SBIRT administered by mental health counselors for hospitalized adults with substance misuse or disordered use: Evaluating hospital utilization and costs

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Abstract:

Objective: We analyzed the association of Screening, Brief Intervention, and Referral to Treatment (SBIRT) with hospitalizations, emergency department (ED) visits, and related costs, when administered to inpatients with substance misuse or disordered use by professional mental health counselors. **Methods:** Our study used retrospective program and health records data and a difference-in-differences design with propensity score covariates. The study population consisted of hospital inpatients admitted to integrated care services staffed by physicians, nurses, and mental health counselors. The intervention group consisted of patients selected for intervention based on substance use history and receiving SBIRT (n = 1577). Patients selected for intervention but discharged before SBIRT administration (n = 618) formed the comparison group. The outcome variables were hospitalization and ED visits costs and counts. Costs of hospitalizations and ED visits were combined to allow sufficient data for analysis, with counts treated similarly. Patient-level variables were substance use type and substance use severity. A cluster variable was inpatient clinical service. Zero-censored and two-part logistic and generalized linear models with robust standard errors tested the association of SBIRT interventions with the outcomes. **Results:** For the full study population of patients using alcohol, illicit drugs, or both, SBIRT administered by mental health counselors was not associated with changes in hospitalizations and ED visits. For patients with alcohol misuse or disordered use, SBIRT by mental health counselors was associated an odds ratio of 0.32 ($p < .001$) of having subsequent hospitalizations or ED visits. For patients with alcohol use who did return as hospital inpatients or to the ED, SBIRT by counselors was associated with a reduction in costs of $2547 per patient ($p < .001$) and with an incidence rate ratio of 0.57 for counts ($p = .003$). **Conclusion:** Our results suggest that professional mental health counselors on inpatient integrated care teams may provide SBIRT effectively for patients with misuse and disordered use of alcohol, reducing the likelihood of future healthcare utilization and costs.

Keywords: SBIRT | substance use | counselor | behavioral health | integrated care | health services research

Article:

1. Introduction

The public health crisis of misuse and disordered use of alcohol, illicit drugs, and prescription drugs in the United States has profound consequences. People struggling with substance use are more likely to experience severe physical and mental health conditions, poor medical outcomes, and death (Degenhardt et al., 2018). Costs to society from substance-related crime, lost work productivity, and injury approach $520 billion annually (National Institute on Drug Abuse, 2020b). More than 67 million U.S. residents engage in problematic alcohol use, while 53 million misuse or abuse illicit and prescription drugs (Substance Abuse and Mental Health Services Administration, 2019). Alcohol-related deaths exceed 93,000 per year (Centers for Disease Control and Prevention, 2020b), and more than 67,000 people die annually from drug overdoses, most unintentionally (National Institute on Drug Abuse, 2020a; Olfson et al., 2019). Despite the consequences, few people receive the treatment they need (Grant et al., 2015, Grant et al., 2016).

Medical professionals manage the acute and chronic conditions caused by substance use, particularly during hospitalizations and emergency department (ED) visits. People with substance problems overuse these services, which are among the most expensive for health systems (Cornett & Latimer, 2011; Hankin et al., 2013; Hoffman & Cronin, 2015). Because about 90% of U.S. residents see a physician at least once per year (Centers for Disease Control and Prevention, 2020a), an innovative alcohol intervention model was introduced into medical settings and later adopted for illicit and prescription drug use: Screening, Brief Intervention, and Referral to Treatment (SBIRT) (Substance Use and Mental Health Services Administration, 2013). With a growing evidence base, SBIRT is operational or under implementation in medical practices in over half of U.S. states (Agley et al., 2014) and administered in outpatient, ED, and inpatient settings (Babor et al., 2017). SBIRT interventions by physicians and nurses are associated with reducing alcohol misuse in outpatient and emergency settings (Substance Use and Mental Health Services Administration, 2013). However, research outcomes for SBIRT are inconclusive when applying the intervention to inpatient medical settings, for alcohol use disorders, or for misuse or disordered use of illicit or prescription drugs (Substance Use and Mental Health Services Administration, 2013). A possible explanation for these results is that physicians and nursing staff are willing to screen for substance use but often do not conduct brief interventions or referrals to treatment when use is detected (Agley et al., 2014; Chan et al., 2013; Glass et al., 2015).

