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Benefit-Cost Analysis of SBIRT Interventions for Substance Using Patients in Emergency Departments

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Abstract

Screening, brief intervention, and referral to treatment (SBIRT) has been widely implemented as a method to address substance use disorders in general medical settings, and some evidence suggests that its use is associated with decreased societal costs. In this paper, we investigated the economic impact of SBIRT using data from Screening, Motivational Assessment, Referral, and Treatment in Emergency Departments (SMART-ED), a multisite, randomized controlled trial. Utilizing self-reported information on medical status, health services utilization, employment, and crime, we conduct a benefit-cost analysis. Findings indicate that neither of the SMART-ED interventions resulted in any significant changes to the main economic outcomes, nor had any significant impact on total economic benefit. Thus, while SBIRT interventions for substance abuse in Emergency Departments may be appealing from a clinical perspective, evidence from this economic study suggests resources could be better utilized supporting other health interventions.

Keywords

substance abuse; SBIRT; economic evaluation; benefit-cost analysis

1. Introduction

It is estimated that the cost of addiction in the U.S. is over \$700 billion (Kasunic & Lee, 2014). To mitigate the negative aspects of substance use disorders, many social programs

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have been put in place and it is estimated that the annual expenditures on SUD treatment in the U.S. is over \$20 billion (Mark, Levit, Vandivort-Warren, Buck, & Coffey, 2011). While the overall benefits of addiction treatment are well documented, policy makers are increasingly relying on economic analyses, particularly benefit-cost analyses, because they provide a framework to compare the overall economic impact of different substance use disorder treatment programs (Cartwright, 2000; Doran, 2008; French & Drummond, 2005; Holder, 1998; McCollister & French, 2003; Schori, 2011).

Recently, a growing clinical literature suggests that screening, brief intervention, and referral to treatment (SBIRT) is an effective tool in reducing problematic substance use. SBIRT is an integrated, public health approach to identify at-risk persons with substance use disorders, provide brief interventions, and refer at-risk persons to more specialized treatment. From an economic perspective, a number of studies have found brief interventions in alcohol dependent populations to reduce future costs in a variety of areas (Barbosa, Cowell, Bray, & Aldridge, 2015; Fleming et al., 2000, 2002; Gentilello, Ebel, Wickizer, Salkever, & Rivara, 2005; Kunz, French, & Bazargan-Hejazi, 2004). Additionally, SBIRT for alcohol use disorders have been shown to be economically effective from an employer's perspective (Quanbeck, Lang, Enami, & Brown, 2010).

Although most of the research on SBIRT has involved populations with alcohol use disorders, SBIRT has recently been applied to individuals with substance use disorders, including those presenting in Emergency Departments (EDs). From a clinical perspective, EDs are a logical environment for these interventions as they provide medical care to underserved, disadvantaged, and uninsured patients (Hirshon & Morris, 2006) and improve public health by identifying life-threatening conditions early in their development (Bernstein & Haukoos, 2008). Because of the unplanned and often emergent need for ED visits, patients are potentially more receptive to treatment via the so-called "teachable moment." However, recent randomized control trial studies did not find evidence supporting SBIRT for problematic drug use. Saitz et al. (2014) did not find any significant impact of a brief negotiated interview in primary care on unhealthy drug use and Roy-Byrne et al. (2014) did not find an effect of a one-time brief intervention for problematic drug use.

From an economic perspective, brief interventions have considerably lower costs than more conventional treatment approaches (Bray et al., 2014; Bray, Zarkin, Hinde, & Mills, 2012; Zarkin, Bray, Hinde, & Saitz, 2015). Moreover, because of the prevalence of problematic substance use in ED patients (Barbosa et al., 2015; D'Onofrio, Becker, & Woolard, 2006; Sanjuan et al., 2014), interventions implemented in this environment may have reduced per-patient screening costs. Additionally, beyond reduced costs, given the high healthcare utilization and crime rates associated with substance use disorders, interventions in these settings have the potential to generate considerable economic benefits. Unfortunately, the actual economic impact of these programs is relatively unknown. In fact, only one published study has evaluated the economic impact of SBIRT for substance using patients (Estee, Wickizer, He, Shah, & Mancuso, 2010). In that study, the authors find that a SBIRT program reduced the healthcare costs of a cohort of Medicaid patients by \$300 to \$600 per month. A key limitation, however, is the absence of a randomized control group, forcing the investigators to employ propensity score matching.

In this paper, we further investigate the economic impact of SBIRT for substance use disorders in EDs using data from the Clinical Trial Network (CTN) Protocol 0047: Screening, Motivational Assessment, Referral, and Treatment in Emergency Departments (SMART-ED), which was a randomized control trial implemented in six sites across the United States. The primary outcomes in this trial were self-reported days using drugs, days of heavy drinking, and drug use verification based on hair samples. The main study found no significant differences in self-reported days using drugs or heavy drinking days (Bogenschutz et al., 2014). In the present economic evaluation, we augment the main study by conducting a benefit-cost analysis using numerous additional economic outcome domains including: health status, health services utilization, workplace productivity, and criminal activity. The resulting economic analysis provides policy-relevant information about both the costs and benefits of SBIRT interventions in EDs, and offers evidence on whether these programs are prudent from an economic perspective.

