Drug and Alcohol Dependence 214 (2020) 108156

Contents lists available at ScienceDirect

Drug and Alcohol Dependence

journal homepage: www.elsevier.com/locate/drugalcdep

Full length article

Cost and cost-effectiveness of three strategies for implementing motivational interviewing for substance misuse on medical inpatient units

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ARTICLE INFO

Keywords:
Cost
Cost-effective
Motivational interviewing
Brief intervention
Medical inpatient unit

ABSTRACT

Background: This study conducted cost and cost-effectiveness analyses of three strategies for implementing motivational interviewing for substance misuse on general medical inpatient units: workshop, apprenticeship, and consult.

Methods: The economic analyses were conducted prospectively alongside a type 3 hybrid effectiveness-implementation randomized trial comprising 38 medical providers, 1173 inpatients, and four consultation-liaison motivational interviewing experts. The trial took place in a university affiliated teaching hospital in New Haven, CT, USA. After completing a 1-day workshop on motivational interviewing, providers were randomized to conditions. The primary outcome measure was the number of study-eligible patients who received a motivational interview. The economic analyses included the costs of both start-up and on-going activities in each condition. Incremental cost-effectiveness ratios were used to determine cost effectiveness. Results are presented from the healthcare provider (i.e., hospital) perspective in 2018 US dollars.

Results: The total cost per patient receiving a motivational interview averaged $804.53, $606.52, and $185.65 for workshop, apprenticeship, and consult, respectively. Workshop and apprenticeship were extended dominated by the combination of consult and doing nothing. Doing nothing is cost effective when the willingness-to-pay for an additional patient receiving a motivational interview is less than $185.65, and consult is cost-effective when the willingness-to-pay for an additional patient receiving a motivational interview is greater than $185.65.

Conclusions: Given that typical reimbursements for brief intervention services for substance misuse are $35-$65, none of the three implementation strategies is likely to be economically viable from the healthcare provider perspective.

1. Introduction

Motivational interviewing (MI) is the basis of most brief behavioral interventions for substance misuse employed in medical settings (Rollnick et al., 2008). However, we know little about the cost and cost-effectiveness of strategies for implementing MI-based brief interventions on medical inpatient units, where patients have much higher rates of substance use than found in the general population (Katz et al., 2008; Saitz et al., 2006; Santora and Hutton, 2008; Smothers et al., 2004; Stein et al., 1993; Stinson et al., 2005). To our knowledge, only three studies conducted cost analyses of brief interventions within hospital inpatient settings (Barbosa et al., 2016; Bray et al., 2014; Cowell et al., 2017),[1] and none conducted cost-effectiveness analysis.

In a randomized clinical trial (Martino et al., 2019), we examined the effectiveness of three strategies to implement MI-based brief interventions on medical inpatient units: workshop, apprenticeship, and consult. In the workshop condition, medical providers attended a continuing medical education workshop. In the apprenticeship condition, after workshop training, providers performed MI under expert bedside supervision and received immediate coaching to improve performance.

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[1] All three cost studies estimated the unit costs of SBIRT (screening, brief intervention, and referral to treatment) services and/or the average annual SBIRT program costs as implemented in a variety of medical settings by SAMHSA (Substance Abuse and Mental Health Services Administration) grantees.

https://doi.org/10.1016/j.drugalcdep.2020.108156
Received 2 January 2020; Received in revised form 22 June 2020; Accepted 24 June 2020
Available online 02 July 2020

In the consult condition, after workshop training, we gave providers the option to place consults for MI experts in the psychiatry consultation-liaison service to complete motivational interviews.

Although Martino et al. (2019) found that, compared to workshop and apprenticeship conditions, the consult condition resulted in significantly more patients receiving a motivational interview (0.9% and 2.9% vs. 21.8%, respectively), the cost and cost-effectiveness of these strategies is unknown. This study presents cost and cost-effectiveness analyses of the three implementation strategies, including both start-up (one-time) and on-going (recurring) costs, from the perspective of the healthcare provider (i.e., hospital). The findings can guide decision makers in determining the value of each strategy.

2. Methods

Methods and results of the trial are described in the main report (Martino et al., 2019). The trial design is summarized below, followed by the methods used for the economic analyses. Outcome and resource utilization data for these analyses were taken from the trial and combined with cost data obtained prospectively from study personnel and the healthcare provider where the trial took place. Data collection occurred between February 21, 2013 and August 16, 2017. The Yale University Human Investigation Committee approved the study (ClinicalTrials.gov: NCT01825057).

2.1. Trial design

The study was a type 3 hybrid effectiveness-implementation cluster randomized controlled trial (Curran et al., 2012) that took place on general inpatient medical units of a university affiliated teaching hospital in New Haven, CT, USA. There were three types of study participants: medical providers, patients, and consultation-liaison motivational interviewing experts (CLs).

Provider participants (n = 38) comprised physicians (n = 5), physician assistants (n = 14), and nurses (n = 19) who were assigned to cover one or more of 13 general medical hospitalist units and predominantly worked daytime shifts when CLs were most available. Exclusion criteria included previous supervision in MI, anticipated extended leave or employment termination, and work restricted to nights and/or weekends. We screened interested providers and obtained signed written informed consent alongside baseline assessments. All providers first attended an MI training workshop; we randomized providers after the workshop to 1) workshop only; 2) apprenticeship; 3) consult.

Patient participants (n = 1173) followed the randomization of their providers and met the following eligibility criteria: (a) 18 years of age or older, (b) acknowledged problematic use of nicotine, alcohol, illicit drugs, or prescription medications within the previous 28 days as indicated by endorsement of ≥ 2 symptoms on the modified Mini-International Neuropsychiatric Inventory (MINI; Sheehan et al., 1996), and (c) an expected length of stay of at least 2–3 days (to ensure sufficient time for providers to deliver an interview or place a consult). Exclusion criteria were: (a) acute altered mental status, encephalopathy, dementia, or a Mini Mental Status Exam score that was < 21, (b) inability to speak English, and (c) any medical condition that made it difficult to complete an assessment and interview (e.g., stroke, deafness).

The consultation-liaison MI experts (CLs) comprised three psychiatrists and one social worker.

Patients enrolled in the study were told that a provider might approach them to discuss their substance use and audio record the conversation for the study. We did not inform providers which of their patients enrolled in the study, but rather we expected providers to screen and identify substance misuse among their patients. Only providers randomized to the consult condition could place an order with a CL for a motivational interview. Study personnel followed providers until they each cared for 40 study-enrolled patients, regardless of whether they performed (or ordered) a motivational interview with their patients.