Under emerging structures known as integrated care practices, SBIRT interventions are provided primarily by onsite behavioral health professionals, who collaborate with medical staff to address substance use and other patient biopsychosocial concerns (Collaborative Family Health Association, 2020). Vendetti et al. (2017) performed a large-scale evaluation of the U.S. Substance Use and Mental Health Administration's (SAMHSA) SBIRT grant program with SBIRT provided by behavioral health specialists such as counselors. The researchers' foremost conclusion was that behavioral specialists, rather than medical generalists, should be delivering SBIRT. Early research on SBIRT by behavioral health professionals supports benefits for populations and substance use patterns not amenable to SBIRT by medical staff. In a study of the SAMHSA grant program in four states, Barbosa et al. (2017) found reductions in the probability of alcohol use (27%) and illicit drug use (29%) following brief intervention for patients in outpatient and ED settings. Watkins et al. (2017) researched collaborative care, a form of integrated care in primary care clinics, for alcohol and opioid use. A key finding was higher reported abstinence from opioids and/or alcohol at six months when behavioral health specialists provided SBIRT (33% vs 22%).

SBIRT is well-suited for professional mental health counselors, who focus on the therapeutic relationship and wellness (Council for Accreditation of Counseling and Related Educational Programs, 2020; Substance Use and Mental Health Services Administration, 2013). Recommended SBIRT practice involves facilitative conditions and helping skills that counselors routinely employ, such as empathy, nonjudgmental approach, resistance management, assessments, and patient advocacy (Babor & Higgins-Biddle, 2001). Counselors learn about trauma and psychiatric diagnoses, conditions that often co-occur in substance misuse and disordered use (Patel et al., 2016). Preliminary evidence suggests that SBIRT administered by counselors in inpatient settings is associated with reductions in alcohol use. Veach et al. (2018) found average declines in self-reported drinking at six months of 64% to 69% in study subjects, which included inpatients on the spectrum from misuse to disordered use.

In most SBIRT studies, the primary outcome is self-reported consumption, which risks overstating results due to potential under-reporting by participants (Agley et al., 2014; Glass et al., 2017). The International Network on Brief Interventions for Alcohol & Other Drugs advocates for measuring alternative "hard" health outcomes, such as healthcare utilization and costs (Glass et al., 2017). Examples are hospital admissions and ED visits, which are of high value to health systems (Cornett & Latimer, 2011; Glass et al., 2017) and not typically found in the SBIRT literature (Bray et al., 2007, Bray et al., 2011). In two of the few studies of SBIRT by behavioral health specialists that evaluated inpatient utilization, Estee et al. (2010) found a reduction in per-member/per-month inpatient days of 0.12 while Paltzer et al. (2017) found a reduction of 0.036 days per month.

1.1. Purpose, theoretical framework, and hypothesis

The purpose of our retrospective study was to determine if SBIRT, when administered by mental health counselors to inpatients with alcohol, illicit drug, and/or prescription drug misuse and disordered use, was associated with subsequent reduced hospitalization and ED visit costs and frequency counts. Our conceptual model was the Texas Christian University (TCU) Treatment Model, an evidence-based theoretical framework (Simpson, 2004). The TCU Model delineates the factors associated with treatment outcomes in substance use: patient-level factors, such as substance use severity and time in treatment, and program-level factors, such as staff training and treatment environment (Simpson, 2004). Individuals admitted for acute care hospitalization with concomitant suspected or known substance use problems comprised our study's population. Patient-level factors were substance use severity and type of use (alcohol, illicit and/or prescription drugs, or both). The program-level factor was the hospital clinical service admitting the patient – one of the integrated care services with mental health counselors conducting SBIRT. We hypothesized that counselor SBIRT interventions were associated with decreased substance use, leading to reductions in utilization of inpatient and emergency healthcare and lower costs.

2. Methods

2.1. Study setting and subjects

Our study setting was the primary teaching hospital of a large academic health system in the southeastern U.S., with 50,000 annual inpatient admissions to 885 licensed beds and 111,000 Emergency Department visits. The perspective of the teaching hospital formed the study boundaries, with hospitalizations, emergency department visits and costs limited to activity occurring at the hospital.

Study subjects were patients admitted to the hospital's integrated care services (Trauma, Burns, General Medicine) and selected for SBIRT by hospital-based mental health counselors and by counselor interns from area graduate programs, hereafter referred to collectively as "counselor(s)". Counselors received a minimum of four weeks of training in SBIRT and practiced under supervision and peer review. Training and supervision modalities included shadowing, role playing, live observation, and audiotape review. Two of the authors (first and fifth) are counselors who administered SBIRT interventions to about 5% of study subjects.

To select patients with known or potential substance use, counselors reviewed electronic medical records and/or consulted with physicians and nurses. Patients qualified for SBIRT interventions for reasons such as substance use appearing on the medical problem list, patient disclosure of use, and/or positive blood alcohol or urine drug levels. Counselors entered patient identifiers, demographic information, and clinical data to Microsoft Excel spreadsheets stored securely. The counselors conducted as many initial SBIRT sessions as possible then followed up with some patients previously seen. Patients with known disordered use or whose predicted discharge dates were imminent took priority.

