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Health care utilization after paraprofessional-administered substance use screening, brief intervention, and referral to treatment: a multi-level cost-offset analysis

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Abstract

Background: Authorities recommend universal substance use screening, brief intervention, and referral to treatment (SBIRT) for all (i.e. universal) adult primary care patients.

Objective: The objective of this study was to examine long-term (24-month) changes in health care utilization and costs associated with receipt of universal substance use SBIRT implemented by paraprofessionals in primary care settings.

Research Design: This study used a difference-in-differences (DD) design and Medicaid administrative data to assess changes in health care use among Medicaid beneficiaries receiving SBIRT. The DD estimates were used in a Monte Carlo simulation to estimate potential cost-offsets associated with SBIRT.

Subjects: The treatment patients were Medicaid beneficiaries who completed a 4-question substance use screen as part of an SBIRT demonstration program between 2006 and 2011. Comparison Medicaid patients were randomly selected from matched clinics in Wisconsin.

Measures: The study includes four health care utilization measures: outpatient days; inpatient length of stay; inpatient admissions; and emergency department admissions. Each outcome was assigned a unit cost based on mean Wisconsin Medicaid fee-for-service reimbursement amounts.

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Conflicts of Interest: None to disclose

Results: We found an annual increase of 1.68 outpatient days (P=0.027) and a nonsignificant annual decrease in inpatient days of 0.67 days (P=0.087) associated with SBIRT. The estimates indicate that the cost of a universal SBIRT program could be offset by reductions in inpatient utilization with an annual net cost savings of $782 per patient.

Conclusions: Paraprofessional-delivered universal SBIRT is likely to yield health care cost savings and is a cost-effective mechanism for integrating behavioral health services in primary care settings.

Introduction

Excessive alcohol use remains a leading global risk factor among individuals of ages 15–49 and costs the United States $249 billion, of which, $27 billion is associated with health care.[1,2] Substance use disorders increase the risk of recurrent acute care hospital utilization by almost 50 percent and impact the complexity and severity of other chronic health conditions such as hypertension, diabetes, and several types of cancer.[6-9] Alcohol use disorders have been shown to be associated with post-operative complications such as delirium, cerebral events, and wound infections, leading to additional health care utilization and costs.[11] Wisconsin, the location of this study, ranks third in binge drinking among all states; per capita alcohol consumption was 30 percent higher than the national rate in 2016.[12] In 2015, 873 Wisconsin residents died as a result of illicit drug use.[12]

Rehm et al. (2016) recommend that alcohol use disorders should be managed in primary care settings with regular check-ups, consistent advice, and treatment as appropriate in the same way that hypertension and other chronic conditions are addressed. >A clinical approach to addressing unhealthy substance (alcohol and drug) use is universal screening, brief intervention, and referral to treatment (SBIRT). SBIRT consists of an initial screen for substance use, a brief assessment for patients who screen positive, 1 to 3 sessions of brief motivational intervention for unhealthy substance use or mild substance use disorder, and referral to treatment for more severe substance use disorders.[15] A universal approach is defined as the screening of all patients regardless of the presence of indicators of substance abuse. SBIRT has been shown to reduce substance use over 6 to 12-month follow-up periods in diverse health care settings.[15-24] An analysis of the US Substance Abuse and Mental Health Services Administration's (SAMHSA) SBIRT grant program found SBIRT-associated, 6-month reductions of 35.6, 43.4, and 75.8 percent in alcohol use, heavy drinking and illicit drug use, respectively, among individuals who screened positive for hazardous or harmful substance use.[25]

SBIRT has shown promise in reducing subsequent health care costs associated with outpatient, inpatient, emergency department use, and pharmacy costs among high-risk substance users in emergency department setttings.[22,24] However, the evidence on sustained impacts on substance use, utilization and subsequent cost reductions is mixed.[16,26-30] Horn et al. (2017) found minimal impacts of SBIRT 1 year following implementation.[28] Fleming et al's Wisconsin-based randomized controlled trial showed reductions in net health care costs for up to 4 years after brief alcohol intervention by primary care physicians and nurses.[16] Other studies that evaluated SBIRT beyond 12-months found attenuated effects on

substance use after 12 months.[16,30] Some investigators have experienced difficulty engaging health care practitioners in consistent SBIRT delivery.[14,31,32] Nationally, despite recommendations by the US Preventive Services Task Force, the National Institute on Drug Abuse, and the Office of National Drug Control Policy, and despite ample mortality, morbidity, and economic cost, only a quarter of primary care providers conduct universal screening in their practices. [14,23]