2. Methods

2.1 Protocol

The SMART-ED protocol was a randomized clinical trial implemented by the National Institute on Drug Abuse (National Drug Abuse Treatment, Clinical Trials Network) in EDs at six clinical sites across the US: Albuquerque, New Mexico; Cincinnati, Ohio; New York, New York; Morgantown, West Virginia; Miami, Florida; and Boston, Massachusetts (Bogenschutz et al., 2011; Bogenschutz et al., 2014). The design was a three-arm trial in which patients reporting problematic drug use (scoring a 3 or greater on the 10-item Drug Abuse Screening Test (Skinner, 1982)) were randomly assigned to one of three treatment conditions: 1) minimal screening only (MSO); 2) screening, assessment, and referral to treatment (SAR); and 3) SAR plus brief intervention, with two telephone follow-up booster sessions (BI-B).

Participants in the MSO group received an informational brochure about drug use (its consequences and types of treatment) and no further intervention. Participants in the SAR group received the same informational brochure, minimal scripted feedback about their substance use, and a recommendation to seek treatment, if indicated or requested. Individuals in the BI-B group also received the informational brochure, feedback and recommendation to seek treatment (if indicated or requested), and an additional 30-minute brief intervention coupled with up to two, 20 minute “booster” sessions. These booster sessions were designed to determine if the participant engaged in treatment, review change plans, and seek commitment from the participant. The brief intervention was based on the motivational interviewing approach (Miller & Rollnick, 2002), including the FRAMES heuristic, and the development of a change plan. For each group, self-reported data were collected at 3, 6, and 12 months following the date of the baseline assessment.

2.2 Participants

For this clinical trial, 1,285 participants, ranging from 18 to 72 years of age, were randomized. The first interview was conducted on October 18th, 2010 and the last follow-up interview was completed on March 16th, 2013. Economic outcome data were collected for

1,153 (89.73%) of participants and Table 1 presents the demographic characteristics of these individuals. The first three columns portray the three treatment groups (MSO, SAR and BI-B) and the final column is the total sample. The sample was racially/ethnically diverse, predominantly male, and due to randomization, the distributions of characteristics were similar between groups. Moreover, the sample was relatively young, less educated, and unemployed.

2.3 Economic cost analysis

Economic (opportunity) costs were evaluated for both treatment groups (SAR and BI-B). In terms of cost components, screenings were completed using two tablet PCs (HP Elitebook 2730s), and were assumed to be administered in practice by a medical assistant working in the ED. Aided by the tablet PCs, screenings took approximately five minutes to administer, which included both the time it took to conduct the screening and transition to the next patient. In addition, consistent with the trial, it was assumed that one in every ten ED patients will screen positive for problematic substance use (this assumption is evaluated in the sensitivity analysis section).

All participants who screened positive for problematic substance use were provided an informational tri-fold brochure containing facts about drug and alcohol treatment, and where treatment is available. The specific information in this packet was mainly publicly-available material obtained from the National Institute on Drug Abuse website. Thus, production costs were approximated to be \$2 per handout. In terms of the assessment and referral to treatment component, the baseline assessment took approximately 30 minutes to complete and the minimally-scripted feedback lasted about five minutes.

For the BI-B component, the brief intervention took approximately 30 minutes. Additionally, up to two follow-up telephone booster sessions were provided. These booster sessions took approximately 20 minutes each to administer, and an additional 10 minutes was allocated for scheduling future phone calls and completing other preparatory work. Both the SAR and BI-B components were conducted by a substance abuse and behavioral disorder counselor (SABDC). Finally, yearly staff training consisted of four days of instruction—two days of training in communication skills based on the motivational interviewing approach and two more days of focused training on the SBIRT approach. The training was conducted by a psychologist. In a real-world clinical setting, yearly staff training may not be necessary. Thus, this assumption may slightly inflate our cost estimates.

Unit cost estimates for medical assistants, SABDCs, and psychologists were obtained from the U.S. Bureau of Labor Statistics (2015). These wage data were adjusted to 2013 dollars using the medical care CPI from the Bureau of Labor Statistics. It is also important to note that in addition to the value of professional time, economic costs include participants' opportunity costs for their time. Since the screening and referral to treatment portion of this intervention was completed while participants were waiting to receive ED treatment, the opportunity cost of screening was assumed to be zero. However, the booster session involved a true opportunity cost for participants. The time for these sessions (20 minutes each), was monetized using the inflation-adjusted average median hourly wage rate for the six represented states, which were obtained from the Bureau of Labor Statistics.

For the purposes of the cost analysis, we also made a few general assumptions about the interventions. Namely, we assumed screeners and interventionists were idle for 50% of their total available time (i.e., waiting for patients to arrive and/or preparing), brief interventions were provided to 200 participants per year (i.e., 2,000 screenings per year), and overhead costs amounted to 25% of total labor cost. All of these assumptions are further assessed in the sensitivity analysis section.

2.4 Economic benefit analysis

To estimate the economic benefits associated with the intervention, self-reported information was obtained for all three groups (MSO, SAR and BI-B) within four different outcome domains: (1) health status, (2) health services utilization, (3) workplace productivity, and (4) criminal activity.