SBIRT sessions followed a general format with modification possible based on counselor clinical impressions and judgment. Counselors looked to develop patient trust quickly and create therapeutic alliances using empathy, understanding, and authenticity. Screenings, conducted by counselor interview, employed recommended SBIRT instruments, primarily the Alcohol Use Disorders Identification Test (AUDIT) (Babor & Higgins-Biddle, 2001) or the Cut-down, Annoyed, Guilty, Eye-opener (CAGE) instrument (Ewing, 1984). Brief interventions focused on collaborating and engaging with patients, supplying personalized feedback about screening results, connecting substance use to present health concerns, emphasizing the potential impact of continued use, exploring options for change, and/or developing change goals and plans. If referral to treatment was indicated and patients were willing, counselors connected patients to hospital care coordinators for specialty inpatient treatment options and/or provided patients with names of outpatient counselors in their geographic location. Following each completed intervention, counselors documented details including time spent with patients, notes about SBIRT components, and names of counselors conducting interventions on the secure spreadsheets. Reasons for missed encounters were logged.

Our study sample consisted of adults aged 18 years and older admitted to the integrated care services between January 2014 and December 2017, selected for SBIRT intervention, and meeting criteria for study inclusion. The *intervention group* (n = 1577) consisted of patients who received one or more SBIRT counseling interventions during a single hospitalization. The total time counselors spent with patients across sessions ranged from 15 min to 540 min. The most frequent total was 30 min, with 79% of patients engaging with counselors for one hour or less over 1–3 sessions. The average total time of 53 min skewed right because of the small Burn patient population (7.8% of the intervention group), some of whom stayed in the hospital for months and engaged multiple times with counselors. The *comparison group* (*n* = 618) included patients selected for SBIRT intervention but not receiving one due to timing issues, such as absence from the hospital room, discharge on a weekend when counselors were not available, or discharge earlier than initially predicted due to medical stabilization or response to treatment. For patients selected for SBIRT during more than one hospitalization, the first hospitalization became the *index hospitalization* for inclusion to avoid potential confounding effects from increasing "doses" of counseling, and the later hospitalization(s) were dropped from the data.

Excluded patients (*n* = 473) were patients with temporary or permanent cognitive deficits, active psychotic symptoms, refusal of intervention, or departure from the hospital against medical advice. Such patients were likely to be qualitatively different from the study population. Patients not conversationally fluent in English also were excluded, as translators were not available to the counselors routinely.

2.2. Data procedures

Institutional Review Boards of both the hospital and the former university of the principal investigator approved the study. For patients meeting inclusion criteria, a patient dataset was created in Excel using patient identifiers, demographic data, admission dates, and SBIRT intervention status from the counselor spreadsheets.

2.2.1. Hospitalizations and emergency department visit variables

For each patient, dates, costs, and counts of hospitalizations and ED visits to the teaching hospital one year prior to index hospitalization admission dates and one year after discharge dates were obtained from the medical center's data warehouses. These encounters occurred between January 2013 and December 2018. One-year periods are consistent with studies involving hospital and ED utilization for inpatients (Bray et al., 2007; Saitz et al., 2014) and in other studies of substance use outcomes (Bloor et al., 2008; Glass et al., 2015; Jonas et al., 2012).

2.2.2. Derivation of cost variables

For each hospitalization or ED visit included in our study, cost estimates were extracted from the medical center's data analytics warehouse. The cost estimates are derived from a proprietary cost accounting system that follows generally accepted accounting principles. Clinically related medical center costs are allocated to patient encounters, including hospitalizations and ED visits (G. Carter, personal communication, February 7, 2019). Costs, and metrics for distributing costs, derive from multiple financial sources, including the accounting system and the payroll system. Departments are classified as "direct" or "indirect." Direct departments, such as surgical services, bill patients directly for services. Indirect departments do not bill patients for services;

an example is executive leadership. Indirect departments include only those associated with the clinical mission of the health system, excluding research, teaching, and related administrative activities. Direct department costs are allocated to the inpatient, outpatient, and/or emergency encounters billed by those departments using charge data such as relative value units or diagnostic related groups. Indirect department costs are allocated to the direct departments reasonably associated with their activities using various metrics (e.g., square feet, number of employees) or other allocation methodologies. Direct and indirect costs add up to total costs. Total costs for each inpatient hospitalization and ED visit were extracted from the data warehouse for use in our study as cost outcomes.

