Original investigation

Cigarette Smoking Cessation Intervention for Buprenorphine Treatment Patients

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Abstract

Introduction: Patients receiving medication assisted therapy (MAT) for opioid use disorder have high cigarette smoking rates. Cigarette smoking interventions have had limited success. We evaluated an intervention to increase cigarette abstinence rates in patients receiving buprenorphine-assisted therapy.

Methods: Cigarette smokers ($N = 175$; 78% male; 69% Caucasian; 20% Hispanic), recruited from a buprenorphine clinic were randomly assigned to either an extended innovative system intervention (E-ISI) or to Standard Treatment Control (STC). The E-ISI combined motivational intervention with extended treatment (long-term nicotine replacement therapy , varenicline, and extended cognitive behavioral therapy). STC received written information about quit-lines, medication, and resources. Assessments were held at baseline and 3, 6, 12, and 18 months. Seven-day biochemically verified point-prevalence cigarette abstinence was the primary outcome measure.

Results: Fifty-four percent of E-ISI participants entered the extended treatment intervention; E-ISI and STC differed at 3 months on abstinence status but not at months 6, 12, and 18. E-ISI participants were more likely to attempt to quit, to have a goal of complete abstinence, and to be in a more advanced stage of change than STC participants. A higher number of cigarettes smoked and the use of cannabis in the previous 30 days predicted continued smoking

Conclusions: The E-ISI was successful in increasing motivation to quit smoking but did not result in long-term abstinence. The failure of treatments that have been efficacious in the general population to produce abstinence in patients receiving MAT of opioid use disorder suggests that harm reduction and other innovative interventions should be explored.

Implications: This study demonstrates that an intervention combining motivational interviewing with an extended treatment protocol can increase cigarette quit attempts, enhance cigarette abstinence goals, and further movement through stages of change about quitting smoking in patients receiving MAT for opioid use disorder who smoke cigarettes. The intervention did not increase abstinence rates over those observed in a standard treatment control, however. The latter finding supports those of earlier investigators who also failed to find efficacy for smoking cessation in this population and who also used interventions effective in the general population. This pattern of findings suggests that patients with opioid use disorder can be motivated to change smoking behavior, but alternative and innovative approaches to cigarette smoking treatment should be studied.

Introduction

Tobacco dependence is prevalent among individuals in Medication Assisted Treatment (MAT) for opioid use disorder. Methadone maintenance patients have been the most extensively studied, and between 84% and 94% of them report they are current smokers.[1–3] One group reported a 90% current smoking rate in a sample that included patients receiving methadone or buprenorphine MAT for opioid use disorder[4] Two groups compared the smoking status of patients with opioid use disorder receiving either methadone or buprenorphine; both found similar rates in both groups, with over 90% of the patients reporting current smoking.[5,6]

The high prevalence of cigarette smoking in this population reflects at least three factors. Most patients in treatment for opioid use disorder have lower educational and socioeconomic status than the general population, and higher smoking rates are associated with lower status.[7] Opioid administration may make smoking cessation difficult, as increases in both methadone dose and buprenorphine dose are related to increased smoking.[8–11] Stress is related to cigarette smoking,[12,13] and individuals with opioid use disorders often lead stressful lives.[14] Nevertheless, 44–80% of methadone maintenance clients report wanting to quit smoking cigarettes.[1,3,15–17]

Randomized controlled trials of treatment for cigarette smoking in patients receiving MAT for opioid use disorder have been reported. The earliest study compared cognitive–behavioral therapy (CBT) alone to CBT plus a 20% methadone dose increase ($n = 22$).[18] Posttreatment cigarette abstinence rates were 0 in the dose increase plus CBT condition and 18% in the CBT alone condition. At follow-up, one participant in the control condition was abstinent from cigarettes and none in the experimental condition. In a second study,[19] participants received 12 weeks of nicotine replacement therapy (NRT) and were assigned to one of four conditions: NRT-only, relapse prevention + NRT, contingency management + NRT, or relapse prevention + contingency management + NRT. During treatment, contingency management participants showed higher abstinence rates than those who did not receive contingency management. At 6- and 12-month follow-up visits, there were no differences between conditions. Sigmon et al. found that extending contingent reinforcement for abstinence increased extended abstinence rate over noncontingent reinforcement.[20]

