	Treated	Matched controls	DID	Treated	Matched controls	DID
Total No. of members	900	900		900	900		900	900		900	900	
	Mean diff (CI)	Mean diff (CI)	Mean diff (CI)	Mean diff (CI)	Mean diff (CI)	Mean diff (CI)	Mean diff (CI)	Mean diff (CI)	Mean diff (CI)	Mean diff (CI)	Mean diff (CI)	Mean diff (CI)
Disease-attributable inpatient admissions												
Members with ≥ 1 pre- or postindex hospitalization, n (%)	334 (37)	334 (37)		319 (35)	319 (35)		352 (39)	352 (39)		14 (2)	14 (2)	
Number of hospitalizations for members with ≥ 1 hospitalization, PMPM mean	0.06 (0.04-0.09)	0.02 (-0.03 to 0.06)	0.05 (-0.01 to 0.11)*	0.04 (0.02-0.06)	0.03 (0.02-0.04)	0.01 (-0.01 to 0.04)	0.05 (0.03-0.07)	0.03 (0.01-0.04)	0.04 (-0.00 to 0.05)	0.13 (-0.06 to 0.33)	-0.42 (-1.2 to 0.39)	0.55 (-0.23 to 1.2)
Cost in \$ among members with ≥ 1 hospitalization, mean	493 (287-699)	79 (-83 to 242)	414 (136-667)*	350 (220-479)	220 (78-362)	129 (-61 to 322)	321 (200-444)	307 (157-457)	14 (-174 to 214)	220 (-66 to 507)	-19 (-1455 to 1415)	239 (-993 to 1618)
Disease-attributable ED visits												
Members with ≥ 1 pre- or postindex ED visit, n (%)	313 (35)	313 (35)		282 (31)	282 (31)		261 (29)	261 (29)		12 (1)	12 (1)	
Number of ED visits for members with ≥ 1 ED visit, PMPM mean	0.01 (-0.01 to 0.03)	0.02 (0.001-0.04)	-0.01	0.02 (0.01-0.04)	0.01 (-0.005 to 0.02)	0.0239*	0.02 (0.01-0.04)	0.01 (-0.003 to 0.03)	0.01	0.01 (-0.03 to 0.05)	0.01 (-0.03 to 0.05)	0.00
Cost in \$ among members with ≥ 1 ED visit, mean	28 (-48 to 105)	87 (4-170)	-58	31 (-15 to 78)	32 (-7 to 72)	-1	70 (21-119)	11 (-29 to 51)	59	7 (49-63)	3 (-40 to 45)	4
Disease-attributable office visits												
Members with ≥ 1 pre- or postindex office visit, n (%)	494 (55)	494 (55)		693 (77)	693 (77)		649 (72)	649 (72)		897 (100)	897 (100)	
Number of office visits for members with ≥ 1 office visit, PMPM mean	-0.01 (-0.06 to 0.04)	0.02 (-0.02 to 0.07)	-0.04 (-0.09 to 0.03)	-0.08 (-0.1 to -0.05)	0.01 (-0.02 to 0.04)	-0.09 (-0.13 to -0.05)*	-0.05 (-0.08 to -0.02)	0.04 (0.02-0.07)	-0.09 (-0.13 to -0.05)*	-0.03 (-0.08 to 0.01)	0.09 (0.04-0.13)	-0.12 (-0.18 to -0.06)*
Cost in \$ among members with ≥ 1 office visit, mean	-6 (-11 to 0)	1 (-4 to 6)	-7 (-14 to 1)	-53 (-63 to -44)	4 (-0.5 to 8)	-57 (-67 to -47)*	-40 (-49 to -31)	7 (1-13)	-47 (-57 to -36)*	-56 (-65 to 45)	17	-73 (-87 to -58)*
Disease-attributable outpatient visits												
Members with ≥ 1 pre- or postindex outpatient visit, n (%)	271 (30)	271 (30)		295 (33)	295 (33)		302 (34)	302 (34)		279 (31)	279 (31)	
Number of outpatient visits for members with ≥ 1 outpatient visit, PMPM mean	0.17 (0.07-0.28)	0.15 (0.07-0.24)	0.02	0.04 (0.01-0.07)	0.11 (0.05-0.18)	-0.07	0.11 (0.06-0.17)	0.11 (0.06-0.17)	0.002	0.21 (0.12-0.3)	0.20 (0.11-0.30)	0.00
Cost in \$ among members with ≥ 1 outpatient visit, mean	109 (30-187)	61 (-3 to 125)	48	47 (6-87)	38 (5-81)	9	99 (23-175)	42 (2-82)	57	102 (26-179)	67 (20-114)	35
Total medical costs for members with at least 1 pre- or postindex medical encounter												
Members with ≥ 1 pre- or postindex medical encounter, n (%)	623 (69)	623 (69)		770 (86)	770 (86)		746 (83)	746 (83)		900 (100)	900 (100)	
Total medical costs in \$ for members with ≥ 1 pre- or postindex medical encounter, mean	355 (218-492)	184 (48-320)	171 (-23 to 353)*	151 (86-215)	123 (55-192)	27 (-66 to 119)*	206 (132-280)	189 (109-268)	17 (-89 to 125)	-8 (-39 to 22)	48 (13-84)	-57 (-107 to -11)*

BH, behavioral health; DID, difference in differences; diff, difference; ED, emergency department; PMPM, per member per month; SUD, substance use disorder.