First, to capture the economic benefit associated with changes in health status, participants were asked the number of days they had experienced physical medical problems. Next, to capture economic benefit associated with reduced health services utilization, participants were asked the number of days they had: (1) visited the ED for physical health problems, (2) been hospitalized as an inpatient for physical health problems, (3) made any outpatient visits to any healthcare provider, (4) received inpatient alcohol treatment, and (5) received inpatient illicit drug treatment. To capture benefits associated with workplace productivity, a question was asked about the number of days the participants worked for pay. To capture the economic impact of the intervention on crime, participants were asked the number of days they engaged in illegal activities for profit.

For each economic outcome, self-reported values were summed over the 3-, 6-, and 12-month follow-ups and the economic impact of the intervention on each outcome domain was calculated by taking the difference between each treatment group (SAR or BI-B) and the no-treatment MSO group. Due to randomization, missing follow-up periods are set to zero for each outcome (follow-up rates were 89%, 86% and 81% at 3, 6, and 12 months) We also reran the models with missing responses set to the mean response for each group-specific outcome, which resulted in no appreciable differences.

To calculate the societal benefit of the intervention, differences between study groups were monetized using inflation adjusted unit cost estimates for each outcome, which were obtained from the literature. In most cases, the economic benefit of the interventions corresponded to avoided costs associated with negative outcomes (e.g., avoided criminal activity). The cost of physical health problems (\$33.66) was obtained from French, McCollister, Sacks, McKendrick, & De Leon, (2002), which used quality-adjustment factors corresponding to 19 different medical conditions. The cost of a crime day (\$1,055.62) was monetized using a weighted average of cost of crimes associated with substance abuse (French, Salomé, & Carney, 2002; Rajkumar & French, 1997). In terms of healthcare utilization, the unit cost estimates used for ED visits (\$1,076.05) and inpatient hospital visits (\$2,161.28) were obtained from Machlin & Chowdhury (2011) and Stranges, Kowlessar, & Elixhauser (2011). The unit cost for outpatient visits (\$473.11) was calculated by dividing the yearly outpatient hospital expenditures from the CMS Medicare Current Beneficiary Survey by the average number of Medicare visits per beneficiary from healthindicators.gov.

The cost per day of inpatient drug and alcohol treatment (\$169.41) was obtained from (French, Salomé, Sindelar, & Thomas McLellan, 2002). Finally, productivity differences were monetized using the average median hourly wage rate for the six participating nodes (\$17.23), which was calculated using data from the Bureau of Labor Statistics. Note that all unit cost estimates were updated for inflation to the 2013, the year the trial was completed. All non-medical related outcomes were updated for inflation using the Bureau of Labor Statistics CPI inflation calculator and all medical outcomes were inflated using medical care CPI data from the Bureau of Labor Statistics.

To test the statistical significance of changes in each outcome domain a non-parametric Wilcoxon rank-sum test was used. To test the statistical significance each monetized outcome and the overall societal benefits a non-parametric bootstrap method was used, utilizing 10,000 repetitions with replacement.

2.5 Sensitivity analysis

To evaluate the robustness of our assumptions and selected unit cost estimates, a series of sensitivity analyses were performed. Cost and benefit estimates were evaluated by running individual models with an alternative unit cost estimate—first decreased by 50% and then increased by 50%. For both participant's time and the medical assistant wage rate, the federal minimum wage rate (\$7.25) was used as a lower bound unit cost estimate.

Additionally, to evaluate the impact of our cost assumptions, models were estimated where: (1) idle time is decreased to 0% and increased to 75%, (2) the percentage of patients screening positive was increased to 20% and decreased to 5%, (3) overhead was increased to 50% of total unloaded cost and reduced to 0% of total unloaded cost, (4) the number of screenings was reduced to 1,000 and increased to 4,000, and (5) training days were increased to 8 days per year and reduced to 2 days per year.

3. Results

3.1 Economic cost estimates

Table 2 presents the estimated economic costs for the SMART-ED intervention. In terms of monetary conversion factors for labor, the hourly rate for a medical assistant was \$14.03, the hourly rate for a SABDC was \$18.34, and the hourly rate for a psychologist trained in substance use treatment was \$33.29. Table 2 includes all cost components. The SAR intervention involved screening and information, assessment and referral to treatment, and training. The BI-B intervention involved all three of the SAR components and a brief intervention with booster sessions.

Overall, the estimated cost of implementing the SAR program was \$18,194 (\$90.97 per patient) and the BI-B treatment was estimated to cost \$29,662 (\$148.31 per patient). In terms of cost components, screening was estimated to cost \$10,760 (\$53.80 per patient), the assessment and referral to treatment component was estimated to be \$5,349 (\$26.75 per patient) and the brief intervention and booster sessions are estimated to cost \$11,467 (\$57.34 per patient). Lastly, the estimated yearly training costs of the intervention amounted to \$2,085 (\$10.43 per patient).

3.2 Economic benefit estimates

Table 3 presents changes in the four economic outcome domains, the monetized benefit of each outcome domain, and the overall estimated benefits for each treatment condition. First, it is interesting to note the high levels of healthcare utilization and criminal activity, and the wide variation in these outcome domains. In general, outcomes were highly skewed with many zeros as well as extreme values. In the year after receiving the intervention, the average MSO participant experienced 46.3 days with physical health problems, visited the ED 2.8 times, had 4.3 inpatient hospital visits, and 7.7 outpatient medical visits. This group exhibited a large number of days participating in illegal activities for profit (14.9 days per year). In addition, study participants had relatively low mean days in alcohol and drug treatment (3.7 and 6.8, respectfully). In terms of differences between the treatment and control groups, using the Wilcoxon rank-sum test, none of the mean outcomes for either the SAR or BI-B groups were significantly different from the MSO group. Moreover, none of the BI-B outcomes were significantly different from the SAR outcomes. Only one of the bootstrapped confidence intervals significantly differed from zero (outpatient visits for the BI-B group). In terms of total monetized benefits, relative to MSO, both treatment groups had negative aggregated benefits, even though neither were significant at the 5% level.