Stein et al. randomized 383 patients to either advice only or an experimental condition (brief motivational intervention, a quit date, a behavioral skills counseling session, and a relapse prevention session plus 8–12 weeks of NRT.)[21] Abstinence rates did not differ between conditions at either 3 months (experimental condition = 7.1%; control = 5.8%) or 6 months (experimental condition = 5.2%; control condition = 4.7%). A fourth study recruited 225 cigarette smokers from methadone maintenance and other drug and alcohol treatment clinics.[22] Participants were randomly assigned to 12 weeks of CBT+NRT or to treatment as usual. Smoking abstinence rates were 10–11% during the five-week treatment period in the CBT+NRT condition, and "negligible" in the control condition. At 13- and 26-week follow-up, differences between the two conditions were nonsignificant and ranged from a low of 0 in the control condition at week 13 to a high of 5.7% in the experimental condition at week 26.

Effects of nonnicotinic pharmacotherapy on cigarette abstinence in patients receiving MAT for opioid use disorder have been studied. Efficacy of 6 months of varenicline treatment compared to placebo and to combined NRT (CNRT) did not indicate significant differences, with low rates in all conditions (varenicline = 3.7%; placebo = 2.2%; CNRT = 8.3%). Nahvi et al. found differences favoring varenicline over placebo at 12 weeks in methadone maintenance clients, although rates were low (10.5% for varenicline; 0% for placebo) and differences were not maintained after drug treatment ended.[23] In the combined data from two studies, Sigmon et al. found no effect for bupropion treatment.[20]

In summary, cigarette smoking rates in patients receiving MAT for opioid use disorder are high, although these patients report a desire to quit smoking. Interventions generally considered effective in other populations have not been successful in effecting long-term abstinence in patients receiving MAT for opioid use disorder, and abstinence rates are low.

In the current study, we compared an extended innovative system intervention (E-ISI) with a standard treatment control (STC) to increase cigarette smoking abstinence in buprenorphine treatment patients. The E-ISI had two components modeled after a similar intervention used successfully in a study of smokers in treatment for depression.[24] It included the Expert System intervention, a motivational tool that is designed to intervene with individuals who may not be willing to make the commitment to quit smoking cigarettes.[25] In the current study, we offered an extended, intensive treatment that provided extended NRT, as well as the opportunity to receive varenicline, and an extended cognitive behavioral intervention (E-CBT). The E-CBT has produced high and stable long-term abstinence rates in three treatment studies in the general population.[26–29]

We used contact with the pharmacist as an additional therapeutic modality. Pharmacists encouraged both participation in the study and quitting smoking and provided information about pharmacotherapy. The following hypotheses were evaluated:

(1) At months 12 and 18, E-ISI participants will have higher biochemically verified 7-day point prevalence cigarette abstinence rates than STC participants.

(2) At months 3, 6, 12, and 18, E-ISI participants will report more quit attempts than STC participants.

(3) At months 3, 6, 12, and 18, E-ISI participants will be more likely to be in one of the advanced stages of change (Preparation, Action or Maintenance) than STC participants.

(4) At months 3, 6, 12, and 18, E-ISI participants will have more stringent abstinence goals than STC participants.

(5) Greater cigarettes per day (CPD) at baseline and higher baseline Fagerström Test for Cigarette Dependence (FTCD) scores will predict a lower probability of abstinence at months 3, 6, 12, and 18.

We also examined whether baseline alcohol and illicit drug use predicted smoking cessation in this population but did not have specific hypotheses about this relationship.

Methods

This was an open two condition, random assignment design, with assessments at baseline and at months 3, 6, 12, and 18. After a baseline screening interview conducted by research staff, participants ($N = 175$) were stratified by number of cigarettes smoked per day, sex, and eligibility for varenicline treatment and then randomly assigned to either E-ISI ($n = 85$) or STC ($n = 90$).

Participants

The study was conducted in the Integrated Buprenorphine Intervention Service (IBIS) operated under the San Francisco Department of Public Health (SFDPH). All IBIS patients received

their maintenance drug (Suboxone) through a single central pharmacy.

The study was approved by the University of California San Francisco Institutional Review Board and written informed consent obtained after verification of study eligibility.