*P < .05.

^aOutput represents costs and utilization associated with claims identified with SUD, anxiety, or depression diagnosis on claim line. BH attributable is defined as claims with procedures identified as treating a BH condition.

to medical treatment.^{28,29} Lower patient engagement may decrease the effectiveness of coordinated care delivery³⁰ and presents a challenge for addressing higher medical costs and avoidable utilization within this population. However, in our claims analysis, members of the treated cohort had a mean of 10 provider encounters associated with Ontrak referrals and a mean of 23 contacts with care coaches. This indicates high engagement with providers, care coaches, and BH-related services among the treated cohort, despite low BH care utilization in the general population.¹ High engagement may reflect high levels of patient activation and the effect of the program on increased health-seeking behavior. The study provides evidence for the durability of program impact; the 12-month engagement in this program is longer than that of most BH programs. Additional evaluation will be necessary to confirm that the benefits of the program remain observable beyond 24 months post enrollment.

Limitations

Our conclusions should be interpreted considering several important limitations. First, this observational study was limited to graduates of the Ontrak program. When compared with the ever-enrolled population, our treated cohort was closely matched on clinical and sociodemographic characteristics (eAppendix Table 7). Second, sample size was limited by 36-month health plan eligibility criteria. This criterion was necessary to measure primary end points within our study design. Third, although we employed both 1:1 PSM and DID together to address limitations of cross-sectional matched pair studies, there may be endogeneity inherent in using enrollment (which is not randomized) in our propensity score model. We attempted to control for this in a matching methodology, and yet we recognize this as a limitation. We encourage prospective randomized controlled trials to address this limitation. Due to the limitations of what is possible to control within retrospective, nonrandomized study designs, we implemented several sensitivity analyses. We found the magnitude of savings was smaller but within the 95% CI ranges described, indicating a change in magnitude of savings but no change in directionality. This also indicates that results could be sensitive to cost outliers, and future evaluations should consider this finding.

The use of administrative claims data limits our analysis in a few ways. Data on race, ethnicity, marital status, or income are not available. Plan type information is not available (eg, health maintenance organization, preferred provider organization), and we were not able to evaluate differences in allowed amount, co-payments, and out-of-pocket costs across these plan types, as well as network coverage. Pharmacy data were not available for all participants and could not be used in the analysis. Costs were limited to plan-paid costs.

Finally, although Ontrak has also contracted with Medicaid insurers, this was a newer population to the business and did not meet continuous eligibility criteria for our study design. Therefore, our analysis was limited to commercial and Medicare Advantage lines of business.

CONCLUSIONS

Point estimates presented in this article should be interpreted while considering limitations in our study design and data capabilities. Our findings suggest that care coaching interventions offering BH provider referrals may both increase services to treat SUD and BH conditions and reduce total all-cause health care costs. Findings of our observational retrospective cohort study suggest that telephonic care coaching programs to treat BH conditions may provide long-term savings, reductions in avoidable utilization, and increases in targeted services to treat BH conditions. We encourage additional rigorous evaluations to confirm our findings, ideally incorporating prospective, randomized study designs. Overall, our results may provide support for the shift toward integration of BH interventions to achieve long-term savings in US health care costs. This is critical as we develop a perspective of value-based care in the United States focusing on behavioral interventions embedded within clinical settings. ■

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eAppendix Table 1. Ontrak Inclusion / Exclusion Criteria

Inclusion Criteria:
Member has active health plan coverage
Member is ≥ 18 and < 85 years
member has at least \$7500 of professional and facility claims in past 12 months pre-index time period. Prescription-related costs and any costs associated with shock months (any month identified with at least \$50K in facility and professional claims for an individual) are not included in the calculation.
Member has a diagnosis of Anxiety, Depression or SUD pre-defined by a set of ICD-9 and ICD-10 codes
Exclusion Criteria:
Member has any single facility claim with a surgery CPT code and whose costs exceed 50% of 12-month pre-index cost
Member has received hospice care in 12-month pre-index time period
Member has more than \$100k of facility and professional claims in 12-month pre-index time period
Clinical exclusions: Diagnoses of ESRD, HIV/AIDS, High mortality rate cancer, hemophilia, transplant, chronic paranoid schizophrenia, excludable dementia, cancer in 12 months prior to enrollment

eAppendix Table 2a. SUD-attributable Utilization and Cost by Place of Service during 12 months pre and 24 post-index period for all members

