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The Use of Financial Incentives in Promoting Smoking Cessation

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Abstract

Objective—Cigarette smoking is the leading cause of preventable death in the U.S. and world. Despite the availability of numerous therapies for smoking cessation, additional efficacious interventions are greatly needed. We provide a narrative review of published studies evaluating financial incentives for smoking cessation and discuss the parameters important for ensuring the efficacy of incentive interventions for smoking cessation.

Methods—Published studies that evaluated the impact of incentives to promote smoking cessation and included an appropriate control or comparison condition were identified and reviewed.

Results—Incentives are efficacious for promoting smoking abstinence across the general population of smokers as well as substance abusers, adolescents, patients with pulmonary disease, patients with serious mental illness and other challenging subgroups. To develop and implement an effective incentive treatment for smoking, special attention should be paid to biochemical verification of smoking status, incentive magnitude and the schedule of incentive delivery.

Conclusion—Consistent with the extensive literature showing that incentives are effective in reducing illicit drug use, a large body of evidence supports their effectiveness in reducing smoking. Continued efforts are warranted to further develop and disseminate incentive-based treatments for smoking cessation across clinical settings and populations.

Keywords

incentives; contingency management; smoking cessation; tobacco; nicotine; behavioral; reinforcement

Objective

Cigarette smoking is the leading cause of preventable death worldwide, with a current annual mortality of 5 million and a projected increase to 8 million by 2030 (Mathers & Loncar, 2006). In the U.S., smoking causes over 443,000 premature deaths each year,

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accounting for 30% of all cancer deaths and costing over \$96.8 billion annually (American Cancer Society, 2011; CDC, 2008). Despite the many therapies available for smoking cessation (Fiore et al., 2008; PHS, 2000), most patients relapse within the months following a quit attempt (Ahluwalia et al., 2002; Brigham et al., 1991; Fiore et al., 1994; Hughes et al., 2004; Hurt et al., 1997). Meta-analyses evaluating the effectiveness of the various smoking treatments have shown that estimated abstinence rates tend to be relatively modest (e.g., 6-month abstinence rates of 8–28%; Fiore et al., 2008). Many smokers also experience significant difficulty initiating abstinence. While up to 80% of smokers express some desire to quit, only about 30% actually attempt to quit per year (Eisenberg et al., 1999). Of those who try to quit, at least 75% relapse within 2–3 days following an initial quit attempt (Hughes et al., 1992). Especially problematic are “hard-core” smokers who may be difficult to help with existing treatments (Emery et al., 2000; Seidman & Covey, 1999). These smokers typically have a heavy pattern of smoking (≥15 cigarettes/day), infrequent and unsuccessful quit attempts, and a low motivation to quit (Emery et al., 2000). Data also suggest that socioeconomic disadvantage is associated with poor response to cessation treatments (Higgins & Chilcoat, 2009). Taken together, the available data show that the vast majority of smokers fail to initiate abstinence or have relapsed within six months of treatment (Fiore et al., 1994).

The limitations of current interventions, as well as the difficulties reaching hard-core smokers, suggest the need for innovative and more intensive approaches (Fagerstrom et al., 1996; Henningfield, 2000; Ranney et al., 2006; Stitzer, 1999). We review research on the systematic use of financial incentives to promote abstinence from smoking. Incentive-based interventions, also known as contingency management (CM), are empirically-supported behavioral treatments demonstrated effective across a wide range of populations and drugs. This approach typically involves a tangible reward delivered contingent upon the patient meeting a predetermined therapeutic target (Higgins et al., 2008). In the most common approach, patients earn voucher-based incentives for biochemically-verified abstinence from drug use. In the area of smoking cessation, smoking abstinence is typically the primary target behavior, with incentives contingent upon negative breath carbon monoxide or urine cotinine levels.

The aims of the present report are two-fold: First, we aim to provide the reader with an understanding of the experimental research on incentives for smoking cessation. We present a narrative review of the published experimental studies evaluating financial incentives for smoking cessation, ranging from the early studies demonstrating initial efficacy to more recent replications across populations and platforms. As several quantitative reviews have been published previously on this topic (Cahill & Perera, 2011; Lussier et al., 2006; Prendergast et al., 2006), we will not repeat that exercise here but rather will direct the reader to those reviews for greater details when appropriate. Second, we aim to inform the reader on how to thoughtfully design and implement an incentive program for smoking cessation, with an understanding of the parameters most likely to optimize effectiveness.