Clinic data indicated that 83% of the IBIS patients smoked cigarettes. To be eligible for services through IBIS, patients must have been 18 years of age or older, have had a diagnosis of opioid use disorder, resided in San Francisco City or County, and be eligible for treatment through the SFDPH system of health care. Patients dependent on benzodiazepines or alcohol, who had an uncontrolled medical or psychiatric condition, who had a pain syndrome requiring opioid analgesics, or who were pregnant or planning to become pregnant were treated elsewhere in the SFDPH system.

Potential participants needed to have smoked ≥5 CPD for the last week, and, in order to insure a degree of stability, to have been in IBIS for at least 3 months. They did not need to want to quit smoking. Patients with contraindications for NRT (myocardial infarction within 3 months and uncontrolled high blood pressure) were excluded. Patients with a history of Schizophrenia or Bipolar Disorder in their medical record, or diagnosed with these disorders on the Mini International Neuropsychiatric Inventory,[30] were not eligible. Potential participants with current major depressive disorder, or who reported a suicide attempt within the last year, were not eligible to receive varenicline but were eligible for NRT and E-CBT.

Participants were recruited via flyers at the clinic or were approached by the research staff to solicit participation. Research staff routinely reviewed medical records of patients who had been in treatment at IBIS for at least 3 months,and approached those patients. All participants had clearance from IBIS staff to participate.

Assessments

At each assessment, participants reported CPD and were queried about other smoking treatments used, if any. An expired-air carbon monoxide (CO) sample was obtained and a urine sample for anatabine/anabasine assays.[31]

At the follow-up assessments, participants were coded as abstinent if they reported not smoking within the past 7 days, had expired CO levels <5,[32] and anatabine/anabasine levels <2.[31] The primary outcome variables were 7-day self-reported cigarette abstinence biochemically verified by CO and anatabine and anabasine assays at months 12 and 18.

A questionnaire with demographic, smoking history, and smoking behavior questions was also administered at baseline. At all assessments, we also administered the Profile of Mood States,[33] the Fagerström Test for Cigarette Dependence (FTCD),[34,35] the Medical Outcomes Scale, Short-Form (SF-12),[36] the Drug and Alcohol severity and Psychiatric severity scales of the Addiction Severity Index,[37] the Thoughts About Abstinence Questionnaire,[38] the Minnesota Nicotine Withdrawal Scale,[39] a questionnaire that assessed Stages of Change,[40] and questions about life-time and 30-day cannabis use that are part of the Addiction Severity Index (ASI).

At baseline, participants also completed a tracking form with current information including telephone numbers, home and e-mail addresses, and the names and contact information of two individuals who could be contacted if we were unable to reach the participant as well as current living situation, use of housing providers and shelters, and neighborhood hangouts frequented.

Participants were considered lost to follow-up if they (1) failed to return three phone calls when a message was left; (2) failed to

attend three appointments; and (3) refused an outreach visit. We then attempted to obtain smoking data by telephone, with verification from contacts, and as much of the questionnaire data by mail, as possible. All participants were contacted for all assessments independent of whether or not they continued in treatment.

At each visit, participants received a written reminder of the next follow-up visit. Two weeks before a follow-up interview, the participant was contacted either in person at the pharmacy visit or by telephone or letter to schedule the interview. If three contacts failed and a participant was unreachable, a project assistant called or wrote to the participant's contacts to help in finding the participant. If necessary, staff went to local hangouts to locate participants. The tracking form completed at baseline was updated at each follow-up interview; this included change of address and additional significant others. A participant who missed a follow-up appointment was rescheduled for another appointment the same week, if possible. Participants were paid $35 for completing assessments at baseline and at each of the follow-up assessments, with a $35 bonus for completing all assessments.

For E-ISI participants who accepted treatment, pharmacists recorded numbers of patches, gum, and lozenges dispensed during the study. The counselors for these participants recorded minutes in E-CBT sessions and number of sessions.

Intervention Conditions

Standard Treatment Control (STC)

After baseline, participants received a packet of brochures on quitting, descriptions of self-quitting techniques, and help lines. They also received information on smoking cessation medications and suggestions on approaching their primary care provider about these medications.