2.1.1. Implementation strategies

All providers participated in a 1-day workshop conducted by the senior author (SM), a member of the Motivational Interviewing Network of Trainers (MINT), according to MINT recommendations (Miller and Rollnick, 2013). Trainings included methods for and types of screening tools such as the modified CAGE (cut down, annoyed, guilty, eye opener) for alcohol and drugs (Brown and Rounds, 1995) and Heaviness of Smoking Index (Heatherton et al., 1989). Providers randomized to the workshop and consult conditions received no further MI training, while providers in the apprenticeship condition met with a CL for two live observations of bedside post-workshop motivational interviews followed by immediate feedback and coaching. Providers randomized to the consult condition were given the option to place an order for a motivational interview via the electronic medical record instead of conducting the interview themselves.[2]

All CLs were trained in motivational interviewing using (a) a 2-day skill-building workshop, (b) three post-workshop supervised practice cases, and (c) six months of follow-up monthly group supervision to maintain proficiency (Schwalbe et al., 2014), all provided by the senior author (SM). In addition, CLs were trained in supervisory practices (Martino et al., 2011) so they could perform bedside supervision of providers in the apprenticeship condition.

2.2. Economic evaluation

To allocate the start-up costs of each intervention over a more reasonable number of patients than occurred in the trial, the economic evaluation assumes a full-scale implementation among the 38 study providers for the duration of their expected tenure at the hospital. As noted in the main report (Martino et al., 2019), the study providers were collectively responsible for approximately 10,000 patient discharges annually, or 263 patient discharges annually per provider (10,000/38); the base scenario assumes the same. In 2015, the average turnover rate of US hospitalists was 12.5%-18% (i.e., the average duration in the same job was 5.5–8 years) (Johns Hopkins Healthcare Solutions, 2015); the base scenario assumes 6 years as the useful life of the training.

To enable direct comparisons of costs across interventions, we normalized the start-up costs incurred in apprenticeship by assuming 13 providers (instead of 12 as occurred in the study). To this end, we partitioned start-up costs in apprenticeship into fixed costs (i.e., costs that do not vary with the number of providers trained, such as the cost of the trainer's time delivering the workshops) vs. variable costs (i.e., costs that vary with the number of providers trained, such as the cost of the providers' time in the workshops). Normalized start-up costs for apprenticeship were then obtained as "fixed cost + (13/12)*variable cost".

To determine how the results would change had the trial been implemented under alternative conditions, we conducted sensitivity analyses in which we considered two alternative scenarios – one favorable and one unfavorable to the three interventions – that made different assumptions about five key cost-related parameters (including the two described above) listed in Table 1. Unless specified otherwise, the base

[2] Physicians (MDs) and physician assistants (PAs) were able to order a motivational interview directly via the electronic medical record. Because nurses are not allowed to order specialty consults at the healthcare provider, they had to request PAs and/or MDs to place an order on their behalf (this additional step averaged approximately 1 minute). Upon receipt, all consult orders were reviewed by an administrative staff member who then assigned them to an appropriate CL.

Table 1
Key parameter assumptions – by scenario.

	Base Scenario	Favorable Scenario	Unfavorable Scenario
Annual no. of patients per provider[a]	263	400	150
Useful life of start-up activities (years)[b]	6	8	5
% of patients who need an MI[c]	.123	.25	.075
Wages of study personnel[d]	As in trial	Providers – nurses CLs – social workers	Providers - MDs CLs – psychiatrists
Discount rate (%)[e]	3	2	5

MI = motivational interview; MD = medical doctor; CL = consultation-liaison expert.

[a] Methods section provides the rationale for the base scenario. The favorable/unfavorable scenarios assume approximately +/- 50% of the base (i.e., 400/150 patients per provider annually) to reflect potential variation in provider workload should the interventions be implemented elsewhere.

[b] Methods section provides the rationale for all scenarios.

[c] During the study, 12.3% of patients needed a motivational interview, and the base scenario assumes the same. The favorable/unfavorable scenarios assume 25%/7.5% to reflect potential variation in patient substance use should the interventions be implemented elsewhere.

[d] Wages of study personnel in the base scenario are same as in the trial. The favorable scenario assumes all providers are nurses and all CLs are social workers, while the unfavorable scenario assumes all providers are MDs and all CLs are psychiatrists.

[e] The discount rate is used to estimate the equivalent annual cost of the start-up costs (Drummond et al., 2015). Following recommendations by the Second Panel on Cost-Effectiveness in Health and Medicine (Neumann et al., 2017), the base scenario assumes a 3% discount rate, while the favorable/unfavorable scenarios assume 2%/5%.

Table 2
Average cost per patient receiving a motivational interview – by scenario[a].

	Workshop (2018 US$)	Apprenticeship (2018 US$)	Consult (2018 US$)
(a) **Base scenario**			
Average on-going cost per patient receiving an MI	10.04	19.69	112.42
Average start-up cost per patient receiving an MI	794.49	586.83[b]	73.23
Average total cost per patient receiving an MI	**804.53**	**606.52**	**185.65**
(b) **Favorable scenario**			
Average on-going cost per patient receiving an MI	10.04	17.21	61.92
Average start-up cost per patient receiving an MI	150.82	107.30[b]	14.08
Average total cost per patient receiving an MI	**160.86**	**124.51**	**76.00**
(c) **Unfavorable scenario**			
Average on-going cost per patient receiving an MI	32.24	49.75	128.26
Average start-up cost per patient receiving an MI	4,803.29	3,018.30[b]	362.93
Average total cost per patient receiving an MI	**4,835.53**	**3,068.05**	**491.19**

MI = motivational interview.

[a] Assumptions underlying each scenario are described in Table 1.

[b] Apprenticeship start-up costs are normalized to reflect 13 providers for direct comparison to workshop and consult conditions.

scenario of the economic evaluation is based on the actual costs (i.e., resource utilizations multiplied by unit costs) as occurred in the trial.

2.2.1. Cost analysis

We collected cost data prospectively during the implementation trial. A research assistant surveyed hospital administrators to obtain necessary cost information (e.g., wages of study personnel, overhead and fringe rates, cost of space). Data on resources used (e.g., time spent by study personnel in workshops, time spent delivering motivational interviews to patients) came from the implementation trial. Costs were estimated from the healthcare provider (i.e., hospital) perspective because adoption and implementation decisions are made at the hospital level. We adjusted all costs to 2018 US dollars using the Consumer Price Index, included fringe benefits and overhead in all labor costs, and excluded research-specific costs (e.g., incentive payments for study participation) from the analysis.