Criteria for inclusion

Literature searches were conducted using PubMed, PsychINFO and Cochrane Database of Systematic Reviews, using the terms ‘vouchers’, ‘contingency management’, and ‘incentives’ both alone and paired with the terms ‘smoking’ and ‘nicotine’. Reference sections of published articles were also reviewed, and investigators in this area of research were consulted to ensure that all relevant articles were included (White, 1994). November 2011 represented the last publication month for which studies were included. Studies were included if they met the following criteria: (1) involved contingent financial incentives for smoking abstinence, (2) were published in a peer-reviewed journal; (3) used a research

design wherein treatment effects could be attributed to the incentive intervention. This last criterion included randomized trials that included comparison conditions where subjects either did not receive financial incentives or received them non-contingently, as well as studies that utilized a within-subjects design wherein effects of the incentive condition could be compared to a baseline comparison condition. Publications from two areas (i.e., Quit and Win contests, workplace interventions) were not included in this review. Quit and Win contests typically involve verification of smoking status prior to participant entry, a pledge to quit on a unified date for a predetermined duration of time, and a grand prize (e.g., family vacation) for a randomly-selected abstinent participant (Lando et al., 1994). Workplace incentive interventions typically involve an employer-organized intervention wherein smokers are reinforced individually or in teams for evidence of a cessation attempt, change in self-reported tobacco use, or participation in the program. While both types of interventions represent creative and important approaches, the published studies vary widely in methodology and are generally less rigorous than the interventions reviewed here (i.e., less frequent clinical contact, biochemical monitoring and contingent reinforcement opportunities). For additional information about both approaches, we direct the reader to several recent and very thorough reviews (Cahill & Perera, 2008, 2011; Cahill et al., 2008; Leeks et al., 2010).

Incentives for smoking cessation in the general population

In this section we review the studies evaluating incentives for promoting smoking abstinence in the general population of smokers. We begin by briefly discussing the early studies which demonstrated the initial feasibility and efficacy of incentives for promoting smoking abstinence, followed by more recent efforts to extend incentives to broader populations of smokers.

Seminal studies

The seminal demonstrations of the feasibility of using incentives to reduce smoking were conducted by researchers at Johns Hopkins University (Stitzer & Bigelow, 1982, 1983, 1984, 1985; Stitzer et al., 1986). These studies generally involved non-treatment-seeking adult smokers, rigorous experimental methods, brief intervention durations (mean: 2.3 weeks, range: 1–4 weeks), frequent study visits (range: 1–3×/day), CO monitoring and moderate incentive magnitudes (mean: \$37.25/week; range: \$5–84/week). They provided persuasive demonstrations that offering incentives contingent upon biochemically-verified abstinence could reduce smoking. Overall, these studies provided the first, and most rigorous, demonstrations of the efficacy of incentive interventions in reducing smoking among healthy adult smokers.

Using incentives to examine other questions related to smoking

Subsequent studies conducted over the next two decades replicated the finding that contingent incentives can promote smoking abstinence. Many have also used incentives as a tool to investigate larger scientific questions related to smoking. For example, early abstinence plays a crucial role in determining the likelihood of success of a quit attempt, with smoking abstinence during first two weeks of a quit attempt strongly predicting longer-term success (Garvey et al., 1992; Gourlay et al., 1994; Higgins et al., 2006; Kenford et al., 1994; Lamb et al., 2004a; Yudkin et al., 1996). Several studies demonstrated that a period of experimentally-produced abstinence (or lapses) can directly influence subsequent efforts to abstain from smoking and identified reductions in nicotine withdrawal, craving and relative reinforcing effects of smoking as potential mechanisms underlying this effect (Alessi et al., 2004; Chornock et al., 1992; Heil et al., 2004; Lussier et al., 2005). In the strongest demonstration, Yoon and colleagues (2009) used incentives to experimentally manipulate