	<u>Treated</u>			<u>Matched Controls</u>			<u>Difference-in-Difference</u>	
	Pre	Post	Mean Difference (95% CI)	Pre	Post	Mean Difference (95% CI)	Mean Difference (CI)	P-value
Total Number of Members	900	900		900	900			
Disease- Attributable Inpatient Admissions								
Number of hospitalizations for all members, mean	0.03	0.01	0.02 (0.01 to 0.03)	0.04	0.03	0.01 (-0.01 to 0.02)	0.02	P < .001
Cost among all members, mean, \$	\$284	\$101	183 (105 to 261)	\$193	\$164	29 (-31 to 90)	154	0.002
Disease- Attributable Emergency Room Visits								
Number of ER visits for all members, mean	0.02	0.02	0.003 (0.00 to 0.01)	0.03	0.02	0.01 (0.00 to 0.01)	0.00	0.38
Cost among all members, mean, \$	\$64	\$54	10 (-17 to 36)	\$67	\$37	30 (1 to 59)	-20	0.49
Disease- Attributable Office Visits								
Number of office visits for all members, mean	0.08	0.08	-0.01 (-0.03 to 0.02)	0.08	0.07	0.01 (-0.01 to 0.04)	-0.02	0.77
Cost among all members, mean, \$	\$9	\$12	-3 (-6 to 0)	\$10	\$9	1 (-2 to 3)	-4	0.09
Disease- Attributable Outpatient Visits								
Number of outpatient visits for all members, mean	0.07	0.02	0.05 (0.02 to 0.08)	0.08	0.03	0.05 (0.02 to 0.07)	0.01	0.48
Number of outpatient visits for members with ≥ 1 outpatient visit, mean	0.24	0.07	0.17 (0.07 to 0.28)	0.26	0.11	0.15 (0.07 to 0.24)	0.02	0.53
Cost among all members, mean, \$	\$57	\$24	33 (9 to 57)	\$51	\$32	18 (-1 to 38)	14	0.92
Total Medical Costs, mean, \$	\$431	\$197	235 (144 to 326)	\$382	\$260	122 (32 to 212)	113	0.20

eAppendix Table 2b. Anxiety Attributable Utilization and Cost by Place of Service during 12 months pre and 24 post-index period for all members

	<u>Treated</u>			<u>Matched Controls</u>			<u>Difference-in-Difference</u>	
	Pre	Post	Mean Difference (95% CI)	Pre	Post	Mean Difference (95% CI)	Mean Difference (CI)	P-value
Total Number of Members	900	900		900	900			
Disease- Attributable Inpatient Admissions								
Number of hospitalizations for all members, mean	0.02	0.01	0.02 (0.01 to 0.02)	0.02	0.01	0.01 (0.01 to 0.02)	0.00	0.83
Cost among all members, mean, \$	\$203	\$79	124 (77 to 171)	\$175	97	78 (27 to 129)	46	0.46
Disease- Attributable Emergency Room Visits								
Number of ER visits for all members, mean	0.02	0.01	0.01 (0.00 to 0.01)	0.02	0.01	0.003 (0.00 to 0.01)	0.00	0.07
Cost among all members, mean, \$	\$43	\$33	10 (-5 to 24)	39	29	10 (-2 to 23)	0	0.25
Disease- Attributable Office Visits								
Number of office visits for all members, mean (median, SD)	0.14	0.2	-0.06 (-0.08 to -0.04)	0.14	0.13	0.01 (-0.01 to 0.03)	-0.07	P < .001
Cost among all members, mean, \$	\$18	\$59	-41 (-48 to -34)	18	15	3 (0 to 6)	-44	P < .001
Disease- Attributable Outpatient Visits								
Number of outpatient visits for all members, mean	0.03	0.02	0.01 (0.00 to 0.02)	0.06	0.02	0.04 (0.01 to 0.06)	-0.02	0.20
Cost among all members, mean, \$	\$30	\$15	15 (2 to 29)	35	22	12 (-2 to 27)	3	0.10
Total Medical Costs, mean (median, SD), \$	\$315	\$189	126 (72 to 180)	279	174	104 (47 to 162)	22	0.001

eAppendix Table 2c. Depression Attributable Utilization and Cost by Place of Service during 12 months pre and 24 post-index period for all members