Other patient-level data extracted from the data analytics warehouse were clinical disease coding, measures of illness severity and mortality risk, physician clinical service overseeing the patient's care, room location at time of discharge, and payers (entities responsible for bill payment such as governments, insurance companies, or patients). Prior to analysis, the dataset was checked, verified, and modified using recommended data cleaning processes (Cody, 2008) and validated against the data warehouse.

2.3. Measures

The *outcome variables* included in our study were hospitalizations and ED visit costs and counts. The patient-level *predictor variables* were substance use type and substance use severity. The cluster *predictor variable* was inpatient clinical service.

2.3.1. Hospitalization and ED visits costs and counts

Hospitalizations and ED visits for each one-year period – prior to and after index hospitalizations – were summed by period as count outcome variables, and their associated costs summed as cost outcome variables. In our observational retroactive study, the data were insufficient to analyze hospitalizations and ED visits separately.

2.3.2. Time period

For the time period predictor variable, the one-year period prior to an index hospitalization was coded as ‘0’ and the year subsequent as ‘1’.

2.3.3. SBIRT interventions

The dichotomous SBIRT intervention predictor variable was coded as ‘0’ for no intervention or ‘1’ for one or more intervention sessions.

2.3.4. Substance use type and severity

Substance use type and severity were categorical predictor variables based on clinical diagnosis coding from patient index hospitalizations. Codes for substance use were assigned by treating physicians and/or ancillary service providers, then verified by hospital inpatient coders. If a patient's substance use was not a factor in medical treatment, the diagnosis coding generally would not include a substance use code(s). The counselors did not bill for their services, therefore did not assign diagnosis codes to hospitalizations. The substance use type predictor variable consisted of four levels: '0' absence of substance use coding, '1' alcohol use, '2' illicit and/or prescription drug use, and '3' use of both alcohol and drugs. Substance use severity was a categorical predictor variable with four levels: '0' absence of substance use coding, '1' substance use, '2' substance misuse, and '3' substance use disorder.

2.3.5. Inpatient clinical service

Inpatient clinical service was the cluster *predictor variable* based on the physician specialty service caring for the patient. Participants clustered within six service groupings, three groups for patients admitted to the integrated care unit for each physician service, and three groups for patients assigned to a physician service but not able to stay on the unit due to bed geography limitations. Each service's integrated care teams rounded to patients located on-unit and off-unit.

2.4. Research model

A difference-in-differences (DID) approach is proper to evaluate the association of the SBIRT intervention with outcomes. The DID model is a quasi-experimental research design to control for observed covariates and unobserved confounders that remain stable over time (Crown, 2014). DID is employed when two or more periods of data are available for both intervention and comparison groups: a baseline period where neither group receives the intervention and a following period(s) where one group receives the intervention and the other does not (Crown, 2014), as in our study. The predictor of interest is the interaction of the time and intervention variables.

2.5. Statistical analyses

In our retrospective study, intervention and comparison groups were not randomly assigned, so systematic differences between intervention and comparison patients may overestimate or underestimate changes associated with SBIRT intervention (Heppner et al., 2016). Propensity score analysis balances observed characteristics of patients in the two groups (Ryan et al., 2015). Each patient's score was used as a *predictor variable*. Propensity scores were calculated using logistic regression with observed covariates as predictors and the dichotomous intervention variable as the outcome. Demographic covariates for the propensity scores included a continuous variable, age (mean-adjusted), and three categorical variables: gender, ethnicity/race, and marital status. Clinical covariates were severity of illness and risk of mortality. Payer was a categorical covariate proxy for observed differences in economic circumstances among patients. Payers included major government and commercial insurers, while patients without insurance were classified as self-pay. Payers were grouped into five categories by major type. Finally, to capture potential seasonality of treatment, the calendar quarter was calculated from each admission date. Seasonality helped balance factors such as holidays and weather between groups.

The cost and count outcome variables exhibited non-linear and overly wide distributions with a high prevalence of zero values, suggesting non-normal distributions of error terms and residuals and pointing to generalized linear regression models (Cameron & Trivedi, 2009; Long & Freese, 2014; Raudenbush & Bryk, 2002). A two-part model is appropriate for over-dispersion and excess zeros in cost outcome data, combining a logit model with a generalized linear model with gamma distribution and log link, thus allowing two processes for zero and non-zero prediction (Belotti et al., 2015). A zero-censored negative binomial model is recommended for over-dispersion and excess zero values in count outcome data (Hilbe, 2009). This model fits outcome variables on predictor variables using a maximum-likelihood negative binomial regression model with canonical parameterization (Hilbe, 2009). The censored model can be considered an alternative specification for the second part of a two-part model and as such shares the same first-part logit. The procedures in Stata 16 (StataCorp, 2019) are TWOPM and CNBREG, respectively, with clinical service as a cluster variable in both models and incident rate ratios to improve interpretability in the CNBREG count model (StataCorp, 2019).