The detailed cost analysis estimated the costs of both start-up (one-time) activities (e.g., training study personnel in motivational interviewing) and on-going (recurring) activities (e.g., delivering motivational interviews to patients). Although most of the items presented in the detailed cost analysis are straightforward, one requires explanation. In the consult condition, providers ordered 116 consults but CL experts were able to complete only 100 of them before patients were discharged. Therefore, in the consult condition, we prorated the administrative costs associated with the 16 incomplete consults over the 100 patients who received an interview.

Because most of the implementation costs in this study are easily expressed on an annual recurring basis, we converted the start-up (one-time) costs for training to an annual equivalent cost following Drummond et al. (2015). Annual costs were then normalized by the expected number of patients receiving a motivational interview each year and presented in terms of the average cost per patient receiving a motivational interview.

2.2.2. Effectiveness

Effectiveness in the present study was assessed in terms of the number of study-eligible patients who received a motivational interview. To enable direct comparisons of effectiveness across interventions, we normalized the number of apprenticeship patients receiving a motivational interview by assuming 13 providers (instead of 12 as occurred in the study).

2.2.3. Cost-effectiveness analysis

We determined the cost-effectiveness of the three interventions using incremental cost-effectiveness ratios (ICERs). The ICER measures the additional cost per unit of outcome gained (Drummond et al., 2015; Neumann et al., 2017), and is defined in this study as the incremental cost of using a given intervention, compared to the next least costly intervention, to obtain an additional patient receiving a motivational interview. Interventions were eliminated if they were either strictly

Table 3
Detailed average on-going cost per patient receiving a motivational interview – base scenario[a].

	Workshop (2018 US$)	Apprenticeship (2018 US$)	Consult (2018 US$)
Provider time delivering MI to patients[b]	9.82	19.34	
Space to deliver MI to patients[c]	0.22	0.35	
Provider time ordering MI consult[d]			1.93
Administrator time scheduling MI consult[e]			1.17
CL expert administrative time[f]			51.89
Space for administrative time[g]			0.23
CL expert time delivering MI to patients[h]			51.30
Space to deliver MI to patients[i]			0.48
Incomplete consults[j]			5.42
Average on-going cost per patient receiving an MI	**10.04**	**19.69**	**112.42**

MI = motivational interview; CL = consultation-liaison expert.

[a] based on 3, 11, and 100 patients receiving an interview in workshop, apprenticeship, and consult, respectively.

[b] weighted mean value of provider time * mean time to deliver interview. In workshop, weighted mean value of provider time = $55.22/hr (i.e., $33.98/hr * 1.25 (fringe) * 1.30 (overhead)) and mean time to deliver interview = 0.1778 h (10.67 min). In apprenticeship, weighted mean value of provider time = $70.54/hr (i.e., $43.41/hr * 1.25 (fringe) * 1.30 (overhead)) and mean time to deliver interview = 0.2742 h (16.45 min).

[c] mean time to deliver interview * mean sq ft of space for interview * cost of space, where mean time to deliver interview = 0.1778/0.2742 h (10.67/16.45 min) in workshop/apprenticeship, mean space = 244/252 sq ft in workshop/apprenticeship, and cost of space = $.0051 per sq ft per hr.

[d] weighted mean value of provider time * mean time to order consult, where weighted mean value of provider time = $82.71/hr (i.e., $50.90/hr * 1.25 (fringe) * 1.30 (overhead)) and mean time to order consult = 0.0233 h (1.40 min).

[e] value of administrator time * mean time to schedule consult, where value of administrator time = $43.79/hr (i.e., $26.95/hr * 1.25 (fringe) * 1.30 (overhead)) and mean time to schedule consult = 0.0268 h (1.61 min).

[f] Includes time for CL experts to review chart, travel to and possibly wait in patient's room. Equal to weighted mean value of CL time * mean CL administrative time, where weighted mean value of CL time = $129.67/hr (i.e., $79.80/hr * 1.25 (fringe) * 1.30 (overhead)) and mean CL administrative time = 0.4002 h (24.01 min).

[g] (mean time to order consult + mean time to schedule consult + mean CL administrative time) * 100 sq ft * $.0051 per sq ft per hr.

[h] weighted mean value of CL expert time * mean time to deliver interview, where weighted mean value of CL expert time = $126.15/hr (i.e., $77.63/hr * 1.25 (fringe) * 1.30 (overhead)) and mean time to deliver interview = 0.4067 h (24.40 min).

[i] mean time to deliver interview * mean sq ft of space for interview * $.0051 per sq ft per hr, where mean time to deliver interview = 0.4067 h (24.40 min) and mean space = 236 sq ft.

[j] Providers ordered 116 consults during the trial but CL experts were able to deliver only 100 interviews before patients were discharged. The administrative costs associated with the 16 incomplete consults are prorated over the 100 patients who received an interview using the logic above as follows: $5.42 = $0.27 (provider time ordering MI consult) + $0.15 (administrator time scheduling MI consult) + $4.98 (CL expert administrative time) + $0.03 (space for administrative time).

dominated (i.e., another intervention was both less costly and more effective) or extended dominated (i.e., a more costly intervention had a lower ICER). After eliminating dominated interventions, the cost-effective intervention is the one with the greatest ICER that is less than the decision maker's willingness to pay for an additional patient receiving a motivational interview (Drummond et al., 2015; Neumann et al., 2017). Both incremental costs and incremental effects used to calculate the ICERs were based on costs and effects as described above. Finally, because the healthcare provider where the trial took place does not have a program for delivering brief interventions for substance misuse, the cost-effectiveness analysis also considers a zero cost, zero effect, "do nothing" alternative (Drummond et al., 2015).

3. Results

3.1. Effectiveness

In the implementation trial, 38 providers were randomized to the conditions (workshop = 13, apprenticeship = 12, consult = 13), with no significant demographic differences across conditions (Martino et al., 2019). Providers saw an average of 30.87 study-eligible patients (workshop = 25.85, apprenticeship = 31.58, consult = 35.23; no significant differences across conditions (Martino et al., 2019)), rather than 40 study-eligible patients, because some providers unexpectedly terminated employment, changed administrative roles, or moved to another campus. Patients were demographically similar across conditions (Martino et al., 2019). There were no false alarms (i.e., no interviews were delivered to study-ineligible patients) within any of the conditions, and all interviews in the consult condition were provided by the CLs.