	<u>Treated</u>			<u>Matched Controls</u>			<u>Difference-in-Difference</u>	
	Pre	Post	Mean Difference (95% CI)	Pre	Post	Mean Difference (95% CI)	Mean Difference (CI)	P-value
Total Number of Members	900	900		900	900			
Disease- Attributable Inpatient Admissions								
Number of hospitalizations for all members, mean	0.03	0.01	0.02 (0.01 to 0.03)	0.02	0.01	0.01 (0.00 to 0.02)	0.01	0.10
Cost among all members, mean, \$	221	95	126 (77 to 174)	215	95 (0, 432)	120 (61 to 180)	6	0.24
Disease- Attributable Emergency Room Visits								
Number of ER visits for all members, mean	0.02	0.01	0.01 (0.00 to 0.01)	0.02	0.01	0.003 (0.00 to 0.01)	0.00	0.34
Cost among all members, mean, \$	45	25	20 (6 to 35)	31	28	3 (-8 to 15)	17	0.16
Disease- Attributable Office Visits								
Number of office visits for all members, mean (median, SD)	0.14	0.17	-0.03 (-0.06 to -0.01)	0.13	0.09	0.03 (0.01 to 0.05)	-0.07	0.003
Cost among all members, mean, \$	16	45	-29 (-35 to -22)	16	11	5 (1 to 9)	-34	P < .001
Disease- Attributable Outpatient Visits								
Number of outpatient visits for all members, mean	0.05	0.02	0.04 (0.02 to 0.06)	0.06	0.02	0.04 (0.02 to 0.06)	0.00	0.52
Cost among all members, mean, \$	45	12	33 (8 to 59)	32	18	14 (1 to 27)	19	0.41
Total Medical Costs, mean (median, SD), \$	344	181	163 (103 to 222)	310	159	150 (87 to 214)	12	0.39

eAppendix Table 2d. Behavioral-Health Attributable Utilization and Cost by Place of Service during 12 months pre and 24 post-index period for all members

	<u>Treated</u>			<u>Matched Controls</u>			<u>Difference-in-Difference</u>	
	Pre	Post	Mean Difference (95% CI)	Pre	Post	Mean Difference (95% CI)	Mean Difference (95% CI)	P-value
Total Number of Members	900	900		900	900			
Disease- Attributable Inpatient Admissions								
Number of hospitalizations for all members, mean	0	0	0.002 (0.00 to 0.00)	0	0.01	-0.01 (-0.02 to 0.01)	0.01	0.44
Cost among all members, mean, \$	3	0	3 (-1 to 8)	10	10	-0.3 (-20 to 19)	4	0.41
Disease- Attributable Emergency Room Visits								
Number of ER visits for all members, mean	0	0	0.00 (0.00 to 0.00)	0	0	0.00 (0.00 to 0.00)	0	P > .99
Cost among all members, mean, \$	0	0	0 (-1 to 1)	0	0	0 (0 to 1)	\$0.06	0.76
Disease- Attributable Office Visits								
Number of office visits for all members, mean (median, SD)	1.01	1.04	-0.03 (-0.08 to 0.01)	0.91	0.82	0.09 (0.04 to 0.13)	-0.12	0.002
Cost among all members, mean, \$	116	171	-55 (-65 to -45)	120	103	17 (8 to 27)	-73	P < .001
Disease- Attributable Outpatient Visits								
Number of outpatient visits for all members, mean	0.1	0.03	0.07 (0.04 to 0.10)	0.11	0.04	0.06 (0.03 to 0.09)	0.00	0.72
Cost among all members, mean, \$	37	6	32 (8 to 55)	35	14	21 (6 to 35)	\$11	0.84
Total Medical Costs, mean (median, SD), \$	183	191	-8 (-39 to 22)	192	145	47 (13 to 81)	-55	P < .001

eAppendix Table 3. Features included in PSM Matching

Features included in the forced match:
Health plan line of business (commercial or Medicare)
Health plan customer
Age category at index date
SUD diagnosis in 12-month time period
Anxiety diagnosis in 12-month time period
Depression diagnosis in 12-month time period
Features used in the propensity score model include:
First identification date - e.g. date a member was first identified for Ontrak outreach.
Age at index date (years)
Gender (Male / Female)
pre-index Elixhauser Comorbidity Score
Health plan line of business (Commercial or Medicare)
SUD diagnosis in 12-month time period
Anxiety diagnosis in 12-month time period
Depression diagnosis in 12-month time period
Slope of 1-month pre-enrollment costs: we looked at costs one month prior to enrollment, subtracted PMPM value for the 12-month pre-index time period, and matched treated and control members who had the same slope to account for healthcare trends just prior to enrollment. (Total cost in month prior to enrollment) - (PMPM medical allowed cost in 12-month pre-index time period).