3.3 Sensitivity analysis

Table 4 presents the results of our sensitivity analysis. Individual models were re-estimated after lowering and then raising the unit cost estimates for health status, health services utilization, workplace productivity, criminal activity, and drug and alcohol treatment. None of these unit cost adjustments significantly affected the qualitative results or main conclusions. In terms of structural assumptions, the largest variance in our cost estimates was associated with changes in idle time. When idle time was set to zero, costs of implementing the SAR and BI-B interventions decreased to \$64.89 and \$110.77 per person. When idle time was increased to 75% of total time, the respective implementation costs increased to \$143.13 and \$223.39 per person. Similarly, assumptions pertaining to the number of screenings and the percentage of patients screening positive for drugs had a significant impact on interventions costs.

4. Discussion

Overall, we found that the SAR intervention costs \$90.97 for the average treated participant and the BI-B enhancement costs an additional \$57.34 for the average treated participant. While somewhat expected, it is worth highlighting the substantially lower costs associated with these brief interventions vis-à-vis more conventional types of interventions, such as residential and intensive outpatient treatment programs. Compared to other brief interventions, these estimates are lower than reported by Fleming et al. (2002) and Kunz et al. (2004), but similar to estimates presented by Zarkin, Bray, Hinde, & Saitz (2015).

Reflecting on the sensitivity analysis, we found assumptions surrounding idle time to be an important aspect of SBIRT intervention costs and when idle time was set to zero, overall intervention costs decrease significantly. From a policy perspective, this suggests that significant cost savings can be captured by selectively implementing SBIRT interventions

when the ED is busy. EDs are particularly busy on Friday and Saturday nights, so targeting those peak hours could considerably increase efficiency. Of course, this may change the characteristics and outcomes of patients that are enrolled in such interventions. In terms of participants' opportunity cost of time, brief interventions in EDs have relatively low costs because they are conducted when patients would otherwise be waiting for medical services delivered through the ED (thus, their opportunity cost of screening was avoided). In this study, we used a relatively high estimate for participant opportunity cost (the average median wage rate). An alternative estimate is the federal minimum wage rate (\$7.25), which was used in the sensitivity analysis. This alternative unit cost estimate reduced total cost estimates, but not in a meaningful way. Some studies in the literature did not consider patient opportunity costs, and when these costs were omitted, the total cost of the BI-B condition decreased to \$136.82 for the average patient. Finally, potential cost savings are possible if lower cost hardware is substituted for the HP Elitebook 2730. Anecdotal evidence from interventionists suggests that these tablet PCs were expensive and somewhat difficult for ED patients to operate by themselves.

In terms of economic benefits, the SMART-ED interventions had no statistically significant economic impact relative to MSO. Indeed, none of the economic outcome variables for either treatment group were significantly different from the MSO group, and only one bootstrapped confidence interval for the monetized outcome differences was significant (BI-B outpatient visits were greater than the MSO group). Moreover, neither of the bootstrapped confidence intervals for overall economic benefits were significantly different from zero. Site-specific effects were also investigated, with no individual site displaying significant differences in economic benefits. Additionally, substance-specific effects are not likely as none were found in Bogenschutz et al. (2014).

Other approaches to consider are interventions to link people to treatment, such as case management strengths-based case management (Hesse, Vanderplasschen, Rapp, Broekaert, & Fridell, 2007; C. A. Rapp & Goscha, 2008; R. C. Rapp et al., 2008). From an economic perspective, Horn et al. (2016) found case management to be economically effective in a cohort of high-cost medically complex patients in New Mexico. Additionally, ED-initiated buprenorphine treatment has been found to significantly increase engagement in addiction treatment and reduce illicit opioid use (D'Onofrio et al., 2017; D'Onofrio et al., 2015). Also, it may be the case that more intensive interventions may be required to benefit individuals with serious drug use disorders.

Despite the absence of statistically significant economic benefits, high values for the monetized outcome variables is indicative of the considerable "potential" of interventions for substance-using patients in EDs. For example, the average number of criminal activity days for the MSO cohort was 14.9 days per year, and each criminal activity day was estimated to cost society approximately \$1,055.62. Additionally, the average MSO participant had 4.3 inpatient hospital visits, which has an economic cost of \$2,161.28 per event. Considering that the total cost of the intervention was estimated to be only \$148.31 per patient, even a minor impact on either illegal activities or healthcare utilization could have a considerable economic impact.