The percentage of study-eligible patients receiving an interview in the three conditions was 0.9% (3 patients out of a possible 336), 2.9% (11 patients out of a possible 379), and 21.8% (100 patients out of a possible 458) in workshop, apprenticeship, and consult, respectively. Pairwise comparison tests showed that consult was significantly higher than apprenticeship ($p < 0.001$) and workshop ($p < 0.001$), while workshop and apprenticeship did not differ significantly ($p = .50$). There were no significant differences in the mean percentage of completed motivational interviews by provider type (physician, PA, or nurse) either across ($p = 0.38$) or within (p values ≥ 0.28) conditions. Extrapolating the trial results to a full-scale implementation among the study providers, the annual number of patients in the base scenario expected to receive an interview in the three conditions was 3.75, 12.21, and 91.80 in workshop, apprenticeship, and consult, respectively.[3]

3.2. Cost analysis

Table 2 shows the respective base, favorable, and unfavorable scenario "average cost per patient receiving a motivational interview", in total and disaggregated by on-going cost vs. start-up cost. A detailed breakdown of the on-going and start-up costs in the base scenario is presented in Tables 3 and 4, respectively. Notes accompanying Tables 3 and 4 explain the calculations used to estimate the cost shown in each corresponding line item and are provided to enable both practitioners and researchers to model alternative implementation scenarios.[4]

3.3. Cost-effectiveness analysis

Table 5 shows the expected annual total cost, expected annual

[3] For example, the annual number of patients in the base scenario expected to receive an interview in consult = 13 providers * 263 patients per provider annually * 0.123 (proportion of patients who need an MI) * 0.218 (proportion of patients needing an MI who get one in consult) = 91.80.

[4] For example, the average on-going provider cost to deliver a motivational interview in workshop ($9.82 per patient) shown in Table 3 was determined by first summing across workshop interviews the product of the value of the provider's time (where value = fully-loaded hourly wage = base hourly wage * fringe rate * overhead rate) and the duration of the interview, and then dividing by the number of completed interviews in workshop ($29.45/3). This is equivalent to multiplying the mean time to deliver an interview in workshop (0.1778 hrs, or 10.67 minutes) by the weighted mean value of provider time in workshop ($55.22/hr), as stated in the table notes.

Table 4
Detailed start-up costs – base scenario.

	Workshop (n = 13) (2018 US$)	Apprentice (n = 12) (2018 US$)	Normalized Apprentice* (n = 13) (2018 US$)	Consult (n = 13) (2018 US$)
Deliver 1-Day Workshop to Providers[a]				
Administrator time (schedule/set up)[b]	175	175	175	175
Trainer				
Time in workshop[c]	2102	2102	2102	2102
Travel time[d]	131	131	131	131
Mileage cost[e]	11	11	11	11
Provider time in workshop[f]	9171	8129	8806	7749
Space[g]	34	34	34	34
Materials				
Food[h]	105	97	105	105
Handouts[i]	14	13	14	14
Laminated cards[j]	61	56	61	61
CEU fees[k]	2452	2263	2452	2452
1-Day Workshop subtotal	*14,256*	*13,011*	*13,891*	*12,834*
Provider time reviewing training materials outside of workshop[l]	2389	2752	2982	1195
Deliver 2-Day Workshop to CL Experts[m]				
Administrator time (schedule/set up)[n]		44	44	44
Trainer				
Time in workshop[o]		1971	1971	1971
Travel time[p]		131	131	131
Mileage cost[q]		11	11	11
CL expert time in workshop[r]		7498	7498	7498
Space[s]		32	32	32
Materials				
Food[t]		65	65	65
Handouts[u]		4	4	4
Laminated cards[v]		19	19	19
CEU fees[w]		1509	1509	1509
2-Day Workshop subtotal		*11,284*	*11,284*	*11,284*
CL expert time reviewing training materials outside of workshop[x]		1378	1378	1378
CL Practice Sessions[y]				
Administrator time (schedule/set up)[z]		44	44	44
Trainer				
Time rating practice sessions[aa]		1281	1281	1281
Time giving feedback to CLs[bb]		558	558	558
Travel time[cc]		525	525	525
Mileage cost[dd]		44	44	44
CL Experts				
Time conducting practice sessions[ee]		650	650	650
Time receiving feedback from trainer[ff]		889	889	889
Space[gg]		19	19	19
CL practice sessions subtotal		4010	4010	4010
Bedside training sessions[hh]				
CL time conducting bedside supervision of providers[ii]		3151	3414	
Provider time receiving bedside supervision from CLs[jj]		1288	1394	
Trainer time rating bedside supervisions by CLs[kk]		558	605	
Trainer time giving feedback to CLs[ll]		306	332	
Trainer travel time[mm]		328	328	
Trainer mileage cost[nn]		28	28	
CL time receiving feedback from trainer[oo]		260	282	
Space[pp]		34	37	
Bedside training sessions subtotal		5953	6420	
Supervision of CLs[qq]				
Trainer time rating CL interviews[rr]				2365
Trainer time giving feedback to CLs[ss]				788
Trainer travel time[tt]				394
Trainer mileage cost[uu]				33
CL expert time receiving feedback from trainer[vv]				2999
Digital tape recorders[ww]				216
Space[xx]				23
Supervision subtotal				6818
Total Start-Up Cost	16,645	38,388	39,965	37,519
Equivalent annual cost[yy]	2983		7163	6724
Average start-up cost per patient receiving an MI[zz]	**794.49**		**586.83**	**73.23**

MI = motivational interview; CL = consultation-liaison expert.

* Obtained by multiplying variable costs in the apprenticeship (n = 12) column by 13/12 to enable direct comparison to workshop and consult start-up costs.

[a] In the trial, fourteen 1-day workshops were conducted to train the thirty-eight providers, averaging 2.7 providers per workshop. According to the senior author and trainer (SM), a more realistic and efficient training schedule would require only two 1-day workshops to cover the providers within each condition; all scenarios assume the same.

[b] value of administrator time * time to schedule/set up each workshop * # of workshops, where value of administrator time = $43.79/hr (i.e., $26.95/hr * 1.25 (fringe) * 1.30 (overhead)), time to schedule/set up each work shop = 2 h, and # of workshops = 2.

[c] value of trainer time * time to deliver workshop to providers * # of workshops, where value of trainer time = $131.37/hr (i.e., $80.84/hr * 1.25 (fringe) * 1.30 (overhead)), time to deliver workshop = 8 h, and # of workshops = 2.

[d] value of trainer time * time to travel round-trip to workshop * # of workshops, where value of trainer time = $131.37/hr, time to travel round-trip to workshop = 0.5 h, and # of workshops = 2.

[e] # of round-trip miles trainer travels to workshop * $/mile * # of workshops, where # of round-trip miles trainer travels = 10, $/mile = $0.55, and # of workshops = 2.

[f] mean value of provider time * time providers in workshop * # of providers, where mean value of provider time = $88.18/$84.67/$74.51 per hr in W/A/C, respectively (including fringe = 25 % and overhead = 30 %), time providers in workshop = 8 h, and # of providers in workshop = 13/12/13 in. W/A/C, respectively.