The DID models were specified as follows:

$$\mathrm{Y}_{ij} = \beta_0 + \beta_1 \mathrm{SBIRT}_{ij} + \beta_2 \mathrm{Post}_{ij} + \beta_3 \left(\mathrm{SBIRT}_{ij} \mathrm{x}\, \mathrm{Post}_{ij}\right) + \beta_4 \mathrm{X}_{ij} + \varepsilon_{ij} + \mu_j. \qquad (1)$$

Eq. (1) is the multilevel model used in the analyses. Both parts of the two-part model and the negative binomial model used identical predictors. For the two-part model, the Y outcomes were binary zero/non-zero costs for the first part, then continuous non-zero costs for the second part, for an individual subject *i* within a clinical service *j*. For the negative binomial model, the Y outcomes were non-zero counts for an individual subject *i* within a clinical service *j*. β_3 represented the difference-in-differences estimator adjusted for X_{ij} factors of substance use severity, substance use type, and propensity score. Random intercepts for each clinical service allowed for variations across physician specialties represented by μ_j. An alpha level of 0.05 demonstrated significant association of the interventions with the outcomes.

Three sensitivity analyses assessed bias in our study population using the two-part cost outcomes model. The first sensitivity analysis was a parallel trends test. For each patient, the year prior to the index hospitalization was divided into two equal six-month periods, with hospitalization and ED visit combined costs accumulated for each half-year period. The second sensitivity analysis involved recalculation of the propensity scores to include only patient-level factors present at the start of the pre-index hospitalization year: age, gender, and ethnicity/race. These scores were employed in the two-part model. The third sensitivity analysis excluded patients who lacked disease coding for substance use to determine if these patients differentially affected the results.

3. Results

3.1. Intervention and comparison groups

The intervention and comparison groups differed significantly by insurer, with fewer Medicare patients in the intervention group (19% versus 24%, $p = .026$), and by seasonality, with 28% of intervention patients admitted between October and December versus 31% of comparison patients admitted April through June ($p < .001$) (Table 1). The intervention and comparison groups also differed in substance use severity, substance use type, and inpatient clinical service. Based on clinical disease coding, 54% of intervention patients were coded for misuse or disordered use compared to 33% of comparison patients ($p < .001$), while 22% of intervention patients lacked coding for substance use compared to 39% of comparison patients ($p < .001$). Medicine patients skewed towards intervention (25% of the intervention total vs. 17% for comparison, $p < .001$) and Burns patients towards comparison (20% of the comparison total vs. 8% of the intervention group, $p < .001$).

Table 1. Characteristics of study sample.

Variable	**Intervention**	**Comparison**	***p***
Group Count [n (%)]	1577 (72%)	618 (28%)	
Age [mean (*SD*)]	45.0 (*17.1*)	44.6 (*15.8*)	*0.602*
Gender, Male [n (%)]	1172 (74%)	450 (73%)	*0.471*
Ethnicity/Race [n (%)]			*0.905*
White	1145 (73%)	449 (73%)	
Black/African American	347 (22%)	133 (22%)	
Other	85 (5%)	36 (5%)	
Marital Status [n (%)]			*0.257*
Single	785 (50%)	292 (47%)	
Married	449 (28%)	198 (32%)	
Other	343 (22%)	128 (21%)	
Payer [n (%)]			*0.026**
Managed Care	371 (24%)	159 (26%)	
Medicaid	271 (17%)	98 (16%)	
Medicare	297 (19%)	147 (24%)	
Self-Pay	197 (12%)	61 (10%)	
All Other	441 (28%)	153 (25%)	
Quarter of Admission [n (%)]			*0.000**
Jan-Mar	369 (23%)	137 (22%)	
Apr-Jun	361 (23%)	193 (31%)	
Jul-Sep	410 (26%)	160 (26%)	
Oct-Dec	437 (28%)	128 (21%)	
Severity of Illness [n (%)]			*0.495*
Minor	113 (7%)	45 (7%)	
Moderate	465 (30%)	162 (26%)	
Major	715 (45%)	296 (48%)	
Extreme	284 (18%)	115 (19%)	
Risk of Mortality [n (%)]			*0.763*
Minor	536 (34%)	205 (33%)	
Moderate	558 (35%)	217 (35%)	
Major	350 (22%)	135 (22%)	
Extreme	133 (9%)	61 (10%)	
Substance Use Severity [n (%)]			*0.000**
Absence of use	341 (22%)	238 (39%)	
Use	375 (24%)	173 (28%)	
Misuse (abuse)	509 (32%)	138 (22%)	
Disordered Use (dependence)	352 (22%)	69 (11%)	
Substance Use Type [n (%)]			*0.000**
Absence of use	341 (22%)	238 (39%)	
Alcohol	229 (14%)	53 (8%)	
Illicit and Prescription Drugs	505 (32%)	221 (36%)	
Alcohol and Drugs	502 (32%)	106 (17%)	