eAppendix Table 4. Comparisons of populations used to assess quality of match

	Graduated	Never Enrolled	p-value	Treated + Matched Controls	Unmatched Controls	p-value	Matched Controls	Random Sample of Unmatched Controls	p-value
Total Number of Members (n)	28222			28220			1800		
Number of Members (n)	902	27320		1800	26420		900	900	
Age									
Age Group on Index Date, n(%)									
18-34	52 (6)	3444 (13)	P < .001	102 (6)	3393 (13)	P < .001	51 (6)	79 (9)	P < .001
35-44	71 (8)	2895 (11)		142 (8)	2824 (11)		71 (8)	90 (10)	
45-54	148 (16)	5767 (21)		296 (16)	5619 (21)		148 (16)	191 (21)	
55-64	342 (38)	7800 (29)		684 (38)	7458 (28)		342 (38)	250 (28)	
65+	289 (32)	7414 (27)		576 (32)	7126 (27)		288 (32)	290 (32)	
Mean Age at Index Date (SD)	58.3 (13)	54.41 (15.8)	P < .001	58.3 (13)	54.3 (16)	P < .001	58.3 (13)	56.97 (15.46)	0.09
Gender, n(%)									
Female	578 (64)	14337 (52)	P < .001	1164(65)	13751 (52)	P < .001	586 (65)	507 (56)	P < .001
Male	324 (36)	12983 (48)		636 (35)	12669 (48)		314 (35)	393 (44)	
Geographic Region ^a, n(%)									
West	0 (0)	11 (0)	P < .001	0 (0)	11 (0)	P < .001	0 (0)	0 (0)	0.28
Midwest	373 (41)	9396 (34)		766 (43)	9003 (34)		393 (44)	360 (40)	
South	434 (48)	11225 (41)		819 (46)	10838 (41)		387 (43)	408 (45)	
Northeast	95 (11)	6688 (24)		215 (12)	6568 (25)		120 (13)	132 (15)	
Plan Type, n(%)									
Commercial ^b	451 (50)	16266 (60)	P < .001	900 (50)	15816 (60)	P < .001	450 (50)	468 (52)	0.42
Medicare ^c	451 (50)	11054 (40)		900 (50)	10604 (40)		450 (50)	432 (48)	
Rural Type ^d, n(%)									
Rural	230 (25)	5233 (19)	P < .001	410 (23)	5053 (19)	P < .001	180 (20)	212 (24)	0.42
Not Rural	672 (75)	22087 (81)		1390 (77)	21367 (81)		720 (80)	688 (76)	

Elixhauser Comorbidity ^e, mean (SD)	2.09 (12.02)	1.97 (12.15)	0.63	2.04 (11.61)	1.97 (12.18)	0.31	2.01 (11.2)	2.98 (12.7)	0.32
General Comorbidities ^f, n(%)									
Asthma	224 (25)	5665 (21)	P < .001	461 (26)	5428 (21)	P < .001	237 (26)	172 (19)	P < .001
COPD	262 (29)	6485 (24)	P < .001	507 (28)	6240 (24)	P < .001	245 (27)	214 (24)	0.1
Chronic Pain	376 (42)	9443 (35)	P < .001	712 (40)	9106 (34)	P < .001	337 (37)	314 (35)	0.28
CHF	150 (17)	3819 (14)	0.03	278 (15)	3691 (14)	0.09	128 (14)	143 (16)	0.36
CAD	258 (29)	6772 (25)	0.01	508 (28)	6522 (25)	P < .001	250 (28)	228 (25)	0.26
Diabetes	333 (37)	8173 (30)	P < .001	619 (34)	7886 (30)	P < .001	287 (32)	280 (31)	0.76
Gallbladder Disease	103 (11)	3110 (11)	P > .99	198 (11)	3014 (11)	0.62	96 (11)	97 (11)	P > .99
Hypertension	694 (77)	18589 (68)	P < .001	1353 (75)	17929 (68)	P < .001	660 (73)	636 (71)	0.23
Injury Poisoning	85 (9)	2871 (11)	0.32	176 (10)	2780 (11)	0.34	91 (10)	114 (13)	0.1
Pneumonia	184 (20)	4825 (18)	0.04	350 (19)	4659 (18)	0.06	166 (18)	171 (19)	0.81
Hypertriglyceridemia	221 (25)	6091 (22)	0.13	420 (23)	5892 (22)	0.32	199 (22)	180 (20)	0.3
Multiple sclerosis	14 (2)	354 (1)	0.6	24 (1)	344 (1)	P > .99	10 (1)	12 (1)	0.83
Hepatitis C	27 (3)	813 (3)	P > .99	49 (3)	791 (3)	0.56	22 (2)	30 (3)	0.32
Rheumatoid Arthritis	84 (9)	1917 (7)	0.01	157 (9)	1844 (7)	0.01	73 (8)	62 (7)	0.37
Mental Health Comorbidities ^g, n(%)									
Anxiety	639 (71)	16825 (62)	P < .001	1276 (71)	16187 (61)	P < .001	638 (71)	534 (59)	P < .001
Attention Deficit	51 (6)	1634 (6)	0.74	125 (7)	1560 (6)	0.08	74 (8)	45 (5)	0.01
Bipolar	101 (11)	2716 (10)	0.24	189 (11)	2628 (10)	0.47	88 (10)	74 (8)	0.28
Depression	615 (68)	14335 (52)	P < .001	1228(68)	13721 (52)	P < .001	614(68)	475(53)	P < .001
Other Psych	213(24)	6216 (23)	0.57	7 (0)	132 (0)	0.63	4 (0)	7 (1)	0.55
Personality Disorder	14 (2)	364 (1)	0.68	28 (2)	350 (1)	0.47	14 (2)	11 (1)	0.69
SUD	562 (62)	21299 (78)	P < .001	1124 (62)	20737 (78)	P < .001	562 (62)	594 (66)	0.13
Suicide	2 (0)	227 (1)	0.07	8 (0)	221 (1)	0.1	6 (1)	4 (0)	0.75
Nicotine Dependence	422 (47)	12104 (44)	0.15	830 (46)	11695 (44)	0.13	409 (45)	398 (44)	0.64