A team-based approach to SBIRT could improve adoption and circumvent barriers relating to clinician training, time, and reimbursement.[13,14] Under the SAMHSA-funded Wisconsin Initiative to Promote Healthy Lifestyles (WIPHL), receptionists or medical assistants administered written alcohol and drug screens, and trained paraprofessionals conducted brief assessment, brief interventions, and referrals for treatment at 31 health care settings. A pre-post analysis found substantial reductions in alcohol and drug use after paraprofessional-administered SBIRT.[15] A previous economic analysis, which compared health care costs before and after SBIRT for Medicaid recipients receiving versus not receiving SBIRT at WIPHL clinics found evidence of reductions in health care costs over 2 years.[35] This paper reports on an economic analysis of health care use for Medicaid recipients at WIPHL clinics before and after SBIRT, compared to health care use of similar Medicaid recipients at similar clinics that did not participate in WIPHL.

Methods

Sample

Thirty-one clinics participated in the WIPHL program. Comparison clinics, matched on clinic type (e.g. Federally Qualified Health Centers, Critical Access, Women's clinic), size, region, and rurality were identified, and forty-four non-WIPHL clinics located in Wisconsin were selected resulting in an intended 2:1 clinic match. From those clinics' Medicaid rolls, we sought comparison patients who were of the same gender as the index patient, were between the ages of 18–64, received at least one service in the study period of 2006 to 2011, and had at least one month of Medicaid coverage in each 12-month period. Twelve comparison clinics with fewer than 25 matched patients were dropped from the analysis. The process yielded a total of 7,192 working-aged Medicaid beneficiaries at 20 WIPHL clinics and 7,664 matched patients at 32 comparison clinics for a total sample of 14,856 patients (Figure 1).

Intervention

The WIPHL program staff trained and provided ongoing support for bachelor's and master's prepared paraprofessional health coaches to implement SBIRT services based on motivational interviewing methods. WIPHL provided a 1-week training, follow-up support, and funding for a health coach to implement SBIRT.[15] Each clinic determined its own process for screening patients. In most clinics, receptionists or medical assistants asked patients to complete written substance use screens. Some clinics added nutrition, tobacco, or depression screens to the 4-question substance use screen.[15] In all clinics, patients with positive substance use screens were referred to paraprofessional health coaches who administered the Alcohol, Smoking, and Substance Involvement Screening Test, a validated

brief assessment questionnaire. [38] The health coach encouraged low-risk individuals to continue low-risk behaviors, delivered 1 or more brief intervention sessions to individuals with unhealthy substance use or DSM-4 abuse, and attempted to refer to treatment individuals with likely dependence.

Data and Measures

SBIRT program data were collected under a Substance Abuse and Mental Health Service Administration (SAMHSA) funded demonstration program from 2006–2011, included screening and contact information on all patients. These data were used to identify patients who reported Medicaid as a source of health care funding. Medicaid patients were selected, and their data were linked by a third party based on name, sex, and date of birth to the individual's Medicaid fee-for-service claims and encounter data between 2005 and 2012. With IRB oversight, HIPAA-compliant Data Use and Business Associate Agreements were signed to link the WIPHL and Medicaid data sets. The study received ethics approval from the University of Wisconsin-Madison Institutional Review Board.

SBIRT treatment was defined as a completed substance use screen, regardless of result, to determine the effectiveness of universal implementation. For each patient, the month the screen was completed was considered the index month and was excluded from the analysis. The median index month of the SBIRT group was used as the index month for the comparison group in delimiting the baseline and follow-up periods. The median index month was used to match the increase in patients receiving SBIRT during the latter part of the grant period.

Claims and encounters with "claim type" codes for outpatient and inpatient services were included. ED utilization was identified using revenue codes 450–456 in outpatient and inpatient claim types. Crossover claims, which are partially covered under another insurer such as Medicare, were included. Pharmacy, dental, and long-term stay claims were excluded.

For each participant, days of outpatient services, inpatient services, and ED visits were summed over the 12-month baseline period and the 24-month follow-up period. Inpatient claims for consecutive days were grouped to identify numbers of distinct hospital admissions. Each aggregate utilization measure was divided by the subject's total number of months enrolled in Medicaid resulting in a pre and post per member per month measure for each utilization type.