4.1 Limitations

When interpreting the results of this economic evaluation, a few limitations should be noted. First, the economic impact of the SMART-ED trial was evaluated using self-reported data. While self-reported data are considered relatively reliable (Darke, 1998; Langenbucher & Merrill, 2001; Needle et al., 1995) a number of factors can lead to inaccuracies (Bhandari & Wagner, 2006). Second, a number of assumptions must be made when calculating the societal costs associated with different outcome domains and some of the outcome questions were somewhat generic and vague. As an example, total criminal activity was assessed via only one question regarding the number of days participating in illegal activities for profit. Other studies have elicited more comprehensive information about crime, using a number of questions pertaining to different types of illegal activities. Overall, given that no significant differences were found across the four identified outcome domains associated with the SMART-ED intervention, we do not anticipate that collecting more sophisticated outcome/benefit information would have a meaningful impact on our results. Furthermore, in this trial, outcomes were not collected at baseline, only follow-up. In addition, a number of assumptions were made about program costs, which may change when the programs are implemented in community-based settings (i.e., transitioned from a clinical trial) and/or applied in different locations. Finally, individuals were excluded from the SMART-ED trial if they were currently engaged in or actively seeking addiction treatment. This exclusion criteria may have restricted the sample to individuals who might not be receptive to formal treatment for substance abuse. Future research should evaluate whether brief interventions such as those evaluated here may be more effective if applied to individuals who are “treatment ready.”

4.2 Conclusion

This study evaluated the economic impact of SBIRT using data from a multisite, randomized controlled trial. We find that neither of the two intervention conditions is costlier or more beneficial than the control condition. While brief interventions for substance abuse in EDs are appealing from an economic perspective due to their relatively low cost, the SBIRT model implemented in this trial was not economically beneficial. This suggests that the limited resources available for health-related interventions could be better utilized elsewhere. Future research is needed to identify more effective and cost-beneficial interventions for ED populations.

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References Cited

- Barbosa C, Cowell A, Bray J, Aldridge A. The Cost-effectiveness of Alcohol Screening, Brief Intervention, and Referral to Treatment (SBIRT) in Emergency and Outpatient Medical Settings. *Journal of substance abuse treatment*. 2015; 53:1–8. [PubMed: 25648375]
- Bernstein SL, Haukoos JS. Public Health, Prevention, and Emergency Medicine: A Critical Juxtaposition. *Academic Emergency Medicine*. 2008; 15(2):190–193. [PubMed: 18275450]

- Bhandari A, Wagner T. Self-Reported Utilization of Health Care Services: Improving Measurement and Accuracy. *Medical Care Research and Review*. 2006; 63(2):217–235. [PubMed: 16595412]
- Bogenschutz MP, Donovan DM, Adinoff B, Crandall C, Forcehimes AA, Lindblad R, et al. Design of NIDA CTN Protocol 0047: screening, motivational assessment, referral, and treatment in emergency departments (SMART-ED). *The American journal of drug and alcohol abuse*. 2011; 37(5):417–425. [PubMed: 21854285]
- Bogenschutz MP, Donovan DM, Mandler RN, Perl HI, Forcehimes AA, Crandall C, et al. Brief intervention for patients with problematic drug use presenting in emergency departments: a randomized clinical trial. *JAMA internal medicine*. 2014; 174(11):1736–1745. [PubMed: 25179753]
- Bray JW, Mallonee E, Dowd W, Aldridge A, Cowell AJ, Vendetti J. Program-and service-level costs of seven screening, brief intervention, and referral to treatment programs. *Substance abuse and rehabilitation*. 2014; 5:63. [PubMed: 25114610]
- Bray JW, Zarkin GA, Hinde JM, Mills MJ. Costs of alcohol screening and brief intervention in medical settings: a review of the literature. *Journal of studies on alcohol and drugs*. 2012; 73(6):911–919. [PubMed: 23036208]
- Carey K, Stefos T. Measuring inpatient and outpatient costs: A cost-function approach. *Health care financing review*. 1992; 14(2):115. [PubMed: 10127447]
- Cartwright WS. Cost-benefit analysis of drug treatment services: review of the literature†. *The Journal of Mental Health Policy and Economics*. 2000; 3(1):11–26. [PubMed: 11967433]
- Cleverley WO. The hospital cost index: a new way to assess relative cost-efficiency. *Healthcare Financial Management*. 2002; 56(7):36–43.
- D’Onofrio G, Becker B, Woolard RH. The impact of alcohol, tobacco, and other drug use and abuse in the emergency department. *Emergency medicine clinics of North America*. 2006; 24(4):925–967. [PubMed: 16982347]
- Darke S. Self-report among injecting drug users: A review. *Drug and Alcohol Dependence*. 1998; 51(3):253–263. [PubMed: 9787998]
- Doran CM. Economic Evaluation of Interventions to Treat Opiate Dependence: A Review of the Evidence. *Pharmacoeconomics*. 2008; 26(5):371–393. [PubMed: 18429655]
- D’Onofrio G, Chawarski MC, O’Connor PG, Pantalon MV, Busch SH, Owens PH, et al. Emergency department-initiated buprenorphine for opioid dependence with continuation in primary care: outcomes during and after intervention. *Journal of General Internal Medicine*. 2017:1–7.
- D’Onofrio G, O’Connor PG, Pantalon MV, Chawarski MC, Busch SH, Owens PH, et al. Emergency department-initiated buprenorphine/naloxone treatment for opioid dependence: a randomized clinical trial. *Jama*. 2015; 313(16):1636–1644. [PubMed: 25919527]
- Estee S, Wickizer T, He L, Shah MF, Mancuso D. Evaluation of the Washington state screening, brief intervention, and referral to treatment project: cost outcomes for Medicaid patients screened in hospital emergency departments. [Research Support, N.I.H., Extramural]. *Med Care*. 2010; 48(1):18–24. [PubMed: 19927016]
- Fleming MF, Mundt MP, French MT, Manwell LB, Stauffacher EA, Barry KL. Benefit-Cost Analysis of Brief Physician Advice With Problem Drinkers in Primary Care Settings. *Medical Care*. 2000; 38(1):7–18. [PubMed: 10630716]
- Fleming MF, Mundt MP, French MT, Manwell LB, Stauffacher EA, Barry KL. Brief physician advice for problem drinkers: long- term efficacy and benefit- cost analysis. *Alcoholism: Clinical and experimental research*. 2002; 26(1):36–43.
- French MT, Drummond M. A research agenda for economic evaluation of substance abuse services. *Journal of substance abuse treatment*. 2005; 29(2):125–137. [PubMed: 16135341]
- French MT, Martin RF. The costs of drug abuse consequences: a summary of research findings. *Journal of substance abuse treatment*. 1996; 13(6):453–466. [PubMed: 9219142]
- French MT, Mauskopf JA, Teague JL, Roland EJ. Estimating the dollar value of health outcomes from drug-abuse interventions. *Medical Care*. 1996; 34(9):890–910. [PubMed: 8792779]
- French MT, McCollister KE, Sacks S, McKendrick K, De Leon G. Benefit– cost analysis of a modified therapeutic community for mentally ill chemical abusers. *Evaluation and Program Planning*. 2002; 25(2):137–148.