Footnotes

- a. Geographic regions are the following: West = Colorado, Wyoming, Montana, Idaho, Washington, Oregon, Utah, Nevada, California, Alaska, Hawaii; Midwest = Ohio, Indiana, Michigan, Illinois, Missouri, Wisconsin, Minnesota, Iowa, Kansas, Nebraska, South Dakota, North Dakota; Northeast = Maine, Massachusetts, Rhode Island, Connecticut, New Hampshire, Vermont, New York, Pennsylvania, New Jersey, Delaware, Maryland; South = West Virginia, Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Arkansas, Louisiana, Florida, Texas, Oklahoma, New Mexico, Arizona
- b. Commercial = subscriber and dependents with healthcare insurance that is provided by subscriber's employer
- c. Medicare = subscriber that is 65+ years old and/or has disability pension and/or has Lou Gehrig's disease and/or permanent kidney failure
- d. Rurality is defined by zipcode using Federal Office of Rural Health Policy definition
- e. Elixhauser assigns weights to specific comorbid conditions. It is an integer score on a scale, where a higher score indicates increased comorbidity.¹²
- f. General Comorbidities indicate comorbidities that are non-psychiatric. The flags will come from diagnoses codes in administrative claims data.
- g. Psychiatric Comorbidities indicate comorbidities that are behavioral. The flags will come from diagnoses codes in administrative claims data.

eAppendix Table 5. Standardized Differences across matched treated and control cohorts used to assess quality of match

variable	SD
age_cat_at_index_18-34	0.00
age_cat_at_index_35-44	0.00
age_cat_at_index_45-54	0.00
age_cat_at_index_55-64	0.00
age_cat_at_index_65+	0.00
gender_f	0.02
gender_m	0.02
us_region_Midwest	0.04
us_region_Northeast	0.09
us_region_South	0.10
us_rurality_not_rural	0.13
us_rurality_rural	0.13
us_subregion_East North Central	0.05
us_subregion_East South Central	0.13
us_subregion_Mid Atlantic	0.04
us_subregion_New England	0.12
us_subregion_South Atlantic	0.03
us_subregion_West North Central	0.00
us_subregion_West South Central	0.04
pre_anx_flag_1	0.00
pre_ast_flag_1	0.03
pre_bip_flag_1	0.05
pre_cad_flag_1	0.02
pre_chf_flag_1	0.07
pre_copd_flag_1	0.04
pre_cp_flag_1	0.09
pre_dep_flag_1	0.00
pre_dev_flag_1	0.02
pre_dm_flag_1	0.11
pre_esrd_flag_0	0.00
pre_hem_flag_0	0.00
pre_hiv_flag_0	0.00
pre_htg_flag_1	0.06
pre_hyp_flag_1	0.08
pre_injpo_flag_1	0.02
pre_mr_flag_1	0.05
pre_nic_flag_1	0.03

pre_pneu_flag_1	0.05
pre_sud_flag_1	0.00
pre_sui_flag_1	0.07
pre_add_adhd_flag_1	0.09
pre_adj_flag_1	0.10
pre_arth_flag_1	0.13
pre_exe_flag_1	0.05
pre_gad_flag_1	0.02
pre_hepc_flag_1	0.03
pre_ms_flag_1	0.04
pre_othpsy_flag_1	0.07
pre_ra_flag_1	0.04
pre_stroke_flag_1	0.04
pre_med_trend_increasing_1	0.04
pre_elix9_wscore_ahrq	0.01
pre_all_anx_cnt	0.01
pre_all_bh_cnt	0.11
pre_all_dep_cnt	0.05
pre_all_ed_cnt	0.03
pre_all_inp_cnt	0.02
pre_all_med_cnt	0.19
pre_all_out_cnt	0.05
pre_all_ov_cnt	0.17
pre_all_sud_cnt	0.02
pre_anx_ed_cnt	0.02
pre_anx_inp_cnt	0.05
pre_anx_out_cnt	0.11
pre_anx_ov_cnt	0.01
pre_bh_ed_cnt	0.03
pre_bh_inp_cnt	0.02
pre_bh_out_cnt	0.02
pre_bh_ov_cnt	0.12
pre_dep_ed_cnt	0.01
pre_dep_inp_cnt	0.05
pre_dep_out_cnt	0.01
pre_dep_ov_cnt	0.03
pre_sud_ed_cnt	0.04
pre_sud_inp_cnt	0.01
pre_sud_out_cnt	0.01
pre_sud_ov_cnt	0.03
pre_all_inp_los	0.07

