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Economic Evaluation

Paying Low-Income Smokers to Quit? The Cost-Effectiveness of Incentivizing Tobacco Quit Line Engagement for Medicaid Recipients Who Smoke

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ABSTRACT

Objectives: To determine the cost-effectiveness of an incentive-based stop-smoking intervention that paid Medicaid recipients who smoke to take calls from a tobacco quit line. **Methods:** A cost-effectiveness analysis was conducted alongside a randomized controlled trial. The analysis was conducted from a health care systems perspective on the basis of costs and effectiveness over a 6-month follow-up. Participants (n = 1900) were recruited from May 2013 to June 2015 through quit line (n = 980), clinic-based (n = 444), or community-based (n = 476) referrals. Incentive group participants (n = 948) received $30 a call for taking up to five tobacco quit line calls and $40 for biochemically verified tobacco abstinence at 6 months. Control group participants (n = 952) did not receive financial incentives for taking quit line calls. Intervention resource costs included incentive payments to participants, counselor and administrative staff time, and smoking cessation medications. Smoking status at baseline and 6 months was determined for all study participants via carbon monoxide (CO) breath tests (abstinence: CO < 7 ppm). Cost-effectiveness analysis calculated the incremental cost-effectiveness ratio (ICER). **Results:** Incentive treatment produced higher 6-month CO-confirmed 7-day point-prevalence abstinence than did the control treatment (21.6 vs. 13.8%; P < 0.001). The ICER of the financial incentives intervention was $2316 (95% confidence interval $1582–$4270) per additional person who quit. The study ICER compares favorably with other smoking treatments, such as varenicline combined with proactive telephone counseling, whose ICER has been estimated at $2600 per additional smoker who quits. **Conclusions:** Use of financial incentives to engage with tobacco quit line treatment is a cost-effective option to enhance smoking cessation rates for low-income smokers.

Keywords: clinical trials, cost-effectiveness, Medicaid, smoking and tobacco

Introduction

Approximately 25% of adult US residents living below the poverty line smoke—a rate substantially higher than the overall adult rate of about 15.5% [1]. This puts individuals with incomes below the poverty line at a disproportionally higher risk for cancer and other smoking-associated diseases [2]. Furthermore, relative to other smokers, socioeconomically disadvantaged smokers are less successful in their quit attempts, perhaps because they are less likely to use evidence-based treatments [3–6]. To date it has been difficult to increase low-income smokers' participation in evidence-based smoking cessation treatments (although some progress has been made; see Christiansen et al. [7]) and to improve their quitting success rates (e.g., 2%–4% continuous abstinence at 6-month follow-up after smoking cessation intervention) [8–14].

Notably, providing tangible reinforcement (i.e., financial incentives) for abstinence increases smoking abstinence [15–20]. Relatively large incentives for smoking abstinence ($750–$800) have successfully increased smoking cessation rates in employee groups, from 5% to almost 15% [18]. Small financial incentives ($63.40 on average) for abstinence improved short-term abstinence rates among socioeconomically disadvantaged individuals participating in a smoking cessation treatment program at a safety net hospital [21]. Research, however, suggests that

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abstinence is challenging to maintain after the incentives are removed [22].

One alternative to incentivizing abstinence is to incentivize treatment engagement among smokers trying to quit. Incentivizing treatment avoids the burden and expense of biochemically confirming abstinence, which is required when abstinence is incentivized [23,24]. For instance, it is likely to be more feasible to incentivize counseling session attendance in a timely and repeated manner than to determine and incentivize biochemically confirmed abstinence [25]. The rationale for incentivizing treatment engagement is that such incentives should increase exposure to smoking treatment, and there is substantial evidence that increased treatment exposure leads to increased abstinence rates [26]. It is also possible that smaller incentives would be required to increase treatment engagement than to increase abstinence directly, given the lower difficulty of engaging in treatment versus becoming abstinent. Finally, it may be that monetary incentives for treatment engagement are especially effective at increasing treatment utilization, and thereby increasing abstinence, among low-income smokers.