Innovative System (E-ISI)

Expert System Use in E-ISI. At the baseline interview, patients were staged on their readiness to quit smoking, using the Expert System. The Expert System provided computerized motivational feedback individualized for each participant. The counselor and the participant reviewed the printed report together. Sessions lasted about 15 min, and they were held at baseline and at months 3, 6, and 12.

The Expert System is based on the Stages of Change model that posits five stages of change in quitting smoking. These stages are precontemplation (no intention of quitting), contemplation (thinking about quitting in the next 6 months), preparation (thinking about quitting in the next month and one quit attempt in the past year), action (quit for less than 6 months) and maintenance (quit for more than 6 months). Participants in the precontemplation and contemplation stages were provided with relevant chapters of pathways to change, a self-help workbook based on the stages of change model. When participants reached contemplation, they were reminded of the availability of treatment. Patients who were in preparation stage were strongly encouraged to take part in the treatment intervention. At any point, participants who expressed a desire to quit could receive treatment.

Pharmacological Therapy in E-ISI. Treatment included both extended pharmacotherapy and E-CBT. The primary pharmacological modality was long-term NRT which was available for 6 months after the participant entered the treatment portion of the

intervention. Participants smoking ≥10 CPD when entering treatment received 24 weeks of nicotine patch: 8 weeks of 21-mg patch, 8 weeks of 14-mg patch, and 8 weeks of 7-mg patch. Participants who smoked <10 CPD received 12 weeks of 14-mg patch and 12 weeks of 7-mg patch. All participants received 2 mg nicotine gum or 2 mg lozenges for 24 weeks. Participants were instructed to use gum or lozenge in high-risk situations and to carry a supply with them at all times.

Participants who failed to achieve abstinence with NRT were eligible for varenicline up to month 12, if they did not have a medical or psychiatric condition that excluded varenicline. Failure to achieve abstinence with NRT was defined as inability to stop smoking for 24 hours. Only three participants requested varenicline. All were medically ineligible.

E-CBT in E-ISI. The E-CBT component provided individual treatment focused on a quit plan and on strategies to prevent relapse. Content was adapted from the extended treatment used in earlier work by our group.[27,28] The treatment addressed six areas that are important to smoking abstinence, with the content and skills tailored to low-income smokers: information, education and preparation for quitting; poor mood, weight control, social support, increasing and maintaining motivation, and stress management

This content was provided in 10 individual counseling sessions during the 6-month treatment period. Sessions occurred during weeks 1, 2 (two sessions) 3, 5, 8, 12, 16, 20, and 22. The first counseling session was conducted face-to-face. Subsequent sessions were conducted either in person or by telephone. The first session was approximately 45 min long and the subsequent sessions about 30 min long.

E-ISI Counselors. Counselors were master0level psychologists or health educators, trained by Dr. Humfleet.

Training began with role-playing of sessions, discussion and feedback, and observation. Counselors then observed Dr. Humfleet facilitating each individual session and conducted one round of each session with Dr. Humfleet observing.

Pharmacists' Role in E-ISI. A note was attached to buprenorphine prescription dose containers to identify E-ISI participants: STC participants were not identified. The clinic pharmacists queried E-ISI participants about their current smoking at each medication pickup. If the participant was abstinent from tobacco, the pharmacist congratulated them on being a nonsmoker. If the participant had relapsed, or had not stopped smoking, the pharmacist reminded them about the importance of continuing to attend the Expert System sessions or the continued availability of treatment, as appropriate. All were doctoral level.

Before participating in the study, pharmacists participated in smoking cessation treatment training led by Dr. Gasper, using the Prescription for Change curriculum.[41] Participating pharmacists were knowledgeable about smoking cessation. However, training insured current knowledge and consistent skill level across pharmacists.

Statistical Methods

We first evaluated the data to determine whether there were differences between conditions in missing data at each assessment. None were found. Also, when entered into hypothesis testing models, number of assessments missed was not a significant predictor of abstinence and was therefore eliminated from further consideration.