[g] time to deliver workshop * sq ft of space where workshop occurs * cost of space * # of workshops, where time to deliver workshop = 8 h, space = 225 sq ft, cost of space = $0.0096 per sq ft per hr, and # of workshops = 2.

[h] food for each provider in workshop @ $8.08.

[i] handouts for each provider in workshop @ $1.06.

[j] laminated cards for each provider in workshop @ $4.68.

[k] CEU (Continuing Education Unit) fees for each provider in workshop @ $188.63.

[l] weighted mean value of provider time * mean time providers spend reviewing workshop training materials outside of workshop * # of providers, where weighted mean value of provider time = $91.89/$72.80/$63.40 per hr in W/A/C, respectively (including fringe = 25 % and overhead = 30 %), mean time providers spend reviewing workshop materials outside of workshop = 2.00/3.15/1.45 h in W/A/C, respectively, and # of providers = 13/12/13 in W/A/C, respectively.

[m] Assumes 1 workshop is delivered to 4 CL experts.

[n] value of administrator time * time to schedule/set up the 2-day workshop, where value of administrator time = $43.79/hr and time to schedule/set up the 2-day workshop = 1 h.

[o] value of trainer time * time to deliver the 2-day workshop, where value of trainer time = $131.37/hr and time to deliver workshop = 15 h.

[p] value of trainer time * time to travel round-trip to the 2-day workshop * # of days in the 2-day workshop, where value of trainer time = $131.37/hr, time to travel round-trip to workshop = 0.5 h, and # of days = 2.

[q] # of round-trip miles trainer travels to 2-day workshop * $/mile * # of days in the 2-day workshop, where # of round-trip miles trainer travels = 10, $/mile = $0.55, and # of days = 2.

[r] mean value of CL expert time * time CL experts in 2-day workshop * # of CL experts, where mean value of CL expert time = $124.97/hr (i.e., $76.89 * 1.25 (fringe) * 1.30 (overhead)), time CL experts in 2-day workshop = 15 h, and # of CL experts = 4.

[s] time to deliver 2-day workshop * sq ft of space where workshop occurs * cost of space, where time to deliver 2-day workshop = 15 h, space = 225 sq ft, and cost of space = $0.0096 per sq ft per hr.

[t] food for each CL expert in workshop @ $8.08 * 2 days.

[u] handouts for each CL expert in workshop @ $1.06.

[v] laminated cards for each CL expert in workshop @ $4.68.

[w] CEU fees for each CL expert in workshop @ $377.25.

[x] weighted mean value of CL expert time * mean time CL experts spend reviewing workshop training materials outside of 2-day workshop * # of CL experts, where weighted mean value of CL expert time = $134.53/hr, mean time CL experts spend reviewing workshop materials outside of 2-day workshop = 2.56 h, and # of CL experts = 4.

[y] Each CL expert conducted 3 practice cases as part of training. Practice cases were rated and feedback provided (in group format) by the trainer.

[z] value of administrator time * time to schedule each practice case * # of practice cases, where value of administrator time = $43.79/hr, time to schedule each practice case = 0.0833 h (5 min.), and # of practice cases = 12 (i.e., 3 practice cases for each of 4 CL experts).

[aa] value of trainer time * total time trainer spent rating practice cases, where value of trainer time = $131.37/hr and total time spent rating practice cases = 9.75 h.

[bb] value of trainer time * total time trainer spent giving feedback to CL experts, where value of trainer time = $131.37/hr and total time spent giving feedback to CL experts = 4.25 h.

[cc] value of trainer time * time to travel round-trip to provide feedback * # of feedback sessions, where value of trainer time = $131.37/hr, time to travel round-trip to provide feedback = 0.5 h, and # of feedback sessions = 8 (several sessions were conducted with multiple CL experts).

[dd] # of round-trip miles trainer travels to provide feedback * $/mile * # of feedback sessions, where # of round-trip miles trainer travels = 10, $/mile = $0.55, and # of feedback sessions = 8 (several sessions were conducted with multiple CL experts).

[ee] weighted mean value of CL expert time * mean time for CL experts to conduct a practice session * # of practice sessions, where weighted mean value of CL expert time = $125.39/hr, mean time for CL experts to conduct a practice session = 0.4320 h (25.92 min.), and # of practice sessions = 12.

[ff] weighted mean value of CL expert time * mean time CL experts received feedback from trainer * # of CL experts, where weighted mean value of CL expert time = $122.79/hr, mean time CL experts received feedback from trainer = 1.81 h, and # of CL experts = 4.

[gg] ((total time trainer spent rating practice cases + total time trainer spent giving feedback to CL experts) * sq ft of space where rating and feedback occurred * cost of space where rating and feedback occurred) + (total time CL experts spent conducting practice sessions * mean sq ft of space where practice sessions occurred * cost of space where practice sessions occurred), where total time trainer spent rating practice cases = 9.75 h, total time trainer spent giving feedback to CL experts = 4.25 h, sq ft of space where rating and feedback occurred = 100 sq ft, cost of space where rating and feedback occurred = $.0096 per sq ft per hr, total time CL experts spent conducting practice cases = 5.18 h, mean sq ft of space where practice sessions occurred = 205 sq ft, and cost of space where practice sessions occurred = $0.0051 per sq ft per hr.

[hh] Each provider in apprenticeship condition received a minimum of 2 bedside coaching sessions from CL experts, and each CL expert received a minimum of one feedback session on their coaching from the trainer.

[ii] Includes CL time scheduling, preparing, observing and providing feedback to providers; weighted mean value of CL expert time * mean time CL expert conducted bedside supervision of provider * # of bedside supervisions, where weighted mean value of CL expert time = $117.40/hr, mean time CL expert conducted bedside supervision of provider = 0.9942 h (59.65 min.), # of bedside supervisions = 27.

[jj] Includes provider time giving MI interview to patient and receiving feedback from CL expert; weighted mean value of provider time * mean time provider received bedside supervision from CL expert (including interview time) * # of bedside supervisions, where weighted mean value of provider time = $84.73/hr, mean time provider received bedside supervision from CL expert (including interview time) = 0.5630 h (33.78 min.), and # of bedside supervisions = 27.

[kk] value of trainer time * total time trainer spent rating CL bedside supervisions, where value of trainer time = $131.37/hr and total time spent rating CL bedside supervisions = 4.25 h.

[ll] value of trainer time * total time trainer spent giving feedback to CL experts, where value of trainer time = $131.37/hr and total time spent giving feedback to CL experts = 2.33 h.