At present, little research exists on programs that incentivize smokers' engagement with cessation counseling. Nevertheless, our previous study [27] examined the effects of incentivizing calls to the Wisconsin Tobacco Quit Line (WTQL) among smokers receiving Medicaid. The study offered the same five-call WTQL treatment to two groups of smokers; one group received incentives for call engagement, whereas the other did not. Results showed that the group that was offered incentives took more WTQL calls (mean = 3.8 vs. 2.9 for the control condition; $P < 0.001$) and had higher rates of biochemically determined point-prevalence abstinence at 6-month follow-up (21.6% vs. 13.8% abstinence; $P < 0.001$). These results are encouraging, but clearly more research is needed before promulgating incentives for receipt of counseling.

Not only do these promising effects require replication, but it is also vital to determine the cost-effectiveness of incentivizing treatment engagement, particularly in high-risk populations such as low-income smokers, who are relatively unlikely to use evidence-based cessation treatments [6,28–30]. Cost-effectiveness evaluations are essential for policymaker and stakeholder decisions about the adoption of new treatments [31,32]. Thus, the purpose of this study was to conduct a cost-effectiveness evaluation of financial incentives for low-income smokers to engage in counseling calls with a tobacco quit line. The data for this evaluation come from the Wisconsin Medicaid Quitline Incentive project, a $10 million grant awarded by the Centers for Medicare & Medicaid Services of the US Department of Health and Human Services to the state of Wisconsin and the University of Wisconsin Center for Tobacco Research and Intervention (see Fraser et al [27] for details). The cost-effectiveness is stated in terms of the costs necessary to gain one additional smoker who achieves long-term abstinence.

Methods

This study is a cost-effectiveness analysis alongside a randomized controlled trial (RCT). The analysis was conducted from a health care systems perspective on the basis of costs and effectiveness over a 6-month follow-up. The study data are from an RCT of Medicaid recipients who smoked. Medicaid recipients were recruited via primary care clinic referral (n = 444), community-based referral (n = 476), and callers to the WTQL (n = 980). Community-based referral sources included public health agencies contracted by the Wisconsin Department of Health Services to support smoking cessation. Eligible smokers were randomized to either an incentive (n = 948) or a control condition (n = 952). All participants were offered five WTQL smoking cessation counseling calls and received payment for completing a baseline assessment ($40) and a 6-month assessment ($40). Incentive group participants also received compensation for taking WTQL counseling calls ($30/call) and for biochemically verified abstinence at the 6-month visit ($40).

Data

The primary outcome was biochemically confirmed 7-day point-prevalence abstinence at the 6-month follow-up visit. The 6-month follow-up visit occurred at a clinic or community testing site. All study participants completed either a carbon monoxide (CO) breath test or a cotinine urine test to determine abstinence status (the same test as that used at baseline). The result was recorded dichotomously as either abstinent or smoking.

Incentive group participants could receive up to $270 in incentive payments ($40 for enrollment and 6-month follow-up assessments, $30/WTQL call for up to five calls, and $40 for 6-month abstinence). Control participants could receive up to $80 ($40 for enrollment and 6-month follow-up assessments). Incentive costs were, however, calculated on the basis of the actual incentives received by participants.

Service costs included billed staff time for counseling and testing, as well as all staff costs connected with intervention scheduling and follow-up. Service costs for counselor-initiated WTQL counseling were calculated on a per-call basis and were based on actual reimbursement rates from Medicaid for treatment services. Service costs also included additional participant-initiated calls to the WTQL, because study participants were eligible to reach out to the WTQL counselors for additional counseling support beyond the five scheduled counselor-initiated calls (additional calls were not incentivized for either condition).

Medication costs were calculated using the pharmacy records for smoking cessation medications purchased by Medicaid during the 6-month study period. Medicaid-weighted average reimbursement rates, as of January 1, 2016, were drawn from the Medicaid Web site [33] and applied to each medication.

Analyses

Cost-effectiveness is reported in terms of the incremental cost-effectiveness ratio (ICER) [34]. The ICER is calculated as follows:

$$\text{ICER}=\frac{\sum(\text{Intervention group costs})-\sum(\text{Control group costs})}{\sum(\text{Intervention group quit rate})-\sum(\text{Control group quit rate})}$$

To determine the ICER, the proportion of smokers receiving from 0 to 5 WTQL counseling calls was computed for the incentive and control groups, resulting in 12 treatment combinations (see Table 1 for the pathway probabilities). Cumulative costs and the cumulative probability of 6-month smoking abstinence by study group were determined by calculating the weighted sum of the individual pathways for each study arm. Confidence intervals (CIs) for the ICER were determined through Monte-Carlo simulation [35].