To test the first through fourth hypotheses, we included in the model intervention condition, usual cigarettes per day (CPD) in the month preceding the baseline assessment and sex of participant. We also included those variables that were found to correlate with abstinence as the dependent variable at two or more assessments. These were goal (quit forever vs. all other goals), ASI Psychiatric Score, SF-12 Physical Component Scale (PCS), SF-12 Mental Component Scale (MCS), and Profile of Mood States-TMD. For hypothesis 1, that there would be significant differences between conditions in abstinence status at months 12 and 18, we evaluated the Intervention × Assessment interaction. For the remaining three hypotheses, the main effects for intervention were of primary interest. Tests of cigarette abstinence and goal were based on a logistic distribution; tests of quit attempts were based on a negative binomial distribution; and the test of stages of changes was based on a multinomial distribution. Differences between intervention conditions at each assessment were evaluated using a chi-square test. Differences between conditions on dependent variables with multiple categories were evaluated by the Jonckheere-Terpstra Test.[42]

To test the final hypothesis, that abstinence status would be predicted by usual CPD and FTCD, we estimated and tested a model that included these two variables at baseline along with treatment condition and assessment. The model failed to converge due to a poor distribution of variables, so we inspected the correlations of each variable at each assessment.

Exploratory analyses of drug and alcohol use were conducted using a model including baseline drug and alcohol use, as assessed by the ASI. In addition to looking at composite drug use, we examined the item reporting self-reported marijuana use in the past 30 days. These three variables were entered into a model to predict abstinence across all assessments.

We also examined differences between treatment conditions in use of NRT and counseling to determine whether interventions were used at a greater rate by E-ISI than STC. We compared reported use across the study period between intervention conditions using Pearson's chi-square test.

Results

A CONSORT chart describing the study is shown in Figure 1. Demographic, smoking, and drug use variables separated by treatment condition at baseline are shown in Table 1. There were no significant differences between conditions on any of these variables.

Follow-up rates were: at 3 months, E-ISI = 96.5%; STC = 91%; at 6 months, E-ISI = 96.5%, STC = 89%; at 12 months, E-ISI = 94.1%; STC = 88%; and at 18 months, E-ISI = 92.9%; STC = 85.6%.

For hypothesis 1, that E-ISI participants would have higher abstinence rates at months 12 and 18, the Assessment × Treatment condition approached traditional levels of significance ($p = .0522$). Abstinence rates by treatment and assessment month are shown in Table 2. There were differences between conditions at 3 months favoring E-ISI, but differences were not maintained at months 6, 12, and 18. Across both conditions, fewer usual CPD predicted a greater probability of abstinence over time ($p = .0226$) as did a more stringent abstinence goal ($p = .0006$). The significant relationship between CPD and abstinence provided a confirmation of hypothesis 4 that CPD would predict abstinence in this sample.
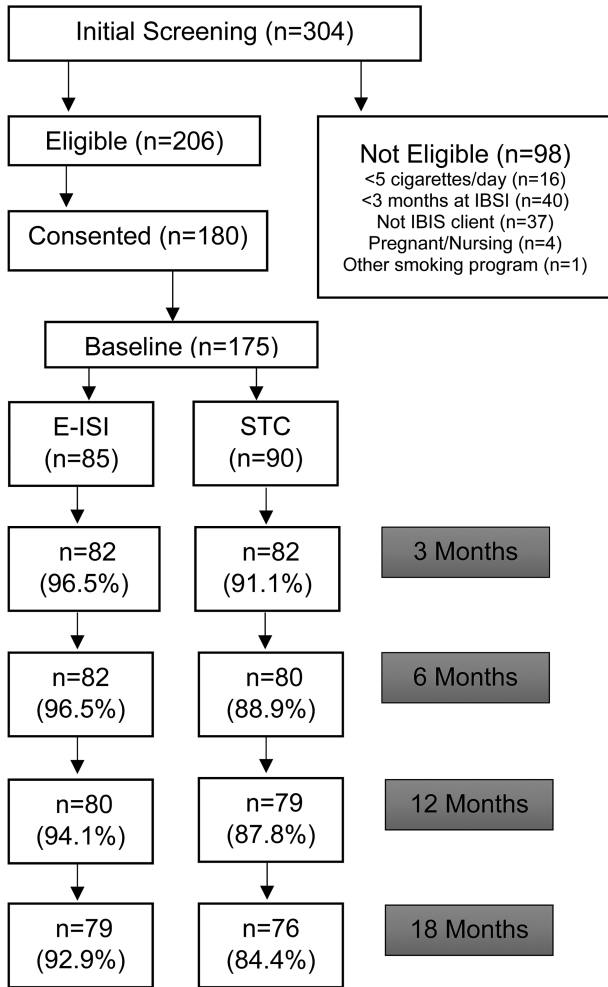
Figure 1. CONSORT chart of participant flow from initial screening to 18-month follow-up.