[mm] value of trainer time * time to travel round-trip to provide feedback * # of feedback sessions, where value of trainer time = $131.37/hr, time to travel round-trip to provide feedback = 0.5 h, and # of feedback sessions = 5.

[nn] # of round-trip miles trainer travels to provide feedback * $/mile * # of feedback sessions, where # of round-trip miles trainer travels = 10, $/mile = $0.55, and # of feedback sessions = 5.

[oo] weighted mean value of CL expert time * mean time CL experts received feedback from trainer * # of CL experts, where weighted mean value of CL expert time = $111.43/hr, mean time CL experts received feedback from trainer = 0.5833 h (35 min.), and # of CL experts = 4.

[pp] ((total time trainer spent rating CL bedside supervisions + total time trainer spent giving feedback to CL experts) * sq ft of space where rating and feedback occurred * cost of space where rating and feedback occurred) + (mean time CL expert conducted bedside supervision of provider * # of bedside supervisions * mean sq ft of space where bedside supervision occurred * cost of space where bedside supervision occurred), where total time trainer spent rating CL bedside supervisions = 4.25 h, total time trainer spent giving feedback to CL experts = 2.33 h, sq ft of space where rating and feedback occurred = 100 sq ft, cost of space where rating and feedback occurred = $.0096 per sq ft per hr, mean time CL expert conducted bedside supervision of provider = 0.9942 h (59.65 min.), # of bedside supervisions = 27, mean sq ft of space where bedside supervisions occurred = 205 sq ft, and cost of space where bedside supervisions occurred = $0.0051 per sq ft per hr.

[qq] In consult condition, assumes trainer supervision of CLs occurred monthly for 6 months following CL practice sessions.

[rr] value of trainer time * total time trainer spent rating CL interviews, where value of trainer time = $131.37/hr and total time spent rating CL interviews = 18 h.

[ss] value of trainer time * total time trainer spent giving feedback to CL experts, where value of trainer time = $131.37/hr and total time spent giving feedback to CL experts = 6 h (feedback provided in group format).

[tt] value of trainer time * time to travel round-trip to provide feedback * # of feedback sessions, where value of trainer time = $131.37/hr, time to travel round-trip to provide feedback = 0.5 h, and # of feedback sessions = 6.

[uu] # of round-trip miles trainer travels to provide feedback * $/mile * # of feedback sessions, where # of round-trip miles trainer travels = 10, $/mile = $0.55, and # of feedback sessions = 6.

[vv] mean value of CL expert time * mean time CL experts received feedback from trainer * # of CL experts, where mean value of CL expert time = $124.97/hr, mean time CL experts received feedback from trainer = 6 h, and # of CL experts = 4.

[ww] digital tape recorder for each CL expert @ $53.92.

[xx] (total time trainer spent rating CL interviews + total time trainer spent giving feedback to CL experts) * sq ft of space where rating and feedback occurred * cost of space where rating and feedback occurred, where total time trainer spent rating CL interviews = 18 h, total time trainer spent giving feedback to CL experts = 6 h, sq ft of space where rating and feedback occurred = 100 sq ft, and cost of space where rating and feedback occurred = $.0096 per sq ft per hr.

[yy] total start-up cost * annuity factor, where annuity factor depends on the assumed discount rate and useful life of the start-up activities. In the base scenario, the annuity factor is 5.5797 (assuming 3% discount rate, 6 years of useful life, and start-up costs paid at the beginning of the program).

[zz] The average start-up cost per patient receiving a motivational interview is equal to the equivalent annual cost divided by the expected annual number of patients receiving a MI. For example, the average start-up cost per patient receiving a MI in consult in the base scenario = $6724/(263*13*0.123*.218) = $73.23.

Table 5
Incremental cost-effectiveness ratios – base scenario.

	Annual Total Cost (2018 US $)[a]	Annual Expected No. of Patients Receiving an MI	Initial ICERs (2018 US$)	Final ICERs (2018 US$)
Workshop	3017	3.75	804.53[b]	ED
Apprenticeship	7406	12.21	518.79	ED
Consult	17,043	91.80	121.08	185.65

ICER = incremental cost-effectiveness ratio. MI = motivational interview. ED = extended dominated by the combination of "do nothing" and consult.

[a] Annual total cost = Average total cost per patient receiving an MI * annual expected number of patients receiving an MI.

[b] Workshop's initial ICER is based on a zero cost, zero effect, "do nothing" alternative.

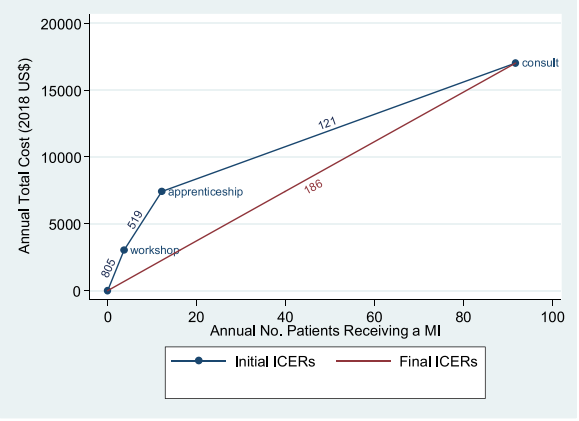

Fig. 1. Incremental cost-effectiveness ratios – initial and final (base scenario).

number of patients receiving a motivational interview, initial ICERs and final ICERs for the three interventions in the base scenario. Fig. 1 illustrates the results presented in Table 5 (the origin in Fig. 1 corresponds to the "do nothing" alternative). As seen in Fig. 1 and Table 5, both workshop and apprenticeship are extended dominated by the combination of "do nothing" and consult in the base scenario. Said differently, a linear combination of "do nothing" and consult is both less costly and more effective than both workshop and apprenticeship. After eliminating workshop and apprenticeship from consideration in the base scenario, "do nothing" is cost-effective if the threshold willingness-to-pay of the healthcare provider for an additional patient receiving a motivational interview is less than $185.60, and consult is cost-effective if the threshold is greater than $185.60.

In the favorable and unfavorable scenarios (results not shown), workshop and apprenticeship continue to be extended dominated by the combination of "do nothing" and consult. Doing nothing is cost-effective in the favorable scenario if the threshold willingness-to-pay of the healthcare provider for an additional patient receiving a motivational interview is less than $76.00, and consult is cost-effective if the threshold is greater than $76.00. For the unfavorable scenario, the threshold is $419.19.