The analyses were conducted from a health care system perspective, including counselor time, personnel time, cost of cessation medications, and financial incentives.

Subgroup Analyses

Variation in the cost-effectiveness of the intervention was explored for various subgroups of participants. Subgroup analyses included differences in cost-effectiveness by sex, age, race, ethnicity, education, chronic disease status, previous attempts to quit smoking, previous use of tobacco cessation medications,

Table 1 – Sociodemographic and smoking-related variables by treatment group

Variable	Treatment group		P value
	Incentive (n = 948)	Control (n = 952)	
Sex: female, n (%)	569 (60.0)	577 (60.6)	0.793
Age (y), mean ± SD	45.0 ± 11.2	44.9 ± 11.2	0.839
Race, n (%)			
White	393 (41.5)	390 (41.0)	0.919
Black or African American	485 (51.2)	487 (51.2)	
Asian	1 (0.1)	3 (0.3)	
American Indian/Alaska native	16 (1.7)	18 (1.9)	
Other	38 (4.0)	36 (3.8)	
Refused/not collected	15 (1.6)	18 (1.9)	
Ethnicity Hispanic, n (%)	35 (3.7)	40 (4.2)	0.415
Education, n (%)			
<9th grade	31 (3.3)	34 (3.6)	0.092
Grades 9–11	194 (20.5)	206 (21.6)	
GED	92 (9.7)	84 (8.8)	
High school degree	278 (29.3)	248 (26.1)	
Some college	190 (20.0)	244 (25.6)	
Some technical/trade school	15 (1.6)	15 (1.6)	
Technical/trade school degree	23 (2.4)	25 (2.6)	
College/university degree	87 (9.2)	65 (6.8)	
Refused/not collected	39 (4.1)	32 (3.4)	
Cigarettes per day, mean ± SD	17.0 ± 10.3	17.4 ± 10.9	0.359
Years smoked, n (%)			
<1 y	4 (0.4)	5 (0.5)	0.849
1–5 y	28 (3.0)	26 (2.7)	
6–19 y	222 (23.4)	238 (25.0)	
≥20 y	694 (73.2)	683 (71.7)	
Previous use of nicotine replacement therapy, n (%)	308 (32.5)	275 (28.9)	0.089
Previous use of varenicline, n (%)	121 (12.8)	103 (10.8)	0.189
Previous use of bupropion, n (%)	53 (5.6)	51 (5.4)	0.823
Tried to quit on own, n (%)	543 (57.3)	504 (52.9)	0.057
Tried a quit program, n (%)	11 (1.2)	10 (1.1)	0.646
Confidence in quitting, mean ± SD	7.7 ± 2.1	7.7 ± 2.1	0.958
Motivation to quit, mean ± SD	7.6 ± 2.8	7.9 ± 2.6	0.017

Source: Authors' analysis of randomized controlled trial data. Means were compared using unpooled *t* tests of means, and percentages were compared using χ^2 tests.
GED, general education development.

motivation to quit smoking, confidence in being able to quit smoking, and recruitment stream.

RCT Enrollment

Biochemical verification of initial smoking status was required for enrollment eligibility. WTQL and community-based referrals used CO testing to confirm current smoking (CO ≥ 7 ppm indicated smoking). Clinic-based referrals used cotinine tests for smoking verification (clinics used different cutoff scores for smoking ranging from 50 to 200 ng/ml). In the literature, there is no consensus on a single cutoff value for cotinine biochemical verification of smoking status [36]. It is generally accepted that a urinary cotinine cutoff score of at least 50 ng/ml or more has sufficient sensitivity and specificity to be useful in assessing tobacco cessation trials [37].

Baseline questionnaires assessed age, sex, race, ethnicity, education, current smoking and dependence, basic health information, as well as participants' previous attempts to quit smoking and previous use of tobacco cessation medications. Motivation to quit smoking and the confidence in being able to quit smoking were assessed on an 11-point Likert scale (i.e., a 0–10 scale), with higher scores indicating more motivation or confidence.