Medicaid reimbursement amounts from fee-for-service claims were used to establish the asymmetric triangular cost distributions used in the simulation resulting in mean costs of $48.44 per outpatient day, $1,120.45 per inpatient day, and $402.94 per emergency department admission (2018 dollars). Paid fee-for-service claims in 2010 were used to establish a standard cost for both fee-for-service and managed care utilization. First and last days of service were used to calculate the number of days of service in each group of claims and the total amount paid was divided by the number of days of service in the year to determine the mean cost per day. To calculate the cost of SBIRT services, a weighted micro-costing method was used based on screening outcomes and proportions of individuals in

each risk category to determine the expected number of brief interventions among those screening positive. Based on this method, the mean cost of SBIRT as implemented in the WIPHL program was $51.05 per individual screened (2018 dollars).

Statistical Analyses

Multilevel generalized linear models (GLM) with a gamma distribution and log link were used to assess changes in 4 utilization outcomes: outpatient days, inpatient days, inpatient admissions, and emergency department admissions. A visual inspection of the 12-month baseline utilization trends for the SBIRT and comparison groups supported the plausibility of the parallel trends assumption (See Supplement Digital Content 1, for graphical displays). Robust standard errors were estimated.

$$Y_{ij} = \beta_0 + \beta_1 SBIRT_{ij} + \beta_2 Post_{ij} + \boldsymbol{\beta_3 (SBIRT * Post)_{ij}} + \beta_4 X_{ij} + \varepsilon_{ij} + \mu_j \quad (1)$$

Equation (1) represents the multilevel model used in the analysis where j represents the source clinic of each individual, i. Y is the individual per member per month utilization. β_3 represents the difference-in-differences (DD) estimator adjusted for a set of individual characteristics measured at baseline represented by X including sex, age, race, Supplemental Security Income (SSI) eligibility, sex and pregnancy interaction term, and baseline health status indicators of tobacco use, mental health, diabetes, heart disease, COPD, and hypertension diagnoses. (See Supplement Digital Content 2, for a list of ICD-9 codes used to define the health indicator variables). Chronic disease indicators were included to adjust for variation in utilization associated with the management of these common drivers of health care.[8,39-41] Random intercepts for each clinic allowed for variation in overall utilization patterns between clinics. Sensitivity analyses were conducted to evaluate the uncertainty around the results based on full Medicaid enrollment, dual eligibility status, demographics, and both follow-up periods. Stata 15 was used for the analysis.

Monte Carlo simulation with 10,000 trials was used to estimate the potential cost offset associated with SBIRT. The key inputs for the simulation included the estimated average marginal effects from the DD analysis, the mean per unit costs for each health care use outcome and the estimated mean cost of SBIRT as implemented in the WIPHL program. Uncertainty was built into the model based on the standard errors around both the estimated cost savings and the marginal changes in utilization. The Monte Carlo simulation model is available upon request.

Results

The SBIRT and comparison groups were similar in most characteristics (Table 1). Significant differences were observed in race and other drug abuse or dependence diagnoses. Small differences in sex, age, tobacco use, mental health diagnoses, outpatient, and emergency department utilization at baseline were statistically significant. Of note, over 40 percent of each group had a mental health diagnosis in the Medicaid record.

Table 2 (See Supplemental Digital Content 3 for adjusted models with covariates) shows the output for the multilevel generalized linear regression models. The unadjusted model shows an overall increase in outpatient utilization and no changes in other services. The adjusted model (lower panel of Table 2) yields coefficients confirming a significant increase in outpatient utilization (P=0.040) and non-significant but meaningful decreases in inpatient days (P=0.093) and inpatient admissions (P=0.131).

Table 3 shows the post estimation of the average marginal effects of SBIRT. The DD estimator (SBIRT × Post) shows a significant increase in per member per month outpatient utilization and a decrease in inpatient days. Negligible effects were found for inpatient and ED admissions. Assuming continuous enrollment in Medicaid, these changes correspond to an annual increase of 1.68 outpatient days (P=0.027) and an annual decrease of 0.67 inpatient days (P=0.087).

Results from the Monte Carlo simulation are shown in Table 4. Based on the annual utilization changes associated with a universal SBIRT program, annual mean net cost savings of $782 (2018 dollars) per enrolled beneficiary net the cost of the SBIRT program could be expected assuming continuous enrollment in Medicaid. This cost savings was driven primarily by a decrease in inpatient days, with 95 percent of all trials resulting in cost savings sufficient to offset the per patient cost of implementing a paraprofessional-administered SBIRT program.