the amount of abstinence achieved (i.e., 1 vs. 14 days) and demonstrated that the relationship between early and later abstinence is causal rather than correlational. Studies also have used incentives to experimentally manipulate smoking abstinence and evaluate nicotine withdrawal (Alessi et al., 2004; Heil et al., 2003). These provided important information characterizing the time course and severity of nicotine withdrawal among smokers. Incentives have also been used to produce abstinence and examine how abstinence may influence individuals' self-efficacy and readiness to quit. Contrary to earlier assertions that incentives may decrease these measures (Curry et al., 1991), studies have shown that both self-efficacy (Alessi et al., 2004; Heil et al., 2004; Lamb et al., 2005) and readiness to quit (Lamb et al., 2005) increase during incentive-produced abstinence. Incentives also have been used as an evidence-based platform to evaluate the contribution of pharmacotherapies for smoking cessation (Gray et al., 2011; Hanson et al., 2003; Mooney et al., 2005; Perkins et al., 2008; 2010; Tidey et al., 2002, 2011). Finally, as discussed below, studies have used incentives to investigate the procedural details that influence the efficacy of incentive treatments, including schedule, immediacy and incentive magnitude (e.g., Roll et al., 1996, 2000; Roll & Higgins, 2000; Roll & Howard, 2008). In summary, incentives have served as an effective tool for investigating a variety of questions related to smoking cessation and relapse. While these studies were conducted with smokers, their findings likely hold generality to other forms of drug use as well.

Using technology to facilitate implementation

Internet, smart phone and other technologies hold potential for increasing access to incentive treatments, particularly for smokers who may have difficulty accessing treatment. For example, Dallery and colleagues have developed an internet-based incentive program for promoting smoking abstinence (Dallery & Glenn, 2005; Dallery et al., 2007; Glenn & Dallery, 2007; Meredith et al., 2011; Stoops et al., 2009; Reynolds et al., 2008). Smoking status is verified using a web camera to observe participants providing CO samples, which are then time stamped, preserved as video recordings and emailed to clinic staff twice daily. A website provides an individualized home page for each participant and other resources. As incentive holdings accumulate, the participant requests goods and services by email, which are then delivered to them in person or by mail. Results suggest that this approach is feasible and effective in promoting smoking abstinence (see Dallery & Raiff, 2011 for a recent review). Other forms of webassisted tobacco interventions (WATIs) are also receiving increasing attention and could incorporate incentive components for abstinence (e.g., Feil et al., 2003; Riley et al., 2002; Meis et al., 2002; Norman et al., 2008; Woodruff et al., 2001).

Using shaping procedures to aid hard-to-treat smokers

While incentives are effective in promoting abstinence, there is often a subset of hard-to-treat smokers who do not encounter the available incentives because they never meet the abstinence requirement (Lamb et al., 2004a). Shaping procedures may help surmount this problem by increasing the likelihood that early abstinence will be reinforced. Using a behavior-shaping technique with percentile schedules, a participant can receive rewards for demonstrating gradual reductions in CO levels over consecutive visits until he or she eventually achieves CO levels that are below the qualitative abstinence cutoff (Galbicka, 1994). Lamb and colleagues (2004a, b, 2005, 2007) have conducted a series of experimental studies demonstrating that CO contingencies set by percentile schedules produce significant reductions in CO levels, even among smokers without plans to quit. These findings suggest that less stringent shaping procedures may aid individuals who are difficult to treat with typical incentive (or other) approaches.