Variable	Intervention	Comparison	*p*
Clinical Service and Location [n (%)]			*0.000**
Burns inpatient on unit	116 (7%)	107 (17%)	
Burns inpatient off unit	7 (1%)	18 (3%)	
General Medicine inpatient on unit	284 (18%)	83 (13%)	
General Medicine inpatient off unit	105 (7%)	22 (4%)	
Trauma inpatient on unit	665 (42%)	276 (45%)	
Trauma inpatient off unit	400 (25%)	112 (18%)	
Propensity Score [mean (*SD*)]	0.724 (0.*06*)	0.705 (0.*06*)	*0.000**

* significant at $\alpha = 0.05$.

3.2. Outcome variables

Average outcomes for the intervention and comparison groups and by subgroups of substance use type supply context for the model results (Table 2). Costs for the intervention group and substance use type subgroups exceeded costs for the comparison group and subgroups, except for the comparison alcohol subgroup in the year following index hospitalizations. Average costs and counts of hospitalizations and ED visits increased across time for every group and subgroup. For most, the increases were sizable and in certain cases more than double the year prior to the index hospitalization. For all groups and subgroups, the comparison group change was proportionally greater than the intervention group change. The most striking cost and count increases were in the comparison alcohol subgroup.

Table 2. Average count and cost outcome variables by type of substance use.

Time Period and Group	Variable	All Substance Use Types	No Coding for Substance Use	Alcohol Use	Illicit Drug Use	Alcohol + Illicit Drug Use
Intervention	*n*	1577	341	229	505	502
Comparison	*n*	618	238	53	221	106
Year Prior to Index Hospitalization[a]						
Intervention	Counts	0.76	0.47	0.56	0.86	0.95
	Costs	$3610	$3594	$1850	$5364	$2661
Comparison	Counts	0.56	0.32	0.17	0.79	0.84
	Costs	$2398	$2526	$60	$3100	$1818
Year Following Index Hospitalization[a]						
Intervention	Counts	0.98	0.74	0.65	0.93	1.36
	Costs	$6338	$6069	$3406	$6765	$7428
Comparison	Counts	0.87	0.65	0.96	0.89	1.30
	Costs	$4718	$4777	$4639	$3887	$6363

[a] Counts and costs are averages for hospitalization and ED visit combined data.

3.3. Association of SBIRT with hospitalizations and ED visits

For the cost model with all patients, our results show that SBIRT interventions by counselors were not associated with changes in hospitalization and ED visit combined costs (Table 3). For the logit model with the alcohol-only subgroup, SBIRT was associated with an odds ratio of 0.32 that patients would have subsequent hospitalizations or ED visits ($p < .001$). For the generalized linear model of the alcohol-only subgroup, SBIRT was associated with reductions in hospitalization and ED visit costs of $2547 per patient compared to patients not receiving SBIRT

($p < .001$). The results were not significant for patients using illicit and/or prescription drugs or both alcohol and drugs. Thus, SBIRT by counselors for patients with alcohol misuse or disordered use was associated with significant reductions in the likelihood of inpatient or emergency care and, if care was needed, with significant reductions in the costs for that care.

Table 3. Association of counselor-administered SBIRT for substance use with hospital and emergency department costs.

SBIRT[a]	Odds Ratio or Coefficient[a]	Robust SE	p*	95% CI	Predicted Mean[b]	Marginal Effect[b]
First part: Logit model						
All use types	0.90	0.10	0.325	0.73, 1.11		
Alcohol only	0.32	0.04	0.000*	0.25, 0.41		
Illicit and prescription drug only	1.07	0.20	0.677	0.75, 1.54		
Alcohol + drug	0.89	0.26	0.695	0.51, 1.56		
Second part: Generalized linear model						
All use types	(0.02)	0.15	0.873	(0.32), 0.27		
Alcohol only	(2.81)	0.74	0.000*	(4.24), (1.36)	$2610	($2547)
Illicit and prescription drug only	(0.04)	0.27	0.884	(0.57), 0.49		
Alcohol + drug	(0.06)	0.52	0.913	(1.06), 0.95		

* significant at $\alpha = 0.05$.
[a] Model: Two-part model with first part logit using odds ratios and second part generalized linear regression (cluster variable Clinical Service).
[b] Predicted means and marginal effects for significant interactions.