pre_anx_inp_los	0.02
pre_dep_inp_los	0.08
pre_sud_inp_los	0.02
pre_all_anx_cost	0.05
pre_all_bh_cost	0.02
pre_all_dep_cost	0.03
pre_all_ed_cost	0.06
pre_all_inp_cost	0.09
pre_all_med_cost	0.09
pre_all_out_cost	0.01
pre_all_ov_cost	0.00
pre_all_sud_cost	0.04
pre_anx_ed_cost	0.02
pre_anx_inp_cost	0.04
pre_anx_out_cost	0.02
pre_anx_ov_cost	0.01
pre_bh_ed_cost	0.01
pre_bh_inp_cost	0.04
pre_bh_out_cost	0.01
pre_bh_ov_cost	0.02
pre_dep_ed_cost	0.08
pre_dep_inp_cost	0.01
pre_dep_out_cost	0.04
pre_dep_ov_cost	0.00
pre_sud_ed_cost	0.01
pre_sud_inp_cost	0.09
pre_sud_out_cost	0.02
pre_sud_ov_cost	0.02
pre_all_med_cost_index_month_minus_1	0.01
int_first_identification_date	0.03
int_index_date	0.04
age_at_index	0.00

eAppendix Table 6. Results from Sensitivity Analyses: Loglinear and Winsorized Cost Threshold Investigation

Logarithmic DiD Results for All-cause and Attributable Healthcare Utilization and Cost by Place of Service for BH Patients	<u>DiD value</u> (<u>\$</u>)	<u>Coeff Estimate</u>	<u>SE of Coeff</u>		Winsorized Amount (%)	Lower bound	Upper bound	DiD Value(\$)
All-Cause Medical Cost (DiD)	426	-0.09	0.09		0	0.00	1.00	485
All Cause Inpatient Cost (DiD)	32	-1.02	0.23		2%	0.01	0.99	510
All Cause ER Cost (DiD)	3	-0.10	0.19		4%	0.02	0.98	484
All Cause Office Visit Cost (DiD)	-66	0.44	0.12		6%	0.03	0.97	463
All Cause Outpatient Visit Cost (DiD)	17	-0.16	0.22		8%	0.04	0.96	440
					10%	0.05	0.95	432
BH-Attributable Cost (DiD)	-29	0.33	0.09		12%	0.06	0.94	425
BH-Attributable Inpatient Cost (DiD)	0	-0.02	0.03		14%	0.07	0.93	438
BH-Attributable ER Cost (DiD)	0	0.00	0.02		16%	0.08	0.92	467
BH-Attributable Office Visit Cost (DiD)	-24	0.33	0.11		18%	0.09	0.91	446
BH-Attributable Outpatient Visit Cost (DiD)	0	0.02	0.09		20%	0.10	0.90	427
					22%	0.11	0.89	427
Anxiety-Attributable Cost (DiD)	-5	0.38	0.19		24%	0.12	0.88	407
Anxiety-Attributable Inpatient Cost (DiD)	0	-0.11	0.15		26%	0.13	0.87	394
Anxiety-Attributable ER Cost (DiD)	0	-0.14	0.11		28%	0.14	0.86	416
Anxiety-Attributable Office Visit Cost (DiD)	-4	0.70	0.13		30%	0.15	0.85	384
Anxiety-Attributable Outpatient Visit Cost (DiD)	0	0.09	0.10		32%	0.16	0.84	397
					34%	0.17	0.83	390
Depression-Attributable Cost (DiD)	-2	0.20	0.18		36%	0.18	0.82	386
Depression-Attributable Inpatient Cost (DiD)	1	-0.18	0.15		38%	0.19	0.81	400
Depression-Attributable ER Cost (DiD)	0	-0.13	0.10		40%	0.20	0.80	392

Depression-Attrib Office Visit Cost (DiD)	-2	0.45	0.12					
Depression-Attributable Outpatient Visit Cost (DiD)	0	0.02	0.10					
SUD-Attributable Cost (DiD)	1	-0.07	0.20					
SUD-Attributable Inpatient Cost (DiD)	1	-0.38	0.16					
SUD-Attributable ER Cost (DiD)	0	0.13	0.12					
SUD-Attributable Office Visit Cost (DiD)	0	0.05	0.10					
SUD-Attributable Outpatient Visit Cost (DiD)	0	0.02	0.11					

eAppendix Table 7. Clinical and sociodemographic characteristics of study population as compared to the ever-enrolled in Ontrak population