Larger-scale applications of incentives for smoking cessation

While incentives can clearly produce robust effects on smoking, most of the above studies utilized limited sample sizes and tight experimental control. An important question is whether incentive-based smoking cessation can be implemented on a larger scale. Several recent studies suggest that this approach can be scaled up and still retain efficacy in promoting abstinence. One randomized trial, for example took place at a Veterans Affairs Medical Center with 179 smokers (Volpp et al., 2006). The incentive group received financial incentives for attending smoking classes and for evidence of abstinence 30 days after treatment (defined as a self-report of no smoking during the past seven days and urine cotinine < 500 ng/ml). The control group were simply offered the five smoking classes. Attendance rates were higher in the incentive vs. control group. While these abstinence criteria were less stringent and the levels of smoking abstinence somewhat lower than many of the above studies, this trial demonstrated that modest financial incentives can increase enrollment and short-term quit rates in a community-based clinical setting. Another study was conducted with 878 employees of a large, multinational company (Volpp et al., 2009). Smokers in the incentive group received information about smoking-cessation programs available in the community plus financial incentives for completing a program and for evidence of smoking abstinence. Smokers in the control group simply received information about available smoking-cessation programs. Significantly more incentive participants participated in and completed smoking-cessation programs compared to controls. Additionally, significantly more incentive participants achieved biochemically-verified abstinence and these differences persisted 6 months after discontinuation of the incentive program. This study provided the first empirical data showing that incentives, implemented on a large scale, can produce significant treatment effects that persist after the program is discontinued.

Incentives for smoking cessation in special populations

Over the past two decades, incentives have also been used to target smoking in a variety of challenging smoker subgroups. Below we briefly review the published studies that have evaluated the efficacy of incentive-based approaches in special populations of smokers.

Substance abusers

Nine studies have evaluated the use of incentives for promoting smoking abstinence among illicit drug abusers (Alessi et al., 2008; Dunn et al., 2008, 2010; Hunt et al., 2010; Robles et al., 2005; Schmitz et al., 1995; Shoptaw et al., 1996, 2002; Wiseman et al., 2005). Most of this work has been done with patients receiving methadone or buprenorphine maintenance treatment for opioid dependence. Prevalence of smoking in these patients is estimated at 84–94% and associated with increased morbidity and mortality (Clemmey et al., 1997; Hser et al., 1994; Hurt et al., 1996; Nahvi et al., 2006; Richter et al., 2001). The majority of patients recognize the serious health risks associated with smoking and express interest in quitting (Clemmey et al., 1997; Frosch et al., 1998; Kozlowski et al., 1989; Richter et al., 2001; Sees & Clark, 1993). Further, the opioid treatment modality is uniquely situated for implementing smoking-cessation interventions as many patients are stable, achieve prolonged periods of abstinence from illicit drug use and remain in treatment for extended periods. This lends itself to frequent and, if necessary, prolonged clinical contact to ensure success with smoking cessation. Additionally, methadone and buprenorphine programs adhere to a relatively uniform set of state and federal regulations. Thus, development of an effective intervention in these patients holds substantial potential for impacting tobacco use in this group throughout the country.

Of the five studies investigating incentives for smoking cessation in opioid-maintained patients, four have showed a significant treatment effect (Dunn et al., 2008, 2010; Shoptaw et al., 1996, 2002). These were randomized trials wherein methadone- or buprenorphine-maintained smokers could earn voucher-based incentives contingent upon smoking-abstinent breath or urine samples. They generally involved frequent study visits (range: daily-3×/week), moderate incentive magnitudes (mean: \$104.51/week; range: \$18.25–\$181.25/week) and an escalating schedule of reinforcement for consecutive negative samples (cf. Higgins et al., 1991). These studies provided clear support for the efficacy of incentives in promoting smoking abstinence in opioid-dependent patients. In contrast to the above studies, no treatment effect was seen in an early report by Schmitz and colleagues (1995), which used a within-subject design and involved relatively low-frequency visits (2×/week), modest incentive magnitudes (\$10/week) and no escalating schedule. As noted previously, magnitude and schedule of reinforcement can be important determinants of the efficacy of incentive interventions (Kirby et al 1998; Roll et al., 1996; Roll & Higgins, 2000; Silverman et al., 1999; Stitzer & Bigelow, 1983, 1984). The remaining studies with non-opioid substance abusers have also used relatively frequent study visits (range: 3×/day-2×/week) and moderate incentive magnitudes (range: \$50–\$149.50/week) and also produced significant effects (Alessi et al., 2008; Hunt et al., 2010; Robles et al., 2005; Wiseman et al., 2005). Overall, incentives are effective at promoting smoking abstinence in substance-abusing patients and offer potential for wide dissemination to treatment programs throughout the country.