RCT Study Procedures

Study participants received a prequit counseling call at study enrollment and four additional proactive counselor-initiated WTQL counseling calls in 1-month intervals, for a total of up to five WTQL calls. Participants could also initiate their own calls to the WTQL for additional assistance. WTQL quit coaches made three attempts on different days to reach participants for each proactive call. Participants not reached on the first two proactive calls were sent a letter urging them to call the WTQL. The WTQL reported the number of proactive and participant-initiated calls completed by each participant.

WTQL quit coaches routinely recommended that participants obtain a prescription for a Medicaid-approved smoking cessation medication from their primary care provider, usually provided at minimal or no co-pay. Cessation medications were not provided by the study or the WTQL.

Results

Table 1 presents the demographic characteristics and smoking history data by randomization group. As seen in the table, 60% of the study participants were female and more than half of the study participants self-identified as black or African American. Participants' mean age was 45 years. Approximately two-thirds of the study participants had a high school degree or less. Participants smoked an average of 17 cigarettes per day at baseline, and more than 70% of the study participants had smoked for 20 years or more. More than half of the study participants reported trying to quit smoking on their own (i.e., without counseling or cessation medication) at least once. Comparison of the treatment groups revealed no statistically significant differences between the groups at baseline except in terms of motivation to quit. Control group participants indicated higher baseline motivation to quit than the incentive group participants ($P = 0.017$), although that difference was not clinically meaningful (7.9 vs. 7.6 on a 1–10 scale).

Engagement in WTQL Calls

Figure 1 shows the cost and effectiveness probabilities by randomization group and number of WTQL calls taken. Incentive group participants took more WTQL calls than the control group participants; 45.9% of the incentive group participants took all five WTQL calls, compared with 21.3% of the control group participants. The number of WTQL calls averaged 3.8 calls per incentive group participant, compared with 2.9 calls per control group participant. Figure 1 also shows that the number of WTQL calls taken was strongly associated with smoking cessation rates at 6-month follow-up. Across both randomization groups, subjects who took all five WTQL calls had a biochemically verified abstinence rate at 6 months of 28.8% compared with 17.3% when taking four WTQL calls, 12.7% with three WTQL calls, and 8.7% with two or fewer calls. Participants who quit smoking averaged 4 WTQL calls, whereas nonquitters averaged 3.2 calls across the study arms.

Quit Rate Effectiveness

Overall, 21.6% (205 out of 948) of the incentive group participants and 13.8% (131 out of 952) of the control group participants had biochemically verified abstinence at 6-month follow-up. The differential effectiveness of the financial incentive intervention was 7.9%.

Resource Costs

Table 2 presents the average cost per unit of the resources used by participants. Incentive group participants were eligible to receive up to $270 if they completed all the study visits and were abstinent at 6-month follow-up. The average cost of counselor time was estimated at $38 per completed WTQL call. Participants were encouraged to obtain cessation medications from their primary care providers and 52% of participants used at least one cessation medication during the study. Medication costs ranged from $0.38 to $5.14 per dose, depending on the medication [33].

Average and Incremental Costs

Table 3 presents the average and incremental costs for the incentive group participants relative to the control group participants. The total cost per participant, on average based on treatments used, was $499 for the incentive group and $316 for the control group, resulting in an incremental cost of $183 per participant.

Incremental Cost-Effectiveness Ratio

Table 3 also presents the ICER taking into account the incremental costs of the intervention and the incremental effectiveness. With an incremental cost of $183 per participant and an incremental effectiveness of 0.079 per participant, the ICER (i.e., cost of one additional tobacco quitter) was calculated as $2316 (95% CI $1582–$4270) per additional smoker who quit.

Subgroup Analyses

Subgroup analyses revealed that the ICER for participants who had previously tried quitting smoking on their own was significantly lower per additional person who quit ($1,681; 95% CI $1,125–$3,123) than for subjects who had never tried to quit on their own ($3,885; 95% CI $1,889–$25,305). In addition, participants who had a chronic health condition had a significantly lower ICER per additional person who quit ($1,495; 95% CI $970–$2,603) compared with participants who did not have a chronic health condition ($4,142; 95% CI $1,955–$22,161).