- French MT, Salomé HJ, Carney M. Using the DATCAP and ASI to estimate the costs and benefits of residential addiction treatment in the State of Washington. *Social Science & Medicine*. 2002; 55(12):2267–2282. [PubMed: 12409139]
- French MT, Salomé HJ, Sindelar JL, Thomas McLellan A. Benefit- Cost Analysis of Addiction Treatment: Methodological Guidelines and Empirical Application Using the DATCAP and ASI. *Health Services Research*. 2002; 37(2):433–455. [PubMed: 12036002]
- Gentilello LM, Ebel BE, Wickizer TM, Salkever DS, Rivara FP. Alcohol interventions for trauma patients treated in emergency departments and hospitals: a cost benefit analysis. *Annals of surgery*. 2005; 241(4):541. [PubMed: 15798453]
- Hesse, M., Vanderplasschen, W., Rapp, R., Broekaert, E., Fridell, M. Case management for persons with substance use disorders. *The Cochrane Library*; 2007.
- Hirshon JM, Morris DM. Emergency medicine and the health of the public: the critical role of emergency departments in US public health. *Emergency medicine clinics of North America*. 2006; 24(4):815–819. [PubMed: 16982340]
- Holder HD. Cost benefits of substance abuse treatment: an overview of results from alcohol and drug abuse. *The Journal of Mental Health Policy and Economics*. 1998; 1(1):23–29. [PubMed: 11964488]
- Horn BP, Crandall C, Moffett M, Hensley M, Howarth S, Binder DS, et al. The Economic Impact of Intensive Care Management for High-Cost Medically Complex Patients: An Evaluation of New Mexico's Care One Program. *Population health management*. 2016; 19(6):398–404. [PubMed: 27031738]
- Kasunic A, Lee MAC. Societal burden of substance abuse. *International Public Health Journal*. 2014; 6(3):269.
- Kunz FM, French MT, Bazargan-Hejazi S. Cost-effectiveness analysis of a brief intervention delivered to problem drinkers presenting at an inner-city hospital emergency department. *Journal of Studies on Alcohol*. 2004; 65(3):363–370. [PubMed: 15222593]
- Langenbucher J, Merrill J. The Validity of Self-Reported Cost Events by Substance Abusers. *Evaluation Review*. 2001; 25(2):184–210. [PubMed: 11317716]
- Machlin, S., Chowdhury, S. Expenses and characteristics of physician visits in different ambulatory care settings, 2008. *Agency for Healthcare Research and Quality*; 2011.
- Mark TL, Levit KR, Vandivort-Warren R, Buck JA, Coffey RM. Changes in US spending on mental health and substance abuse treatment, 1986–2005, and implications for policy. *Health Affairs*. 2011; 30(2):284–292. [PubMed: 21289350]
- McCollister KE, French MT. The relative contribution of outcome domains in the total economic benefit of addiction interventions: a review of first findings. *Addiction*. 2003; 98(12):1647–1659. [PubMed: 14651494]
- Miller, WR., Rollnick, S. Motivational interviewing: preparing people for change. New York; London: Guilford Press; 2002.
- Needle R, Fisher DG, Weatherby N, Chitwood D, Brown B, Cesari H, et al. Reliability of self-reported HIV risk behaviors of drug users. *Psychology of Addictive Behaviors*. 1995; 9(4):242–250.
- Quanbeck A, Lang K, Enami K, Brown RL. A cost-benefit analysis of Wisconsin's screening, brief intervention, and referral to treatment program: adding the employer's perspective. *WMJ: official publication of the State Medical Society of Wisconsin*. 2010; 109(1):9. [PubMed: 20942294]
- Rajkumar AS, French MT. Drug abuse, crime costs, and the economic benefits of treatment. *Journal of Quantitative Criminology*. 1997; 13(3):291–323.
- Rapp CA, Goscha RJ. Strengths-based case management. *Clinical Handbook of Schizophrenia*. 2008; 319
- Rapp RC, Otto AL, Lane DT, Redko C, McGatha S, Carlson RG. Improving linkage with substance abuse treatment using brief case management and motivational interviewing. *Drug and alcohol dependence*. 2008; 94(1):172–182. [PubMed: 18242883]
- Roy-Byrne P, Bumgardner K, Krupski A, Dunn C, Ries R, Donovan D, et al. Brief intervention for problem drug use in safety-net primary care settings: a randomized clinical trial. *Jama*. 2014; 312(5):492–501. [PubMed: 25096689]