Adolescents and young adults

Another growing area of research is with younger smokers. More than 80% of established adult smokers began smoking before age 18 years and, in 2009, 8.2% of middle school and 23.9% of high school students reported current tobacco use (CDC, 2010). Applying innovative and efficacious treatments to this population seems particularly important. Ten experimental studies have been published evaluating the efficacy of incentives in promoting smoking abstinence in adolescents (Corby et al., 2000; Gray et al., 2011; Krishnan-Sarin et al., 2006; Reynolds et al., 2008; Roll, 2005; Tevyaw et al., 2007) and college students (Correia & Benson, 2006; Irons & Correia, 2008; Kassaye, 1984; Tevyaw et al., 2009). Of these, eight showed a significant treatment effect (Corby et al., 2000; Correia & Benson, 2006; Irons & Correia, 2008; Kassaye, 1984; Krishnan-Sarin et al., 2006; Reynolds et al., 2008; Roll, 2005; Tevyaw et al., 2009). They generally involved brief durations (range: 1–4 weeks), a wide range of visit frequencies (range: 1×/week-3×/day), and moderate incentive magnitudes (mean: \$47.27/week; range: \$17.49–\$94.50/week). These studies provided clear support for the efficacy of incentives in promoting abstinence in adolescent smokers. In contrast, no significant treatment effect was seen in reports by Tevyaw et al. (2007) or Gray et al. (2011). While these studies used generally similar parameters, possible reasons for the lack of significant effects may include the unusually high abstinence rate during baseline (Tevyaw et al., 2007) and infrequent study visits (Gray et al., 2011). In addition, while Gray and colleagues (2011) did not show a main effect of vouchers, they did find a significant interaction wherein bupropion + incentives demonstrated superior abstinence over either bupropion or incentives alone.

Taken together, a growing literature is demonstrating the efficacy of incentives for reducing smoking in young people. School settings may offer a particularly good setting in which to implement smoking cessation, as most students attend the school or college frequently and for extended periods. While not experimental evaluations, several additional publications have reported on important issues related to this topic. These have included examinations of spending behavior among adolescents receiving incentives for smoking abstinence (Cavallo et al., 2010), efforts to combine incentives with other treatment components such as nicotine

replacement and cognitive-behavior therapy (Cavallo et al., 2007; Hanson et al., 2003), examination of predictors of treatment response among adolescent smokers (Krishnan-Sarin et al., 2007) and more general reviews of this treatment approach (Stanger & Budney, 2010).

Patients diagnosed with pulmonary disease

While smoking produces a wide range of health problems, respiratory illness is one of the most common smoking-related consequences. Chronic obstructive pulmonary disease (COPD) is one respiratory illness that includes chronic bronchitis, emphysema and other significant comorbidities (Agusti, 2005; GOLD, 2010; van Weel & Schellevis, 2006). An estimated 90% of all COPD deaths in the U.S. are attributable to smoking, and smoking cessation is identified as the single most effective intervention to reduce the incidence and progression of COPD (NCCCC, 2004; GOLD, 2010; Mannino et al., 2003; USDHHS, 1984, 2004). Two studies have been conducted with COPD-diagnosed smokers (Crowley et al., 1991, 1995). These involved lottery tickets as the incentives, daily study visits, moderate incentive magnitudes (range: 7–140 tickets/week) and an adaptive reinforcement schedule dependent upon smoking abstinence. Both studies produced significant treatment effects, providing support for the efficacy of incentives in promoting abstinence in this challenging group of smokers.

Other special smoker populations

Incentives have been used to promote smoking abstinence among other special subgroups of smokers at particularly-elevated risk for specific health implications, including patients with serious mental illness (e.g., Gallagher et al., 2007; Kollins et al., 2010; Roll et al., 1998; Tidey et al., 2002, 2011) and pregnant women (e.g., Donatelle et al., 2000, 2004; Gadowski et al., 2011; Heil et al., 2008; Higgins et al., 2004, 2010; Ker et al., 1996). Detailed information on the use of incentives for smoking cessation with these important groups is covered elsewhere in this Special Issue.