Other subgroup analyses were not statistically significant, although the ICER per additional person who quit for women ($2,080; 95% CI $1,309–$4,470) was marginally lower than the ICER per additional person who quit for men ($2,882; 95% CI $1,455–$12,741), and participants who were more motivated to quit ($1,909; 95% CI $1,273–$3,581, motivation = 9 or 10 on a 10-point scale) trended toward a lower ICER per additional person who quit than participants who were less motivated to quit ($2,946; 95% CI $1,517–$15,647, motivation < 9). There were minimal differences in ICER on the basis of age, race, education, or enrollment stream into the trial.

Discussion

The objective of this study was to determine whether financial incentives to take tobacco quit line calls are cost-effective for smokers who are Medicaid recipients. Our overall finding was that financial incentives for tobacco quit line engagement are cost-effective.

The ICER of financial incentives to engage in tobacco quit line counseling was $2316 per additional smoker who quit, attributable to a $183 difference in costs per person between the incentive group and the control group, and a 7.9% difference in tobacco abstinence rates between the two arms of the study at 6-month follow-up. Two-thirds of the ICER ($1557) comes from the financial incentive payments to low-income smokers. One-third of the ICER ($759) resulted from increased use of quit line counselor time and use of smoking cessation medications. The ICER demonstrates that $2316 in staff time, medication costs, and financial incentives is needed to gain one additional Medicaid patient who abstains from smoking at 6-month follow-up after the intervention compared with the control condition. Control group participants were referred to the tobacco quit line for cessation counseling, but they did not receive financial incentives to complete the counselor-initiated calls.

One of the mechanisms by which providing financial incentives increased quit rates among smokers receiving Medicaid was by increasing the number of quit line counselor calls taken by the participants. In the incentive group, approximately twice as many participants accepted all five calls initiated by the quit line counselors compared with the control group participants (45.9% vs. 21.3%). Greater engagement with the quit line was associated with a dose-response increase in quit rates. For instance, participants who took all five quit line calls had a 29% abstinence rate at 6 months, whereas those taking two or fewer quit line calls had only a 9% abstinence rate. It may be beneficial to offer