- Saitz R, Palfai TPA, Cheng DM, Alford DP, Bernstein JA, Lloyd-Travaglini CA, et al. Screening and brief intervention for drug use in primary care: the ASPIRE randomized clinical trial. *Jama*. 2014; 312(5):502–513. [PubMed: 25096690]
- Sanjuan PM, Rice SL, Witkiewitz K, Mandler RN, Crandall C, Bogenschutz MP. Alcohol, tobacco, and drug use among emergency department patients. *Drug and alcohol dependence*. 2014; 138:32–38. [PubMed: 24594289]
- Schori M. Valuation of Drug Abuse: A Review of Current Methodologies and Implications for Policy Making. *Research on Social Work Practice*. 2011; 21(4):421–431.
- Skinner HA. The drug abuse screening test. *Addictive behaviors*. 1982; 7(4):363–371. [PubMed: 7183189]
- Stranges E, Kowlessar N, Elixhauser A. Components of growth in inpatient hospital costs, 1997–2009. *Statistical brief*. 2011; 123
- U.S. Bureau of Labor Statistics. Occupational Employment Statistics. May 2014 National Occupational Employment and Wage Estimates United States. 2015 Mar 25. 2015Retrieved June 23, from http://www.bls.gov/oes/current/oes_nat.htm#21-0000
- Zarkin G, Bray J, Hinde J, Saitz R. Costs of Screening and Brief Intervention for Illicit Drug Use in Primary Care Settings. *Journal of studies on alcohol and drugs*. 2015; 76(2):222–228. [PubMed: 25785797]

Highlights

- The cost of implementing a screening, assessment, and referral to treatment intervention in emergency departments was estimated be \$90.97 per treated participant.
- An additional brief intervention, with follow-up booster sessions was estimated to cost an additional \$57.34 per treated participant.
- A high-level of healthcare utilization and crime was found in substance using patients in emergency departments.
- Neither SMART-ED treatment condition resulted a significant change in any of the identified benefit outcomes domains compared with the minimal screening only treatment condition.
- The SBIRT model for substance using patients in emergency departments implemented in this trail was not found to be effective from an economic perspective.

Table 1

Demographic and Substance Use Characteristics

	MSO % (n)	SAR % (n)	BI-B % (n)	Total % (n)
<u>Age</u>				
18–29	34.10% (133)	34.73% (133)	36.84% (140)	35.21% (406)
30–39	26.67% (104)	25.07% (96)	21.84% (83)	24.54% (283)
40–49	23.08% (90)	25.85% (99)	24.47% (93)	24.46% (282)
50>	16.15% (63)	14.36% (55)	16.84% (64)	15.78% (182)
<u>Gender</u>				
Male	71.03% (277)	67.10% (257)	69.74% (265)	69.30% (799)
Female	28.97% (113)	32.90% (126)	30.26% (115)	30.70% (354)
<u>Race/Ethnicity</u>				
White	53.08% (207)	51.44% (197)	50.26% (191)	51.60% (595)
Black	37.95% (148)	39.95% (153)	37.37% (1442)	38.42% (443)
American Indian	4.36% (17)	5.22% (20)	5.26% (20)	4.94% (57)
Other	8.97% (35)	7.05% (27)	10.53% (40)	8.85% (102)
<u>Education</u>				
1–11	35.90% (140)	30.29% (116)	31.84% (121)	32.70% (377)
High School	31.79% (124)	32.90% (126)	31.84% (121)	32.18% (371)
Some College	25.38% (99)	26.11% (100)	26.05% (99)	25.85% (298)
College	6.92% (27)	7.83% (30)	7.37% (28)	7.11% (82)
Post College	0.77% (3)	2.87% (11)	2.89% (11)	2.17% (25)
<u>Marital Status</u>				
Married	7.18% (28)	10.44% (40)	9.74% (37)	9.11% (105)
Previously married	21.54% (84)	18.80% (72)	23.16% (88)	21.16% (244)
Never married	71.28% (278)	70.76% (271)	67.11% (255)	69.73% (804)
<u>Employment</u>				
Full Time	17.44% (68)	14.88% (57)	23.42% (89)	18.56% (214)
Part Time	18.46% (72)	16.45% (63)	15.00% (57)	16.65% (192)
Student	5.64% (22)	7.05% (27)	6.32% (24)	6.33% (73)
Unemployed	42.82% (167)	46.21% (177)	37.37% (142)	42.15% (486)