Parameters of Effective Incentive Interventions

Our second aim is to provide the reader with an understanding of the procedural details that are central to developing and implementing an effective incentive program for smoking cessation.

Biochemical monitoring

There are two common approaches to monitoring recent smoking: measuring breath carbon monoxide (CO) levels and measuring cotinine levels found in urine, plasma or saliva. Breath CO levels are typically measured using hand-held meters, which are simple to use and require little technical training. CO is generally considered the best way to verify smoking abstinence during the initial days of cessation (Jarvis et al., 1987). As the elimination half-life of CO averages about 4 hrs, abstaining smokers can achieve a level in the non-smoker range within 12–24 hrs (SRNT Subcommittee on Biochemical Verification, 2002). Thus, breath CO monitoring can provide a sensitive method for detecting and reinforcing abstinence in the early days following a quit attempt when relapse risk is at its highest. In designing a treatment, it is important to choose a CO cutoff that is low enough to detect low rates of ongoing smoking but not so low that second-hand smoke or another environmental source of CO create a false-positive reading. Recent studies suggest that cutoffs of 3–6 ppm provide an appropriate level of sensitivity (Higgins et al., 2004, 2007; Javors et al., 2005; Middleton & Morice, 2000; SRNT Subcommittee on Biochemical Verification, 2002). When breath CO is used as the primary measure, the schedule of monitoring also becomes important. Given the short elimination half-life, light smokers can rapidly achieve a negative CO within several hours of their last cigarette. Thus, interventions need to include at least

daily monitoring in order to be confident of continuous abstinence. Even with daily monitoring, smokers may be able to engage in low levels of smoking that go undetected (Javors et al., 2005). As a result, some incentive studies have required CO monitoring to take place multiple times per day (e.g., Alessi et al., 2004; Heil et al., 2003).

Cotinine is a metabolite of nicotine that has a half-life of approximately 20 hours and is an especially sensitive biomarker for verifying smoking status (Benowitz, 1996; Jarvis et al., 1987; Rebagliato, 2002). Cotinine testing requires several continuous days of abstinence for smokers to achieve levels in the non-smoker range (SRNT Subcommittee on Biochemical Verification, 2002). Levels can be obtained from a range of bodily fluids (e.g., urine, plasma, saliva) and are typically analyzed using enzyme immunoassay testing (EMIT) or gas chromatography (GC). More recently, semi-quantitative test strips (e.g., NicAlert), which require no specialized equipment or training, have been demonstrated reliable for measuring cotinine (Gaalema et al., 2011). This approach may provide a cost- and time-sensitive alternative to EMIT or GC. An advantage of cotinine is that a monitoring frequency of 2–3 times per week should be sufficient to detect recent smoking. However, because of its relatively long half-life, basing incentive delivery on cotinine during the early days of a quit attempt can be problematic. For example, an individual smoking 20 cigarettes/day would need approximately 5 days to meet the commonly-used cutoff of 80 ng/ml, which would significantly delay the first opportunity to reward this early abstinence (Higgins et al., 2007; SRNT Subcommittee on Biochemical Verification, 2002). Considerations for choosing an appropriate cotinine cutoff are similar to those outlined above for CO (e.g., balancing risks of both sensitivity and specificity). Currently, there are no clear published guidelines about the sensitivity of different cotinine cutoffs, though a urinary cutoff of 50 ng/ml is generally recommended when using GC to classify smoking status in the general population of smokers (SRNT Subcommittee on Biochemical Verification, 2002). A final consideration is that other sources of nicotine, such as nicotine replacement therapies, will elevate cotinine levels and confound testing. This can be circumvented by using non-nicotine (e.g., varenicline, bupropion) rather than nicotine-containing medications. Overall, considering the above issues, an effective intervention might strategically combine both methods in order to maximize the opportunity to detect and reinforce smoking abstinence. For example, breath CO could be used during the initial days of the cessation effort, followed by less frequent monitoring using urinary cotinine later in the intervention (Dunn et al., 2008, 2010; Heil et al., 2008; Higgins et al., 2004). This procedure maximizes confidence that the person is not engaging in low levels of undetected smoking while minimizing the chance that early efforts at abstinence go unrewarded.