As part of the sensitivity analysis, changes in utilization by each 12-month follow-up period was conducted. This analysis shows a significant increase in outpatient utilization during the first 12-month period and a significant decrease in inpatient utilization during the second post 12-month period (See Supplemental Digital Content 4 and 5). Additional sensitivity analyses showed the results were robust when the data were stratified by sex, race, age groups, continuous Medicaid enrollment, and SSI eligibility. Among individuals with continuous Medicaid enrollment, significant decreases in inpatient days and admissions were observed but the utilization changes were similar to the full sample results (See Supplemental Digital Content 6 and 7). Among SSI eligible individuals not dually enrolled in Medicaid and Medicare, results showed greater decreases in inpatient days of 1.38 days ($P=0.125$) and in ED utilization of 0.27 admissions (P=0.050) per year. No increase in outpatient utilization was observed among this subgroup.

Discussion

This study investigated the effects of a universal SBIRT program delivered by paraprofessional health coaches through primary care clinics. It assessed changes in health care utilization over a 24-month follow-up period to understand the sustained effects of SBIRT on a low-income Medicaid patient population in Wisconsin. A prior study used propensity score matching to assess treatment effects of SBIRT relative to a non-SBIRT patient population within the WIPHL clinics, and found an estimated cost savings of $391 annually per patient (2014 dollars).[35] The present study expanded on these results by investigating the effects using a larger, non-WIPHL external clinic comparison population and applying multilevel modeling to adjust for clinic-level variation in utilization.

The results suggest that SBIRT programs administrated by paraprofessional health coaches generate meaningful increases in outpatient visits, which have not been observed in other studies. The results in each 12-month follow-up period suggest that SBIRT is associated with greater outpatient seeking behavior in the short-term followed by a decrease in inpatient care over the long-term follow-up period. Potential cost savings associated with screening all patients will likely come from a reduction in inpatient length-of-stays and admissions over a longer time horizon. The increase in outpatient visits provides evidence that SBIRT might influence greater awareness among patients of the need for additional preventive health services. The increase in outpatient utilization observed in this analysis could be linked to an increase in receiving integrated outpatient care in which substance use is addressed. Future analysis will investigate the potential increase in substance use diagnoses among those receiving SBIRT services as an indicator of greater awareness among clinicians of substance use problems.

SBIRT has previously shown to be effective in reducing health care utilization and costs among emergency department and disabled patient populations.[22,24,33] These studies show significant cost savings and cost effectiveness among individuals with evidence of substance use disorders. A gap exists in understanding the longer-term impacts of universal SBIRT services among a general Medicaid population with the majority receiving only substance use screening services. Evidence shows paraprofessional health coaches can effectively deliver SBIRT in primary care settings.[15,32,42-44] This present study estimates the impact on total utilization if more primary care and community health clinics implement SBIRT services as part of a comprehensive integration of behavioral health services.

The smaller impacts observed in this study relative to past research may arise from including all patients screened rather than only those receiving a brief intervention. It may be that with the increased availability of paraprofessional-administered screening and brief intervention, the reach is greater, the individual benefits smaller, but the population impact larger.[45] Research supports the use of a local champion and an interprofessional team as best practices when it comes to implementing SBIRT in primary care settings.[46] Universal implementation is an important aspect when moving towards a preventive model with increased integration of behavior health services. Services will increasingly need to be provided by paraprofessionals given the shortage of primary care clinicians and their time constraints. It is necessary for health care administrators to identify the work flow that maximizes the use of SBIRT providers, while ensuring that individuals who screen positive are directed to receive appropriate brief intervention services. The evidence provided here raises additional questions pertaining to the implementation of SBIRT in primary care settings and the possible use of additional outpatient services to address comorbidities often association with substance use. The high rate of diagnosed mental health disorders in this population would suggest a further need to build mental health screening into SBIRT services and integrated primary care.

Future research should investigate health care seeking behavior among individuals with a probable substance use disorders following receipt of SBIRT, how SBIRT influences adherence to chronic disease treatment regimes, and changes in use of prescription

medicines among individuals receiving SBIRT.[7-9] Such research could inform the effectiveness of SBIRT on patients with various comorbidities.