4. Discussion

This study examined the cost and cost-effectiveness of three strategies – workshop, apprenticeship, and consult – for implementing motivational interviewing for substance misuse on medical inpatient units. Based on our results, it appears that none of the strategies are economically viable from the healthcare provider perspective. In all three scenarios, workshop and apprenticeship were extended dominated by the combination of doing nothing and consult. In the base scenario, which most closely approximates the actual costs as incurred in the trial, consult is cost-effective only if the threshold willingness-to-pay of the healthcare provider for an additional patient receiving a

motivational interview exceeds $186, a figure well above typical reimbursement rates for brief interventions.[5] Even in the favorable scenario, which made strong assumptions about annual throughput, percentage of patients needing a motivational interview, and wage rates of both providers and CLs (without negatively impacting the frequency or fidelity of delivered interviews), consult is cost-effective only if the threshold is greater than $76, a figure still well above the average expected reimbursement in this study ($42.50).

Although the average on-going cost to provide a patient with an interview was fairly low in both workshop and apprenticeship,[6] the average fixed cost was very high because few patients received an interview in either condition (0.9% in workshop; 2.9% in apprenticeship). Despite a willingness to participate in the study, providers in workshop and apprenticeship may not have used motivational interviewing because they felt it was too time consuming, outside of their scope of practice, or that a discussion with a patient about their use of substances would adversely affect their treatment alliance with the patient (Martino et al., 2019). While augmenting workshop and apprenticeship with an organizational-level implementation facilitation strategy to improve hospital administrative support (e.g., appropriate schedules, caseloads, and incentives) for providers' use of MI might increase uptake (Garner et al., 2017), such a strategy would likely incur substantial additional costs (Ritchie et al., 2019). In short, unless and until providers are ready, willing, and able, as well as administratively supported, to directly deliver interviews to patients in much higher numbers, neither workshop nor apprenticeship are likely to be economically viable strategies.

The average on-going cost to provide an interview in consult was several times greater than in workshop and apprenticeship, for several reasons. First, the average fully-loaded hourly wage (including fringe and overhead) of the CLs ($124.97) was higher than the providers ($82.40). Second, the CLs spent more time delivering the interview to patients than did the providers (24.4, 16.5 and 10.7 min for consult, apprenticeship, and workshop, respectively).[7] Finally, the CLs spent a considerable amount of administrative time reviewing charts as well as traveling to and waiting in patients' rooms.

There are two scenarios in which consult might be "worth it", but each scenario would require further research since this study was not designed to test these scenarios. First, investments in technology might lower the on-going cost per patient in consult, either through the use of efficient chart review algorithms (Carrell et al., 2015) or telemedicine (which would obviate the need for CLs to travel to patients' rooms) (Hilty et al., 2018). Second, given the substantial positive externalities associated with proficient treatment for substance use disorder (e.g., improvements in criminal activity, workplace productivity, family functioning, utilization of general health services, spread of disease through risky behaviors), the benefits of consult may outweigh its costs from the *societal* perspective. This possibility has merit in that CL interviews, compared to provider interviews in workshop and apprenticeship, were longer and conducted with more MI integrity, which increases the likelihood of positive treatment outcomes (Magill et al., 2018).

The present study has several strengths. First, it is based on a randomized controlled trial that enrolled a large number of providers and patients. Second, all cost data were collected prospectively alongside the trial and included both start-up and on-going costs. Third, findings are supported by sensitivity analyses on key cost parameters. Fourth, detailed table notes containing unit costs, resource utilizations, and the assumptions underlying the cost analysis are provided to enable both practitioners and researchers to model alternative implementation scenarios.

The study also has limitations. First, it was conducted within one university-affiliated teaching hospital and enrolled only English-speaking and hearing-able patients, thereby limiting the generalizability of the findings. Institutional culture (a tertiary hospital with specialty consults easily available) likely contributed to the preponderance of CL interviews. Second, patients' substance use following discharge from the hospital was not tracked, so the effectiveness of the three implementation strategies measured in terms of abstinence, harm reduction or health care utilization is unknown. Third, the on-going cost estimates do not include the cost of patient screening by the providers. Including such costs, however, would strengthen our main finding that none of the implementation strategies is economically viable from the healthcare provider perspective. Finally, although the Second Panel on Cost-Effectiveness in Health and Medicine (Neumann et al., 2017) recommends adopting a healthcare sector and a societal perspective alongside any other relevant perspective, the data requirements necessitated by both of these perspectives are beyond the scope of this study.

5. Conclusions

We conclude that none of the implementation strategies in this study are economically viable from the healthcare provider (i.e., hospital) perspective, but for different reasons. Workshop and apprenticeship are unattractive because of substantial start-up costs coupled with extremely low uptake, while consult is not viable because its average on-going costs are not covered by existing reimbursements for brief intervention services.

6. Contributors

Martino and Yonkers designed the effectiveness study and wrote the protocol. Forray and Zimbrean assisted with the implementation of study conditions. Gilstad-Hayden oversaw collection of patient outcomes data and conducted statistical analysis. Olmstead collected cost-related data, conducted the economic analyses, and wrote the first draft of the manuscript. All authors contributed to and have approved the final manuscript.

Role of funding source

The National Institute on Drug Abuse funded the study (R01 DA034243). The content of this manuscript solely reflects the authors' views and not those of the funding agency.

Declaration of Competing Interest

The authors declare that they do not have a conflict of interest.

[5] Typical reimbursement rates for alcohol and/or substance abuse structured screening and brief intervention services lasting 15 – 30 minutes are $30-$35, and $55-$65 for services lasting longer than 30 minutes (SAMHSA, 2017). Three-quarters of the interviews in the consult condition took less than 30 minutes, so the average expected reimbursement for the interviews delivered in consult was $42.50 ($35*0.75 + $65*0.25).

[6] These costs are comparable to the cost of brief interventions in hospital inpatient settings reported elsewhere (Barbosa et al., 2016; Bray et al., 2014; Cowell et al., 2017), after adjusting for differences in the hourly wage of providers.

[7] Although motivational interviews conducted by CLs had significantly higher mean fundamental adherence and competence scores than those conducted by providers in workshop and apprenticeship, there were no significant group differences in patient change talk for patients who received a motivational interview (Martino et al., 2019). Only one (workshop) out of 111 completed interviews was delivered with inadequate proficiency. These findings should be interpreted cautiously given the low number of interviews conducted in workshop and apprenticeship.

Acknowledgements

The authors wish to thank the medical providers at the medical hospital where the study was conducted. We also would like to thank Victor Morris, Will Cushing, Jose Salvana, and Scott Sussman for the work they have done in support of the project. Finally, we want to acknowledge our research staff (Rebecca Aldi, Monica Canning-Ball, Heather Howell, Jessica Katon, Ashley McCaherty, and Jonathan Ryan) for their efforts to implement this trial with integrity.