Incentive magnitude

A consistent finding in the incentive literature is that larger-magnitude incentives are more effective than smaller magnitudes (Lussier et al., 2006). In an early study, for example, Stitzer and Bigelow (1983) directly examined the effects of payment amount on the reduction of breath CO levels using a between-groups design in which participants were required to reduce their CO level to half their baseline level to earn an incentive. They found that success at meeting the CO criterion increased as the payment amount increased. These results have been replicated in subsequent studies (Correia & Benson, 2006; Lamb et al., 2004b; Stitzer & Bigelow, 1984). Overall, there is an orderly relationship between the amount of the incentive and amount of smoking abstinence produced and this is consistent with the larger literature on incentives and illicit drug use (e.g., Silverman et al., 1999).

Schedule of incentive delivery

Another important feature of an effective treatment is the schedule used for delivering incentives. Escalating payment schedules, for example, reward an individual for achieving

continuous abstinence by increasing the value of the incentives earned with each consecutive negative (Higgins et al., 1991). Rather than promoting only brief durations of abstinence, they are specifically designed to reinforce the continuous periods of sustained abstinence that are important for longer-term success. To further promote continuous abstinence, they often include a reset component wherein voucher values following an instance of drug use are reset back to the initial value. In studies directly comparing escalating to fixed payment schedules, escalating schedules with a reset contingency are more effective in promoting longer durations of abstinence than fixed conditions (Roll & Higgins, 2000; Roll et al., 1996). Indeed, escalating payments are now a standard feature of many incentive programs for drug abuse (e.g., Dunn et al., 2008, 2010; Heil et al., 2008; Higgins et al., 1993; Shoptaw et al., 2002; Silverman et al., 1996).

Challenges

While three decades of science have demonstrated the efficacy of incentives for smoking, barriers to their widespread adoption have included their perceived cost, complexity and staff burden (Ledgerwood, 2008; Stitzer & Kellogg, 2008). In this final section we discuss some of the challenges encountered thus far, as well as efforts taken to surmount them.

Cost

One commonly-cited challenge is the perceived cost of incentive treatments. There are a variety of potential solutions to help defray or minimize these costs. As discussed above, capitalizing on technology may help to reduce some of the costs of implementation (Dallery & Raiff, 2011). Donations could be solicited from businesses, health care groups and foundations to help cover the incentives themselves (Amass & Kamien, 2004, 2008; Donatelle et al., 2000). While monetary incentives are among the most highly valued rewards (Amass et al., 1996; Roll et al., 2005), one also can consider using other naturally-occurring, often non-monetary forms of reinforcement to promote positive behavior change in challenging clinical populations. Methadone clinics have for decades effectively provided access to clinic privileges (e.g., methadone take-home doses, scheduling flexibility) contingent upon the patient's demonstration of drug abstinence or compliance with treatment (Stitzer et al., 1977, 1986). Further, considering particularly high smoking rates and poor treatment response among disadvantaged individuals (Graham et al., 2007; Higgins & Chilcoat, 2009), there is potential for creatively using Medicaid or other funds as incentives for changes in smoking or other health-related behaviors that increase risk for chronic disease. Indeed, incentive-based policies for a range of health behaviors are being increasingly adopted by health maintenance organizations and policymakers in the U.S. and internationally (Higgins, 2010; Pear, 2009; Rosenberg, 2008). Finally, other creative approaches for mitigating incentive costs include fee rebates, deposit contracting and delivering incentives on an intermittent or random schedule (Amass & Kamien, 2008; Cahill & Perera, 2008, 2011; Elliot & Tighe, 1968; Kaper et al., 2005; Knealing et al., 2008; Paxton, 1980, 1981, 1983; Petry & Alessi, 2008; Winett, 1973). For example, deposit contracting typically requires that the patient make an initial monetary deposit which can then be recouped based on smoking abstinence. While most of these studies have not used a research design wherein treatment effects could be attributed to the incentive intervention, results do suggest that this approach may offer a cost-effective way to deliver incentives for smoking abstinence (Amass & Kamien, 2008; Dallery et al., 2008; Elliot & Tighe, 1968; Lando, 1977; Paxton 1980, 1981, 1983; Spring et al., 1978; Winett, 1973). However, one note of caution is to remember that reward magnitude is an important determinant of the effectiveness of incentive interventions and that at some point reductions in the amount of the reward could inadvertently dilute the efficacy of the intervention (Dallery et al., 2001; Lussier et al., 2006; Petry et al., 2004; Silverman et al., 1999). Worth noting is that incentive interventions for smoking, as well as for other behaviors, actually represent a relatively cost-