This study has several limitations. First, only Medicaid claims data were used to assess utilization. If utilization was covered under another payer such as Medicare or another public or private source, the services were not documented in the data used for this analysis. Second, generalizability is limited to Medicaid patients in Wisconsin engaging with the WIPHL model of SBIRT. Even though Wisconsin does have higher substance use rates than the national average, these results may generalize to other states with high rates of substance use-related health care utilization. Nuances in SBIRT model characteristics and patient populations should be considered in future implementation studies. Third, some clinics may have self-selected into WIPHL based on characteristics resulting in potential unobserved confounding variables influencing the utilization patterns of patients treated in the WIPHL clinics. Fourth, the higher proportion of Black patients in the SBIRT sample suggests possible bias in how patients self-selected into SBIRT or were identified for screening, in spite of universal intent.

Strengths of the study include an analysis of utilization over 24 months after SBIRT delivery. Since the effects of SBIRT attenuate over time, findings of changes in utilization over an extended follow-up period increases the strength of the evidence regarding the sustained impacts of SBIRT and suggest a possible role for booster sessions.[16] Other strengths include the large sample size, a comparison group from matched clinics with similar demographic characteristics and health status indicators, and program data from a real-world implementation of SBIRT.

In conclusion, universal SBIRT services are associated with outpatient and inpatient health care use. Further research is needed to understand if the demand for preventive outpatient services changes after receiving SBIRT. The evidence from this study is encouraging in showing sustained effects on health care use 24 months after receiving SBIRT services. The Monte Carlo simulation shows a 95 percent probability of offsetting the cost of universal SBIRT. Further research is needed to understand the mechanisms through which such changes are happening.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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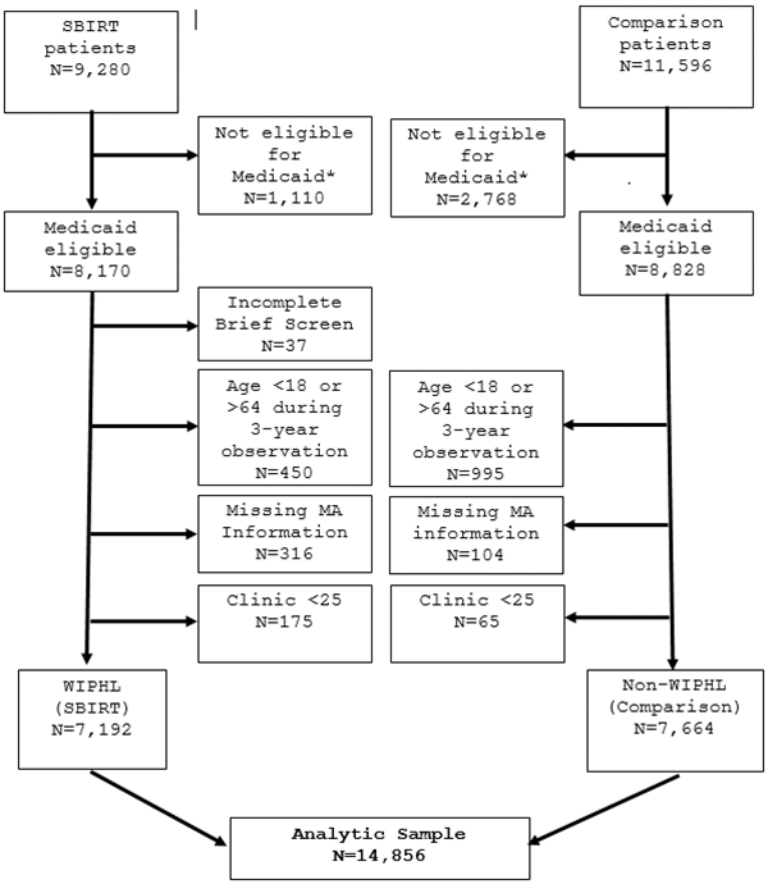

Figure 1:

Selection of participants based on eligibility criteria.

*Participants had to have at least one month of Medicaid eligibility in each 12-month time period, baseline, follow-up months 1-12, and follow-up months 13-24.

Table 1:

Demographic characteristics, baseline health conditions, and health care use by treatment status.