Table 1. Baseline demographics and descriptive variables by condition (*N* = 175)

	IS (*n* = 85)		STC (*n* = 90)	
	n	%	*n*	%
Gender				
Male	66	77.7	66	75.0
Female	19	22.4	22	25.0
Hispanic*				
Yes	17	20.5	11	12.2
No	66	79.5	79	87.8
Ethnicity				
Caucasian/White	59	69.4	66	73.3
Other	26	30.6	24	26.7
Marital status				
Never married	59	69.4	60	66.7
Other	26	30.6	30	33.3
Education				
HS or less	59	69.4	61	67.8
Any advanced degree	26	30.6	29	32.2
Current employment				
Unemployed	55	64.7	50	56.2
Other	30	35.3	39	43.8
Income				
$10 000 or Less	52	61.2	49	54.4
$11 000–$20 000	22	25.9	29	32.2
>$20 000	11	12.9	12	13.3
Living situation				
House/apartment (own/rent)	28	32.9	36	40.0
Marginal housing**	57	67.1	54	60.0
Any alcohol (past 30 days)				
Yes	37	43.5	40	44.4
No	48	56.5	50	55.6
Any Cannabis (past 30 days)				
Yes	42	50.6	39	43.3
No	43	49.4	51	56.7
Depression (current or recurrent)**				
Yes	16	19.1	15	16.7
No	68	81.0	75	83.3
	Mean	*SD*	Mean	*SD*
Age	40.0	10.5	40.6	9.7
Cigarettes (usual/24 hours)	14.8	7.4	14.6	7.1
Fagerstrom test for cigarette dependence (FTCD)	4.4	2.2	4.2	2.4

Abbreviations: E-ISI, extended innovative system intervention STC, standard treatment control.
*IS *n* = 83.
**Marginal housing categories include Another's house/apartment; Halfway house/therapeutic community; SRO room/hotel/motel.
***IS *n* = 84.

The test of hypothesis 2, that the E-ISI condition would report more quit attempts than the STC condition, at months 3, 6, 12, and 18 found significant effects favoring E-ISI (Z = 2.49 p = .0126; odds ratio [OR] = 0.56, confidence interval [CI]95 = .36 to .88). Evaluation of differences between intervention conditions at each assessment after baseline using the Jonckheere-Terpstra Test indicated significant differences between conditions at month 3, 12, and 18 but not at month 6, although those differences were in the predicted direction. Number of quit attempts by condition is shown in Table 3. Significant effects were also found for assessment (Z = 2.39, p = .0169) and usual CPD (Z = −3.45, p = .0006).

With respect to the third hypothesis, that E-ISI participants would be in the more advanced Stages of Change than the STC participants at months 3, 6, 12, and 18; the intervention conditions were significant predictors of differences between treatment conditions (Z = −1.99, p = .0465, OR = .65, CI.95 = .50 to .77) as were baseline CPD (Z = 3.23, p = .0013) and abstinence goal (Z = 8.06, p = .0001). Percentage of participants in preparation, action, or maintenance was: at baseline, E-ISI = 21.9%, STC = 21.1%; at month 3, E-ISI = 57%, STC = 35%; at month 6 E-ISI = 63.5%, STC = 31%; at month 12, E-ISI = 48%; STC = 33%; and at month 18, E-ISI = 51%, STC = 30%. Differences between conditions were

significant at months 3 (p = .01) and 6 (p = .05) but not at the remaining assessments.

The test of the fourth hypothesis, that E-ISI participants would have more stringent abstinence goals than STC participants at months 3, 6, 12, and 18, also indicated significant differences between intervention conditions (Z = 2.05, p = .0402; OR = .29, CI95 = .15 to .49) Percentage of participants reporting "quit forever" as a goal were: at baseline, E-ISI = 28.2%; STC = 23.3% month 3, E-ISI = 28.6%; STC = 14.3%); month 6, E-ISI = 29.7%; STC = 20.1%; month 12, E-ISI = 35%, STC = 23%; and month 18 E-ISI = 27%; STC = 26%. Differences between the conditions were significant at month 3 but not at the remaining assessments.