References

Barbosa, B., Cowell, A.J., Landwehr, J., Dowd, W., Bray, J.W., 2016. Cost of screening, brief intervention, and referral to treatment in health care settings. J. Subst. Abuse Treat. 60, 54–61.

Bray, J.W., Mallonee, E., Dowd, W., Aldridge, A., Cowell, A.J., Vendetti, J., 2014. Program- and service-level costs of seven screening, brief intervention, and referral to treatment programs. Subst. Abuse Rehabil. 5, 63–73.

Brown, R.L., Rounds, L.A., 1995. Conjoint screening questionnaires for alcohol and other drug abuse: criterion validity in a primary care practice. WMJ. 94, 135–140.

Carrell, D.S., Cronkite, D., Palmer, R.E., Saunders, K., Gross, D.E., Masters, E.T., Hylan, T.R., Von Korff, M., 2015. Using natural language processing to identify problem usage of prescription opioids. Int. J. Med. Inform. 84, 1057–1064.

Cowell, A.J., Dowd, W., Landwehr, J., Barbosa, C., Bray, J.W., 2017. A time and motion study of Screening, Brief Intervention, and Referral to Treatment implementation in health-care settings. Addiction 112 (Suppl. 2), 65–72.

Curran, G.M., Bauer, M., Mittman, B., Pyne, J.M., Stetler, C., 2012. Effectiveness implementation hybrid designs combining elements of clinical effectiveness and implementation research to enhance public health impact. Med. Care 50, 217–226.

Drummond, M.F., O'Brien, B., Stoddart, G.L., Torrance, G.W., 2015. Methods for the Economic Evaluation of Health Care Programs, 4th ed. Oxford University Press, Oxford, UK.

Garner, B., Zehner, M., Roosa, M., Martino, S., Gotham, H., Ball, E., Stilen, P., Speck, K., Vandersloot, D., Rieckmann, T., Chaple, M., Martin, E., Kaiser, D., Ford, J., 2017. Testing the implementation and sustainment facilitation (ISF) strategy as an effective adjunct to the Addiction Technology Transfer Center (ATTC) strategy: study protocol for a cluster randomized trial. Addict. Sci. Clin. Pract. 12, 32.

Heatherton, T.F., Kozlowski, L.T., Frecker, R.C., Rickert, W., Robinson, J., 1989. Measuring the Heaviness of Smoking: using self-reported time to the first cigarette of the day and number of cigarettes smoked per day. Br. J. Addict. 84, 791–799.

Hilty, D.M., Sunderji, N., Suo, S., Chan, S., McCarron, R.M., 2018. Telepsychiatry and other technologies for integrated care: evidence base, best practice models and competencies. Int. Rev. Psychiatry 30, 292–309.

Johns Hopkins Healthcare Solutions, 2015. Retain Your Hospitalists by Rating Their Morale. Available at https://www.johnshopkinssolutions.com/newsletters/retain-hospitalists-rating-morale/. Accessed on June 10, 2020. .

Katz, A., Goldberg, D., Smith, J., Trick, W.E., 2008. Tobacco, alcohol, and drug use among hospital patients: concurrent use and willingness to change. J. Hosp. Med. 3, 370–375.

Magill, M., Apodaca, T.R., Borsari, B., Gaume, J., Hoadley, A., Gordon, R.E.F., Tonigan, J.S., Moyers, T., 2018. A meta-analysis of motivational interviewing process: technical, relational, and conditional process models of change. J. Consult. Clin. Psychol. 86, 140–157.

Martino, S., Ball, S.A., Nich, C., Canning-Ball, M., Rounsaville, B.J., Carroll, K.M., 2011. Teaching community program clinicians motivational interviewing using expert and train-the-trainer strategies. Addiction 106, 428–441.

Martino, S., Zimbrean, P., Forray, A., Kaufman, J., Desan, P., Olmstead, T.A., Gilstad-Hayden, K., Gueorguieva, R., Yonkers, K.A., 2019. Implementing motivational interviewing for substance misuse on medical inpatient units: a randomized controlled trial. J. Gen. Intern. Med. https://doi.org/10.1007/s11606-019-05257-3.

Miller, W.R., Rollnick, S., 2013. Motivational Interviewing: Helping People Change, third ed. Guildford Press, New York.

Neumann, P.J., Sanders, G.D., Russell, L.B., Siegel, J.E., Ganiats, T.G., 2017. Cost-effectiveness in Health and Medicine, 2nd ed. Oxford University Press, Oxford, UK.

Ritchie, M.J., Kirchner, J.E., Townsend, J.C., Pitcock, J.A., Dollar, K.M., Liu, C.F., 2019. Time and organizational cost for facilitating implementation of primary care mental health integration. J. Gen. Intern. Med online 02 Dec:1-10.

Rollnick, S., Miller, W., Butler, C.C., 2008. Motivational Interviewing in Health Care: Helping Patients Change Behavior. Guildford Press, New York.

Saitz, R., Freedner, N., Palfai, T.P., Horton, N.J., Samet, J.H., 2006. The severity of unhealthy alcohol use in hospitalized medical patients. The spectrum is narrow. J. Gen. Intern. Med. 21, 381–385.

SAMHSA (Substance Abuse and Mental Health Services Administration), 2017. Coding for Screening and Brief Intervention Reimbursement. Available at https://www.samhsa.gov/sbirt/coding-reimbursement. Accessed on June 9, 2020. .

Santora, P.B., Hutton, H.E., 2008. Longitudinal trends in hospital admissions with co-occurring alcohol/drug diagnoses, 1994–2002. J. Subst. Abuse Treat. 35, 1–12.

Schwalbe, C.S., Oh, H.Y., Zweben, A., 2014. Sustaining motivational interviewing: a meta-analysis of training studies. Addiction 109, 1287–1294.

Sheehan, D., Lecrubier, Y., Janavs, J., Knapp, E., Weiller, E., 1996. Mini International Neuropsychiatric Interview (MINI). University of South Florida, Tampa.

Smothers, B.A., Yahr, H.T., Ruhl, C.E., 2004. Detection of alcohol use disorders in general hospital admissions in the United States. Arch. Int. Med. 164, 749–756.

Stein, M.D., O'Sullivan, P.S., Ellis, P., Perrin, H., Wartenberg, A., 1993. Utilization of medical services by drug users in detoxification. J. Subst. Abuse 10, 187–193.

Stinson, F.S., Grant, B.F., Dawson, D.A., Ruan, W.J., Huang, B., Saha, T., 2005. Comorbidity between DSM–IV alcohol and specific drug use disorders in the United States: results from the National Epidemiologic Survey on alcohol and related conditions. Drug Alcohol Dep. 80, 105–116.