Results for the count model containing all patients showed that SBIRT interventions by counselors were not associated with changes in hospitalization and ED visit combined counts (Table 4). An analysis conducted by type of use – alcohol, illicit and prescription drugs, or both – revealed that patients with alcohol misuse or disordered use who received SBIRT interventions and later were hospitalized or visited the ED had an incident rate ratio of 0.57 events compared to patients with alcohol use and not receiving SBIRT ($p = .003$). Results were not significantly different for patients with illicit and/or prescription drug use or both alcohol and drugs.

Table 4. Association of counselor-administered SBIRT for substance use with hospital and emergency department counts.

SBIRT[a]	Incident-rate ratio	Robust SE	p*	95% CI
All use types	0.95	0.04	0.234	0.86, 1.04
Alcohol only	0.57	0.11	0.003*	0.39, 0.83
Illicit and prescription drug only	0.99	0.03	0.789	0.90, 1.09
Alcohol + drug	0.98	0.04	0.620	0.91, 1.06

* significant at $\alpha = 0.05$.
[a] Model: Censored negative binomial (cluster variable Clinical Service).

3.4. Sensitivity analyses

The first sensitivity analysis was a parallel trends test for the cost model, with results showing similarity between the intervention and comparison groups in costs (logit $p = .835$, generalized linear $p = .677$) (Table 5). These results suggest there were no observable differences between the intervention and comparison groups prior to the index hospitalization. Data were insufficient to conduct the parallel trends test by substance use type.

Table 5. Sensitivity analyses.

Sensitivity Test: Parallel Trends[a]	**Coefficient**	**Robust SE**	**p***	**95% CI**
Costs: logit	0.97	0.13	0.835	0.74, 1.27
Costs: generalized linear	(0.08)	0.19	0.677	(0.44), 0.29
Sensitivity Test: Propensity Scores[a, b]	**Coefficient**	**Robust SE**	**p***	**95% CI**
All patients Costs: two-part model, first part logit	0.90	0.10	0.327	0.73, 1.11
All patients Costs: two-part model, second part generalized linear	(0.07)	0.18	0.693	(0.43), 0.28
Alcohol-only patients Costs: two-part model, first part logit	0.32	0.04	0.000*	0.25, 0.41
Alcohol-only patients Costs: two-part model, second part generalized linear	(3.11)	0.62	0.000*	(4.32), (1.90)
Sensitivity Test: Excluding Patients without Substance Use Disease Coding[c]	**Coefficient**	**Robust SE**	**p***	**95% CI**
All patients Costs: two-part model, first part logit	0.90	0.10	0.326	0.73, 1.11
All patients Costs: two-part model, second part generalized linear	(0.00)	0.15	0.978	(0.30), 0.29
Alcohol-only patients Costs: two-part model, first part logit	0.32	0.04	0.000*	0.25, 0.41
Alcohol-only patients Costs: two-part model, second part generalized linear	(2.81)	0.74	0.000*	(4.25), (1.36)

* Significant at $\alpha = 0.05$.
[a] The parallel trends sensitivity test employed the differences-in-differences design, using data from the one-year period preceding the index hospitalization for each patient. The first six months served as the “pseudo pre-intervention period” and the second six months as the “pseudo post-intervention period.” Data were sufficient only for testing full dataset.
[b] The propensity score sensitivity test employed logistic regression to calculate propensity scores using only age, ethnicity/race, and gender (patient characteristics present at the start of the study). These scores were substituted into the cost models.
[c] This sensitivity test excluded patients without substance use coding from the cost models.

The second sensitivity analysis involved recalculation of the propensity scores to include only fixed patient characteristics such as age and race/ethnicity. The results were similar to the cost models using the original propensity scores. For all patients, the results were not significant (logit $p = .327$, generalized linear $p = .693$), while for patients using alcohol the results were significant (logit $p < .001$, generalized linear $p < .001$), suggesting that the original propensity scores were proper for analysis.

The third sensitivity analysis excluded patients whose disease coding did not contain substance use codes from the cost models. For all patients with substance use codes, the results were not significant (logit $p = .326$, generalized linear $p = .978$), while for patients using alcohol the results were significant (logit $p < .001$, generalized linear $p < .001$), suggesting that excluding patients without substance use coding did not alter the findings.