effective approach. Incentive costs are generally proportional to the degree of behavior change they produce, with costs increasing when the intervention produces the desired results (which are accompanied by their own health-related improvements and cost savings) and decreasing when the individual fails to respond to treatment. Considering that tobacco use results in \$96 billion in health care costs each year (American Cancer Society, 2011), cost and benefit assessments of incentive approaches for smoking cessation are favorable (see contribution by Dr. Sindelar in this Special Issue).

Sustaining abstinence after the intervention

Another challenge is whether incentive-produced abstinence can be sustained after the intervention itself is discontinued. There is some evidence that incentive programs can have lasting effects on smoking following treatment discontinuation (Heil et al., 2008; Higgins et al., 2004; Volpp et al., 2009). That said, as with other chronic health conditions (e.g., diabetes, hypertension), relapse to smoking may occur post-treatment and longer-term or ongoing support may be necessary to sustain treatment effects. As the data suggest that the key to producing longer-term success is increasing during-treatment abstinence (Higgins et al., 2007; Yoon et al., 2009), efforts to further improve rates of initial abstinence are reasonable ways to drive up post-treatment success (e.g., increase incentive magnitude, increase frequency of monitoring, add pharmacotherapy). A second possibility is the use of incentive programs that can be in place for an extended period. Examples of these already exist for using incentives to treat illicit drug use (e.g., Silverman et al., 1996, 1999, 2007) and it is not inconceivable to do the same for smoking. Web-based or other technology platforms could be also used to support the long-term use of incentives for smoking abstinence. Finally, a hybrid approach could include an intensive incentive intervention for the initial months following cessation, followed by a carefully-constructed maintenance phase involving less frequent or perhaps randomly-scheduled biochemical monitoring and high-magnitude rewards for abstinence.

Dissemination

Efforts to extend incentives into widespread practice have also been slow, though the studies by Volpp and colleagues (2006, 2009) demonstrate the significant potential for implementing this approach on a larger scale. The continued use of innovative technology will likely be important for supporting the dissemination of incentives for smoking and other health behaviors, as is evidenced by the exciting work to move incentives to internet-based platforms for smoking (Dallery & Raiff, 2011). As noted above, health maintenance organizations and state and federal policymakers in the U.S. and elsewhere are beginning to incorporate incentive-based policies for a range of health behaviors (e.g., Higgins, 2010; Pear, 2009; Rosenberg, 2008), which will further promote the use of this approach on a large scale. Overall, evidence of the widespread dissemination of incentives for smoking and other behaviors is building.

Conclusion

Tobacco use remains a significant public health problem. Despite the availability of numerous treatments (Fiore et al., 2008), most patients relapse and additional efficacious interventions are sorely needed. Incentives are effective in promoting smoking abstinence across the general population of smokers as well as substance abusers, adolescents, patients with pulmonary disease, patients with serious mental illness and other challenging subgroups. To develop and implement an effective incentive treatment for smoking, special attention should be paid to biochemical verification of smoking status, incentive magnitude and the schedule of incentive delivery. Challenges thus far to the large-scale use of incentives have included perceived cost, the need to sustain the abstinence following

discontinuation of incentives, and the need for innovative ways to support implement incentive treatments on a larger scale. Overall, continued efforts are warranted to further develop and disseminate incentive-based treatments for smoking cessation.

Highlights

- We review the published studies evaluating financial incentives for smoking cessation.
- Parameters that influence the efficacy of incentive treatments are also discussed.
- Incentives are efficacious for smoking cessation across diverse groups of smokers.
- Biochemical verification, incentive magnitude and schedule can influence efficacy.
- Careful dissemination of incentives for smoking on a large scale is a key next step.

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