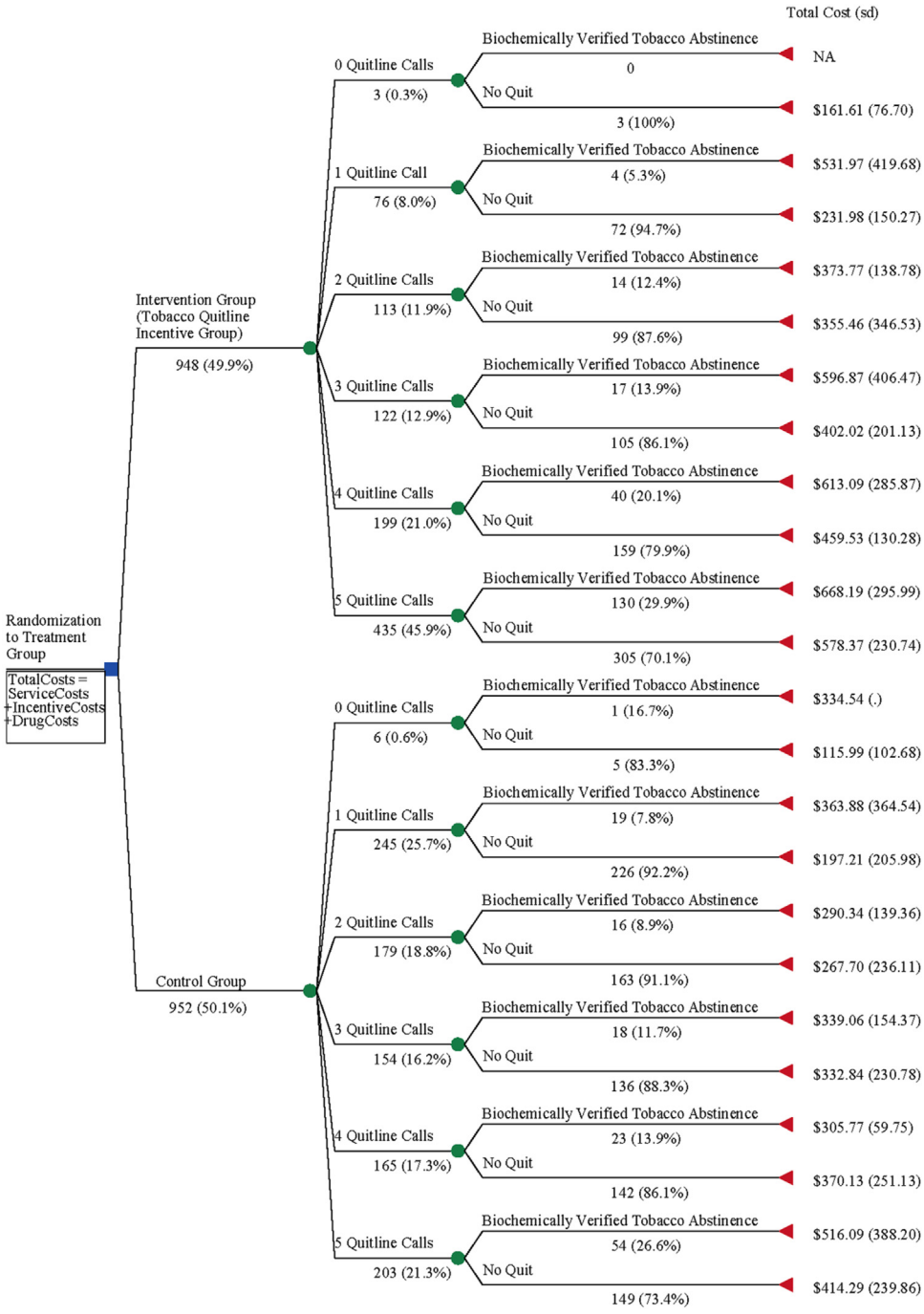

Fig. 1 – Cost-effectiveness tree. *Source:* Authors' analysis of randomized controlled trial data. Branches of the cost-effectiveness tree represent the number of study participants (%) taking 0–5 quit line calls, whether the participant was tobacco-abstinent at 6-mo follow-up, and the mean cost (SD) per participant in the study branch.

progressively greater financial incentives for taking additional quit line calls to increase the number of calls taken. Nevertheless, it is also important to recognize that the causal relation between accepting quit line calls and abstinence may not be direct. For instance, it is possible that incentives may directly enhance abstinence rates and those who have become abstinent are more likely to continue to take calls.

Our study ICER of $2316 per additional smoker who quit for Medicaid recipients is similar to the cost-effectiveness of other tobacco use treatment options for smokers in general populations. For example, the ICER for varenicline combined with proactive telephone counseling has been estimated at $2600 per additional smoker who quits [40]. Our ICER results illustrate that incentivizing engagement with treatment counselors is a viable

Table 2 – Average unit cost of resources for study

Resource costs	Cost per unit ($)
Incentive costs	
Enrollment visit (all participants)	40
6-mo visit (all participants)	40
WTQL call (incentive group only)	30
Biochemically verified 6-mo tobacco abstinence (incentive group only)	40
Service costs	
Counselor time per WTQL call	38
Staff time and materials per cotinine test	35
Medication costs	
Bupropion, per dose	0.38
Chantix, per dose	5.14
Nicoderm, per patch	2.98
Nicorette, per dose	0.41
Nicotrol, per cartridge	1.67

Source: Authors' analysis of randomized controlled trial data.
WTQL, Wisconsin Tobacco Quit Line.

option to increase the number of abstainers among low-income smokers.

Our results could be viewed in light of quality-adjusted life-years (QALYs), a measure of disease burden associated with quality and quantity of life lived [41]. Research suggests that smokers who quit smoking between the ages of 55 and 64 years gain an average of 4 years of life [42]. Smokers between the ages of 25 and 34 years can expect to gain an additional 10 years of life [42]. If the quit line engagement incentive adds at least 1 QALY, or the equivalent of 1 year of life in perfect health, on average, the cost per QALY would be less than $2316. This is significantly below the recommended cost-effectiveness threshold of $50,000 per QALY [43,44]. Furthermore, in this study, the ICER of $2316 per additional smoker who quit does not take into account potential health care cost savings as a result of patients quitting and reducing the burden of smoking-related chronic illnesses and mortality. Future research should explore further the relation among financial incentives to engage in evidence-based treatment, abstinence, and QALYs.