4. Discussion

Our study suggests the value of mental health counselors providing SBIRT to inpatients in an integrated care environment, previously examined in a single clinical trial (Veach et al., 2018). Its major findings associate SBIRT with reductions in healthcare utilization and costs for an inpatient population with alcohol misuse or disordered use. Our study indicates that mental health counselors embedded within integrated care inpatient units may provide SBIRT effectively for this population.

Our study contributes to the SBIRT literature in several ways. The study population consists of inpatients with substance use at levels from unknown to severe, with prior research results inconclusive or not supporting efficacy for this population (Mdege & Watson, 2013). Importantly, our outcomes are objective rather than subjective self-reports of use (Glass et al., 2017). These outcomes are unique in that hospitalizations and emergency department visits are lightly examined in the SBIRT literature, with limited evidence that SBIRT changes these outcomes (Bray et al., 2011, Bray et al., 2017). Our study distinguishes itself with its one-year follow-up period, while most SBIRT studies use six months or less (Gelberg et al., 2015). The real-world data used to generate the outcomes may have greater external validity than data from randomized controlled trials.

Important questions in the field of substance use interventions and the SBIRT model emerge from our study. One question is why the patient population using illicit and prescription drugs did not benefit more from SBIRT. Previous literature also found it less effective for illicit drug use (D'Onofrio & Bernstein, 2015; Saitz et al., 2014), perhaps because SBIRT was originally designed for alcohol intervention. Another question is whether patients hospitalized for longer time periods and thus available for more SBIRT sessions with counselors would experience better outcomes. Similarly, do the number of sessions and length of time spent with counselors affect outcomes? Other future studies could examine outpatient and emergency department integrated care settings, using healthcare utilization or disease state outcomes instead of patient self-reported data. A cost-effectiveness analysis could be conducted, comparing the counseling SBIRT intervention to physician or nurse interventions or to no intervention. Finally, a prospective, controlled, randomized study could correct for threats to validity arising from retrospective data.

4.1. Limitations

Our study has several potential limitations. First, separate analyses for hospitalizations and ED visit outcome variables were not possible, as the data were insufficient. If not for this limitation, the findings may have shown that SBIRT was associated with one or the other type of outcome but not both. Second, patients may have been admitted to or sought emergency care at a competitor hospital. Limiting the study perspective to a single hospital may have understated the actual occurrence of hospitalizations and ED visits for patients or masked differences in hospitalization choice between the intervention and comparison patient groups. Third, interventions may be subject to measurement variability, as mental health counselors had diverse levels of training and experience and had leeway in how they conducted SBIRT. Fourth, unknown confounding variables might be associated with the outcomes when using retrospective data. Fifth, a critical construct may be present but not measured by the model, such as the therapeutic alliance between counselor and patient or patient readiness to change. Finally, our study may be limited by the potential uniqueness of the counseling program and its integration with inpatient care teams of an academic teaching hospital; this treatment milieu may not be generalizable to other locations. The academic health system that attracts physician specialties many hospitals do not offer; integrated care settings in less-specialized hospitals may be quite different.

5. Conclusions

Until treatment rates and outcomes for people with alcohol, illicit drug and prescription drug misuse or disordered use improve, health systems will bear the burdens of conditions caused by substance use, from traumatic injury to life-threatening infections. Many physicians and nurses do not feel comfortable with or qualified to intervene with substance use, with lack of time and motivation challenging effectiveness (Vendetti et al., 2017). In contrast, behavioral health clinicians, especially professional mental health counselors, are trained in building therapeutic alliances with empathy, assessing readiness to change, managing resistance, doing assessment, supplying feedback, and advocating for patients and their wellness (Council for Accreditation of Counseling and Related Educational Programs, 2020). Transforming medical teams into integrated care teams by including behavioral health clinicians can allow medical providers to focus on medical conditions and may increase the likelihood that patients using alcohol will reduce or abstain from harmful use. Counselors who perform SBIRT interventions can reach people who are not seeking help or have not had access to help. Our study's findings set the stage for future research and for increased investment in mental health counseling and SBIRT for hospitalized patients struggling with alcohol misuse and disordered use.

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Marcia H. McCall: Conceptualization, Methodology, Validation, Formal analysis, Investigation, Data curation, Writing – original draft, Writing – review & editing, Visualization, Project administration. **Kelly L. Wester:** Conceptualization, Methodology, Writing – review & editing, Supervision. **Jeremy W. Bray:** Conceptualization, Methodology, Formal analysis, Writing – review & editing, Supervision. **Amresh D. Hanchate:** Formal analysis, Writing – review & editing. **Laura J. Veach:** Resources, Writing – review & editing. **Benjamin D. Smart:** Writing – review & editing. **Carrie Wachter Morris:** Conceptualization, Methodology, Formal analysis, Writing – review & editing, Supervision.

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