Table 2. Abstinence by assessment × treatment condition

	E-ISI		STC		
	n	%	*n*	%	
3 months (*n* = 164)					
Relapsed	71	86.6	79	96.3	*p* = .0254
Abstinent	11	13.4	3	3.7	
6 months (*n* = 162)					
Relapsed	73	89.0	71	88.8	*p* = .9557
Abstinent	9	11.0	9	11.3	
12 months (*n* = 159)					
Relapsed	75	93.8	69	87.3	*p* = .1669
Abstinent	5	6.3	10	12.7	
18 months (*n* = 156)					
Relapsed	66	83.5	66	85.7	*p* = .7072
Abstinent	13	16.5	11	14.3	

Abbreviations: E-ISI, extended innovative system intervention STC, standard treatment control.

Table 3. Number and percentage of participants reporting 0–5 quit attempts at months 3, 6, 12, and 18 by condition

	E-ISI		STC		
	n	%	*n*	%	
3 Months (*n* = 164)					
0	34	41.5	57	69.5	*p* = .02
1	24	29.3	14	17.1	
2	6	7.3	6	7.3	
3	9	11.0	2	2.4	
4	4	4.9	0	0	
5	5	6.1	3	3.7	
6 Months (*n* = 162)					
0	36	43.9	45	56.3	*p* = .12
1	21	25.6	17	21.3	
2	8	9.7	7	8.8	
3	3	3.7	1	1.3	
4	5	6.1	3	3.8	
5	9	11.0	7	8.8	
12 Months (*n* = 159)					
0	30	37.5	45	57.0	*p* = .02
1	22	27.5	15	19.0	
2	5	6.3	7	8.9	
3	6	7.5	1	1.3	
4	4	5	4	5.1	
5	13	16.3	7	8.9	
18 Months (*n* = 156)					
0	34	43.0	46	59.7	*p* =. 05
1	24	30.4	16	20.8	
2	5	6.3	3	3.9	
3	2	2.5	4	5.2	
4	1	1.3	1	1.3	
5	13	16.5	7	9.1	

Abbreviations: E-ISI, extended innovative system intervention; STC, standard treatment control.

The FTCD did not predict abstinence status at any assessment. While CPD did predict abstinence status when included in the overall models evaluating differences in intervention conditions, the univariate correlations of CPD with abstinence at baseline were small and reached traditionally significant levels only at week 78 (r = −.166, p = .0231).

For those E-ISI participants who entered smoking treatment, mean patches dispensed = 72.9 (*SD* = 60.00; minimum = 0; maximum = 264); mean pieces of gum dispensed = 313.6 (*SD* = 468.6; minimum = 0, maximum = 2290); mean lozenges dispensed = 67.2 (*SD* = 126.0; minimum = 0; maximum = 576); mean number of E-CBT sessions = 4.7 (*SD* = 3.0; minimum = 1; maximum = 10); and mean minutes in E-CBT sessions = 167.0 (*SD* = 113.5; minimum = 20; maximum = 441.0).

Of the three indices of drug and alcohol use used, only cannabis use in the past 30 days predicted abstinence over all assessments (z =− 2.15, p = 0.315, estimate = −.06 (CI = −0.12 to 0.01) with greater cannabis use predicting a lower probability of abstinence.

Discussion

The first hypothesis, that E-ISI would produce higher abstinence rates than STC, was not supported. Although there were differences between E-ISI and STC at 3 months, these differences were not maintained.

Three studies of interventions paralleling the intervention reported in this study (Expert System plus treatment availability) have been reported, all with psychiatric patients who were cigarette smokers. The results of these studies are characterized by (1) gradually increasing abstinence rates over an 18-month period and (2) abstinence rates at month 18 ranging between 18% and 20%.[24,43,44] The current results did not replicate those of the earlier studies, particularly with respect to the phenomenon of increasing abstinence rates over time. The most parsimonious explanation for the findings of the current study is that the initially higher abstinence rate in E-ISI reflects a "placebo" effect due the receiving an intensive and novel intervention. Given the significant short-term results, it might be argued that outcomes at later assessments could be improved by modifications to the intervention. However, given the multiple modalities offered, and the duration of the treatment, it is difficult to conceptualize what such modifications might be, especially if feasibility and cost are considered.