It is also important to note that the comparison data on both ICERs and QALYs for smoking cessation interventions do not pertain to low-income smokers per se. It is entirely possible that these comparison figures would change substantially if estimated in a low-income population such as that used in this study. For instance, low-income smokers may be especially prone to severe disease if they do not quit smoking, which might affect the QALY estimates. Furthermore, this research does not reveal whether the prospect of financial incentives may have enhanced overall recruitment into this project; future research should evaluate the effects of incentives as a promotional strategy.

Study Limitations

Our study results should be viewed in light of some limitations. First, data were collected as part of a research study. Therefore, some costs (e.g., promotional materials and clinic incentives) would not apply to a real-world setting. Nevertheless, these costs apply equally to both the intervention and control groups, and so the net effect of the research-only aspects of the study should have little impact on the incremental cost-effectiveness outcomes. A cost-effectiveness analysis including all recruitment costs is available on request.

Second, cost offsets in terms of health care visits, emergency department visits, or hospital stays were not measured. A 6-month follow-up is not likely to be long enough to determine the impact of smoking cessation on long-term health care utilization.

Third, the study enrolled Medicaid participants from Wisconsin, and so results may not be generalizable nationwide. The study, however, enrolled a broad racial and ethnic mix of participants, similar to Medicaid recipients nationwide.

Finally, the original report [27] noted that there were meaningful discrepancies between the biochemical confirmation data at 6-month follow-up (the primary outcome) and self-reports of smoking status. This suggests that some participants in the incentive group may have quit smoking just before the 6-month follow-up visit, and thus their biochemically determined outcome may reflect only recent abstinence. Furthermore, significant effects of the incentive condition were, in fact, found when cotinine-determined abstinence was used as the outcome; cotinine has a much longer half-life than CO [38,39], suggesting that abstinence duration was likely to be of at least several days.

It may also relate to different cotinine cutoff values used by the study clinics to verify smoking status. Study clinics were, however, blinded to the intervention status of the participants, and randomization balanced the study groups on various participant characteristics, so it seems unlikely that the various internal cutoffs ranging from 50 to 200 ng/ml for smoking status at the clinics would have an impact on the study findings.

Further research is required to evaluate the robustness and stability of the effects of incentives for treatment engagement on

Table 3 – Costs and effectiveness of tobacco quit line incentives by treatment group

Variable	Incentive group (n = 948)	Control group (n = 952)	Incentive-control
Cost, mean ± SD			
Incentive cost	$187 ± $58	$64 ± $20	$123 ± $43
Service cost	$196 ± $80	$141 ± $74	$55 ± $77
Medication cost	$116 ± $239	$111 ± $239	$5 ± $239
Total cost, mean ± SD	$499 ± $271	$316 ± $256	$183 ± $377
Effectiveness			
Biochemically verified tobacco abstinence	21.6%	13.8%	7.9%
Incremental cost-effectiveness ratio (95% CI)		*$2316 ($1582–$4270)*	

Source: Authors' analysis of randomized controlled trial data. Incentive costs included payment for enrollment ($40), 6-mo follow-up ($40), and quit line counselor calls ($30/call for incentive group only). Service costs included counselor time, personnel time, and CO confirmatory test costs. Medication costs included tobacco cessation medications only.
CI, confidence interval; CO, carbon monoxide.

long-term smoking abstinence and its health effects among Medicaid smokers.

Conclusions

This study shows that smoking cessation rates among low-income smokers who received payments for treatment engagement with tobacco quit line counselors and a modest incentive for 6-month abstinence were 7.9 percentage points higher than the rates among low-income smokers who were referred to the tobacco quit line but not given financial incentives. At an average differential cost between the incentive group and the control group of $183 per participant, the incremental cost per additional quitter was $2316, a modest price to pay considering the long-term health and longevity benefits associated with quitting smoking. Financial incentives to increase engagement with evidence-based treatments and to promote increased long-term abstinence appear to be a cost-effective option to encourage smoking cessation among low-income smokers.

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