Table 2

Intervention Costs

Component	who/what	quantity	Unit cost	total cost	per patient cost
<u>Screening and information</u>					
Time	Medical assistant	5 mins	\$14.03 ^a	\$4,677 ^{c,d}	\$23.38
Materials	Informational packet	1	\$2.00	\$400	\$2.00
Equipment	HP Elitebook 2730	2	\$2,207.00	\$4,414	\$22.07
Overhead		25%		\$1,269	\$6.35
Total				\$10,760	\$53.80
<u>Assessment and referral to treatment</u>					
Baseline assessment	SABDC	30 mins	\$18.34 ^a	\$3,668 ^d	\$18.34
Minimal feedback	SABDC	5 mins	\$18.34 ^a	\$611 ^d	\$3.06
Overhead		25%		\$1,070	\$5.35
Total				\$5,349	\$26.75
<u>Brief intervention and booster session</u>					
Brief Intervention	SABDC	30 mins	\$18.34 ^a	\$3,668 ^d	\$18.34
Booster session #1	SABDC	30 mins	\$18.34 ^a	\$1,834 ^d	\$9.17
Booster session #2	SABDC	30 mins	\$18.34 ^a	\$1,834 ^d	\$9.17
Participant's time	Average wage	40 mins	\$17.23 ^b	\$2,297	\$11.49
Overhead		25%		\$1,834	\$9.17
Total				\$11,467	\$57.34
<u>Training</u>					
Communication skills	SABDC	2 days	\$18.34 ^a	\$293	\$1.47
SBIRT training	SABDC	2 days	\$18.34 ^a	\$293	\$1.47
Trainer	Clinical psychologist	4 days	\$33.29 ^a	\$1,065	\$5.33
Materials	Informational packet	1	\$20	\$20	\$0.10
Overhead		25%		\$413	\$2.07
Total training costs				\$2,085	\$10.43
Total costs SAR				\$18,194	\$90.97

Component	who/what	quantity	Unit cost	total cost	per patient cost
Total costs BI-B				\$29,662	\$148.31

^aU.S. Bureau of Labor Statistics, 2015;

^bAverage Median wage rate for the six represented states (obtained from the Bureau of Labor Statistics

^cAssumed that one in every ten ED patients screen positive for substance abuse disorders;

^dassumes 50% idle time.

Note: Total costs indicate the costs associated with one site (200 treated patients).

Table 3**Societal Benefits of Treatment**

	Mean Outcomes			Monetized difference	
	MSO	SAR	BI-B	SAR	BI-B
<u>Medical Status</u>					
Physical medical problems	46.3	43.8	45.6	\$86 [−\$264, \$436]	\$26 [−\$332, \$342]
<u>Healthcare Services Utilization</u>					
ED visits	2.8	2.9	3.6	−\$53 [−\$1,042, \$900]	−\$865 [−\$2,326, \$415]
Inpatient visits	4.3	4.8	4.5	−\$1055 [−\$5,646, \$3,419]	−\$505 [−\$5,076, \$3,836]
Outpatient visits	7.7	8.2	9.4	−\$242 [−\$825, \$307]	−\$815 [−\$1,688, −\$71]
Inpatient alcohol treatment	3.7	3.4	3.8	\$49 [−\$394, \$491]	−\$9 [−\$423, \$411]
Inpatient drug treatment	6.8	5.0	5.4	\$305 [−\$308, \$960]	\$237 [−\$373, \$870]
<u>Productivity</u>					
Paid for working	68.7	63.9	72.0	−\$664 [−\$2,356, \$1,050]	\$448 [−\$1,314, \$2,252]
<u>Crime</u>					
Illegal activities for profit	14.9	18.1	15.4	−\$3,432 [−10,572, \$3,217]	−\$549 [−\$7,385, \$6,029]
Total benefits (all outcomes)				−\$5,006 [−\$14,403, \$4,209]	−\$2,032 [−\$11,238, \$7,240]

Note: Significance levels determined using a Wilcoxon rank-sum test.

* indicates significance a significant difference from MSO at the .05 level. Bracketed values indicate 95% confidence intervals using a non-parametric, bootstrap with replacement, using 10,000 repetitions. Positive dollar values indicate that the treatment condition had positive benefits in this category compared with the MSO group.

Table 4

Sensitivity Analysis

	lower bound	upper bound	SAR	BI-B
<u>Imputed wages</u>				
Medical Assistant	\$7.25	\$21.05	\$76.85 – \$105.60	\$134.18 – \$162.93
SABDC	\$9.61	\$27.51	\$76.49 – \$106.18	\$112.01 – \$186.44
Clinical psychologist	\$16.65	\$49.94	\$87.64 – \$94.30	\$144.98 – \$151.64
<u>Other cost estimates</u>				
Equipment	\$1,103.50	\$3,310.50	\$79.94 – \$102.01	\$137.27 – \$159.34
Participants time	\$7.25	\$25.85	\$90.97 – \$90.97	\$141.65 – \$154.05
<u>General modeling assumptions</u>				
Idle time	0%	75%	\$64.89 – \$143.13	\$110.77 – \$223.39
% screen positive	20%	5%	\$76.36 – \$120.20	\$133.69 – \$177.54
Overhead	0	50%	\$82.56 – \$99.38	\$130.73 – \$165.38
Number of screenings	4000	1000	\$74.72 – \$123.47	\$132.06 – \$180.80
Training days	2	8	\$85.81 – \$101.30	\$143.14 – \$158.63