	SBIRT N=7,192	Comparison N=7,664	Significance
Proportion female	0.76	0.72	***
Age, years (sd)	36.1 *(12.0)*	37.8 *(11.5)*	***
% White	38.8	*57.6*	
% Black	43.8	25.4	
% Other	6.3	8.1	
% Missing	11.1	9.0	***
Proportion SSI eligible	0.30	0.29	0.222
Proportion mental health dx baseline	0.45	0.43	0.017
Proportion tobacco dx baseline	0.19	0.17	0.001
Proportion hypertension dx baseline	0.21	0.20	0.176
Proportion diabetes dx baseline	0.10	0.10	0.099
Proportion heart disease dx baseline	0.05	0.05	0.546
Proportion COPD dx baseline	0.05	0.06	0.043
Proportion alcohol-related dx baseline	0.06	*0.05*	0.001
Proportion drug-related dx baseline	0.08	0.05	***
Outpatient days, pmpm (sd)	1.48 *(2.67)*	1.34 *(2.28)*	0.002
Inpatient days, pmpm (sd)	0.133 *(0.839)*	0.132 *(1.190)*	0.955
Inpatient admissions, pmpm (sd)	0.023 *(0.073)*	0.020 *(0.075)*	0.016
ED admissions, pmpm (sd)	0.130 *(0.281)*	0.090 *(0.208)*	***

*** p<0.001

ED = Emergency Department

SSI = Supplemental Security Income

pmpm = per member per month

sd = standard deviation

Table 2:

Unadjusted and adjusted multilevel generalized linear model results based on the gamma family and log link with robust standard errors.

	Outpatient Days	Inpatient Days	Inpatient Adm.	ED Adm.
Unadjusted Model (N=14,856)	e^b (se) / *P*	e^b (se) / *P*	e^b (se) / *P*	e^b (se) / *P*
SBIRT	1.096 (0.091)	0.944 (0.173)	1.110 (0.147)	1.420 (0.164)
	0.271	*0.755*	*0.431*	*0.002*
Post	1.083 (0.020)	0.801 (0.070)	0.856 (0.036)	0.944 (0.029)
	***	*0.011*	***	*0.060*
SBIRT × Post	**1.059 (0.033)**	**0.990 (0.126)**	**1.020 (0.080)**	**0.966 (0.045)**
	0.065	***0.937***	***0.801***	***0.453***
Adjusted Model (N=13,370)				
SBIRT	1.012 (0.056)	0.923 (0.217)	1.047 (0.167)	1.222 (0.142)
	0.825	*0.733*	*0.774*	*0.084*
Post	1.173 (0.019)	1.351 (0.196)	1.343 (0.116)	1.118 (0.052)
	***	*0.038*	***	*0.017*
SBIRT × Post	**1.093 (0.047)**	**0.723 (0.140)**	**0.865 (0.088)**	**0.925 (0.067)**
	0.040	***0.093***	***0.153***	***0.283***

Note: Adjusted model includes covariates for age, sex, tobacco, race, baseline type 2 diabetes dx, baseline mental health diagnosis, baseline hypertension dx, baseline COPD dx, baseline heart disease dx, supplemental security income eligibility, and pregnancy*sex interaction.

***
P-Value < 0.001

Table 3:

Average per member per month change in health care use for SBIRT recipients compared to non-SBIRT patients.

	SBIRT		Comparison		Difference-in-Difference Estimate	
	Pre	**Post**	**Pre**	**Post**	**Average Marginal Effects (95% CI)**	***P-Value***
Outpatient (se)	1.49 (.031)	1.71 (0.032)	1.34 (.026)	1.45 (.027)	0.140 (.016 to .264)	0.027
Inpatient Days (se)	0.133 (.010)	0.104 (.004)	0.132 (.014)	0.103 (.005)	−0.056 (−.120 to .008)	0.087
Inpatient Admissions (se)	0.023 (.001)	0.020 (.001)	0.020 (.001)	0.017 (.043)	−0.004 (−.010 to .002)	0.170
ER Admissions (se)	0.131 (.003)	0.118 (.003)	0.090 (.002)	0.086 (.002)	−0.007 (−.022 to .008)	0.375

Note: Authors' estimates using Medicaid claims and encounter data. The unit of analysis is per member per month and models include age, sex, race, SSI eligibility, diabetes, heart disease, COPD, hypertension, tobacco use, mental health, and pregnancy interacted with sex. For each outcome, the average marginal effects is derived from the regression models and is the change in utilization for SBIRT recipients compared to those not receiving SBIRT following the intervention index month.

Table 4:

Monte Carlo simulation results of costs associated with change in utilization

	Mean (2018 dollars)	Standard Deviation	Min	Max
Total Cost Savings - PMPM	−69.42	51.17	−318.74	46.58
Total Cost Savings - annual	−833.01	614.04	−3824.82	558.98
Cost of SBIRT	51.05	9.82	27.87	75.26
Total Net Cost Savings	−781.97	608.75	−3751.85	626.66

Note: Simulation is based on 10,000 trials with mean and standard deviations as noted. Ninety-five percent of trials resulted in positive net cost offset.