	Treated	Matched Controls	Ever-Enrolled
Total Number of Members (n)	900	900	27,946
Age Group on Index Date, n(%)			
18-34	51 (6)	51 (6)	2481 (9)
35-44	71 (8)	71 (8)	2992 (11)
45-54	148 (16)	148 (16)	5137 (18)
55-64	342 (38)	342 (38)	8349 (30)
65+	288 (32)	288 (32)	8987 (32)
Mean Age at Index Date	58.32 (12.98)	58.29 (13.27)	56.74 (14.38)
Gender, n(%)			
Female	578 (64)	586 (65)	19147 (69)
Male	322 (36)	314 (35)	8799 (31)
Geographic Region^a, n(%)			
West	0 (0)	0 (0)	446 (2)
Midwest	373 (41)	393 (44)	6509 (23)
South	432 (48)	387 (43)	15699 (56)
Northeast	95 (11)	120 (13)	5292 (19)
Plan Type, n(%)			
Commercial ^b	450 (50)	450 (50)	14260 (51)
Medicare ^c	450 (50)	450 (40)	13567 (49)
Rural Type^d, n(%)			
Rural	230 (26)	180 (20)	4708 (17)
Not Rural	670 (74)	720 (80)	23238 (83)
Elixhauser Comorbidity^e, mean (SD)	2.08 (12.01)	2.01 (11.2)	2.39 (11.54)
Physical Comorbidities^f, n(%)			
Asthma	224 (25)	237 (26)	7069 (25)
COPD	262 (29)	245 (27)	6599 (24)
Chronic Pain	375 (42)	337 (37)	10310 (37)
CHF	150 (17)	128 (14)	4353 (16)
CAD	258 (29)	250 (28)	7999 (29)

Diabetes	332 (37)	287 (32)	10539 (38)
Gallbladder Disease	102 (11)	96 (11)	2683 (10)
Hypertension	693 (77)	660 (73)	20474 (73)
Injury Poisoning	85 (9)	91 (10)	3065 (11)
Pneumonia	184 (20)	166 (18)	4816 (17)
Hypertriglyceridemia	221 (25)	199 (22)	7537 (27)
Multiple sclerosis	14 (2)	10 (1)	403 (1)
Hepatitis C	27 (3)	22 (2)	685 (2)
Rheumatoid Arthritis	84 (9)	73 (8)	2133 (8)
Mental Health Comorbidities^g, n(%)			
Anxiety	638 (71)	638 (71)	20219 (72)
Attention Deficit	51 (6)	74 (8)	1596 (6)
Bipolar	101 (11)	88 (10)	2930 (10)
Depression	614 (68)	614 (68)	16432 (59)
Developmental Disorders	3 (0)	4 (0)	139 (0)
Other Psych	212 (24)	185 (21)	5041 (18)
Personality Disorder	14 (2)	14 (2)	159 (1)
SUD	562 (62)	562 (62)	12914 (46)
Suicide	2 (0)	6 (1)	81 (0)
Nicotine Dependence	421 (47)	409 (45)	10722 (38)

Footnotes

- a. Geographic regions are the following: West = Colorado, Wyoming, Montana, Idaho, Washington, Oregon, Utah, Nevada, California, Alaska, Hawaii; Midwest = Ohio, Indiana, Michigan, Illinois, Missouri, Wisconsin, Minnesota, Iowa, Kansas, Nebraska, South Dakota, North Dakota; Northeast = Maine, Massachusetts, Rhode Island, Connecticut, New Hampshire, Vermont, New York, Pennsylvania, New Jersey, Delaware, Maryland; South = West Virginia, Virginia, Kentucky, Tennessee, North Carolina, South Carolina, Georgia, Alabama, Mississippi, Arkansas, Louisiana, Florida, Texas, Oklahoma, New Mexico, Arizona
- b. Commercial = subscriber and dependents with healthcare insurance that is provided by subscriber's employer
- c. Medicare = subscriber that is 65+ years old and/or has disability pension and/or has Lou Gehrig's disease and/or permanent kidney failure
- d. Rurality is defined by zipcode using Federal Office of Rural Health Policy definition
- e. Elixhauser assigns weights to specific comorbid conditions. It is an integer score on a scale, where a higher score indicates increased comorbidity.¹²
- f. General Comorbidities indicate comorbidities that are non-psychiatric. The flags will come from diagnoses codes in administrative claims data.
- g. Psychiatric Comorbidities indicate comorbidities that are behavioral. The flags will come from diagnoses codes in administrative claims data

eAppendix Figure. Cost distributions