Cigarette abstinence rates in the current study are relatively high when compared to most studies reported with patients receiving MAT for opioid use disorder. In the SFDPH, buprenorphine maintenance was reserved for more stable individuals with opioid use disorder because less frequent clinic visits were required than for methadone maintenance and hence less monitoring. This may explain the relatively high abstinence rates, since most previous studies recruited participants from methadone maintenance.

The current study is consistent with the extant literature in its failure to effect cigarette abstinence for patients receiving MAT for opioid use disorder. In that way, it replicates earlier findings.[21–23,45,46] These investigations offered interventions that are efficacious in the general population and found some evidence of efficacy at the end of treatment between experimental and control groups but failed to find long term effects.

The lack of efficacy of E-ISI observed in this study was not the result of lack of interest in abstinence or willingness to change, since 54% of E-ISI participants entered treatment. This compares favorably to the 37% observed in our earlier study of psychiatric outpatients.[24] Also, at baseline, 26% of participants had a goal of complete abstinence and 21% were ready to quit smoking. These baseline figures are not markedly different from baseline figures

reported in the earlier study. In that study, 31% of participants had a goal of complete abstinence, and 25% were ready to quit smoking.[24]

E-ISI participants were more likely to report at least one quit attempt, more likely to be in more advanced stages of change, and more likely to have a goal of "quit forever" than STC participants. These data, in addition to the treatment acceptance rate, suggest that smokers in buprenorphine treatment are at least comparable to other populations in responsiveness to motivational interventions. Participants in E-ISI who accepted treatment used NRT, based on dispensing records. The mean number of patches dispensed (72) would cover about two and a half months of use, if the patch were used daily. It is not possible to accurately judge the days of usage of gum and lozenge, since these would vary by frequency of use. There was moderately good participation in E-CBT, also. The mean number of sessions was almost half of those offered, and the mean minutes in sessions were over 160. Thus, participants received approximately half the E-CBT time available. The protocol was designed so that most of the new content was introduced in 6 of the 10 sessions, with the remaining sessions focusing on review. Thus, on the average, participants were exposed to most of the E-CBT content.

Varenicline was of little interest to participants. This may have been due to the study being conducted during a period when that drug was receiving negative publicity in local media.

This study suggests that currently available treatment interventions do not produce cigarette abstinence in patients receiving MAT for opioid use disorder who smoke cigarettes. The best therapeutic strategy for this population may be to encourage them to use alternate strategies to obtain nicotine and avoid cigarette smoking and thereby reduce harm. These might include long-term multiple NRT medications at a wide range of doses and interventions integrating the suggestions of Miller and Sigmon, particularly the suggestion that use of bupropion, varenicline, and nicotine patches be observed and contingently reinforced.[47]

It is likely that the FTCD is a poor instrument for assessing dependence in this population. Two of the questions on the FTCD (time after arising to first cigarette; smoking when ill) assume that the participant has nonrestricted access to smoking areas. We found that 59.5% of the participants in this study were housed in living situations that would restrict smoking. As has been the case with the general population, CPD did predict abstinence rates, although the magnitude of the relationship was not strong.

Cannabis use predicted continued smoking as has been the case in some studies in the general treatment[48] population although not all.[49,50] Given the mixed findings in the general population, it is difficult to argue that negative effect of cannabis use on abstinence is unique to this population.

In exploratory analyses, we also examined the effects of buprenorphine dose and program participation on abstinence. Neither variable predicted outcome.

In summary, current motivational interventions may be useful in increasing motivation for cigarette abstinence in patients receiving MAT for opioid use disorder. Exploratory analyses did little to shed light on the predictors of outcome in this population of smokers or variables that might differentiate them from the general population and would be useful in explaining the unique lack of efficacy. It is possible that interventions for tobacco dependence in opioid treatment patients should focus on harm-reduction strategies and other alternative strategies.

Declaration of Interests

SH has recently consulted for NIH and the State of Florida, as well as for Carrot Sense, Inc. and BioRealm, Inc. The other authors have no conflicts to declare.

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