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Therapy for Specific Problems: Youth Tobacco Cessation

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Abstract

Cigarette smoking is the leading cause of premature morbidity and mortality in the United States. The majority of children smoke their first cigarette in early adolescence, and many older teens have well-established dependence on nicotine. Efforts to promote and support smoking cessation among these youth smokers are critical. The available experimental studies of youth cessation interventions find that behavioral interventions increase the chances of youth smokers achieving successful cessation. Currently there is insufficient evidence for the effectiveness of pharmacological treatments with youth smokers. Many innovative studies have been compromised by challenges in recruiting sufficient numbers of youth, obtaining approval for waivers of parental consent, and high attrition in longitudinal studies. Key areas for future work include bridging the fields of adolescent development and treatment design, matching treatments to developmental trajectories of smoking behavior, better understanding treatment processes and treatment moderators, and building demand for evidence-based cessation treatments.

Keywords

adolescents; smoking; prevalence; treatment; dependence; intervention

Introduction

Why Is Youth Tobacco-Use Cessation an Important Problem for Psychology?

Nicotine-related disorders are among the deadliest diagnoses in the *Diagnostic and Statistical Manual of Mental Disorders, Fourth Edition* (Am. Psychiatr. Assoc. 2000). Cigarette smoking, the most common form of nicotine use, is the leading cause of premature morbidity and mortality in the United States (Cent. Dis. Control Prev. 2007). Smoking kills more people than AIDS, alcohol, car accidents, illegal drugs, murders, and suicides combined (Lindblom 2008). The Centers for Disease Control and Prevention (CDC) estimates that cigarette smoking is responsible for approximately one of every five deaths annually (Cent. Dis. Control Prev. 2005), and about one-third of youth smokers will die prematurely from smoking-related diseases (Cent. Dis. Control Prev. 1996). More than six million adolescents alive today will ultimately die from smoking unless smoking rates decline. With national data indicating that almost 90% of adult smokers begin while in their adolescent years (Campaign for Tobacco Free Kids 2008), understanding patterns and prevalence of youth smoking and quitting behaviors is critical.

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From a psychological perspective, tobacco use and dependence is a chronic, relapsing disease that begins early in life. Adolescence is a time of heightened vulnerability for both the initiation of tobacco use (U.S. Dep. Health Hum. Serv. 1994) and the development of nicotine dependence (Jamner et al. 2003). Dr. David Kessler, former Food and Drug Administration (FDA) Commissioner, aptly stated, “It is easy to think of smoking as an adult problem. It is adults who die from tobacco-related diseases…” However, “a person who hasn't started smoking by age 19 is unlikely to ever become a smoker. Nicotine addiction begins when most tobacco users are teen-agers, so let's call this what it really is: a pediatric disease” (Hilts 1995).

With the majority of children smoking their first cigarette in early adolescence, many older teens have well-established dependence on nicotine. Efforts to promote and support smoking cessation among these new generations of smokers are critical. The present review represents the first comprehensive summary of research in adolescent tobacco-cessation treatment in the *Annual Review of Psychology*. This review builds on previous syntheses of the field (Backinger et al. 2003, Mermelstein 2003, Pbert et al. 2006, Prokhorov et al. 2003), systematic reviews (Garrison et al. 2003, McDonald et al. 2003, Sussman 2002), and meta-analyses (Grimshaw & Stanton 2006, Sussman et al. 2006). We address youth cessation from several perspectives. First, we examine the question, “who are youth tobacco users?” with respect to their prevalence and patterns of smoking and tobacco use, neurocognitive development, psychosocial development, and nicotine addiction. The second section reviews the state of the art in youth tobacco cessation, drawing on expert summaries and meta-analyses along with recently published results from treatment outcome studies. Our review is limited to treatments delivered to individual smokers, although we acknowledge that policy-level interventions, including product taxes, clean indoor air legislation, and purchase, use, and possession laws, also influence youth tobacco use (e.g., DiFranza et al. 2006, Jason et al. 2007, Pierce 2007). Following the evidence review, we examine the inherent challenges in building the evidence base for youth cessation treatment, including recruitment and retention in studies and human subjects' protections. The article concludes with a view to future directions in youth cessation treatment research.

Who are Youth Tobacco Users?

Prevalence and Patterns of Youth Smoking

Cigarette use by youth in the United States has been measured through national surveys since the early 1970s. Two primary sources of information on youth substance use are the Monitoring the Future study (1975–2007), a school-based survey of adolescents in the United States, and the National Survey on Drug Use and Health (formerly the National Household Surveys on Drug Abuse), a household-based survey of the civilian, noninstitutionalized population of the United States aged 12 years old or older. The two surveys have some key methodological differences, such as interview setting (school versus home), sampling methods, and assessing school dropouts. The Monitoring the Future survey, with its school-based administration format, may underrepresent smoking, given the well-documented association between smoking and school drop-out (U.S. Dep. Health Hum. Serv. 1994). Both surveys are reliable sources of substance-use prevalence for youth in the United States (Gfroerer et al. 1997) and, importantly, both show similar historical trends in prevalence rates. Two additional biennial school-based surveys began measuring national- and state-level youth health risk behaviors and tobacco-use behaviors in the 1990s: the Youth Risk Behavior Surveillance System and the National Youth Tobacco Survey. Smoking-cessation measures that complement data from Monitoring the Future study and the National Survey on Drug Use and Health are reported here.

Trends in cigarette smoking—Prevalence rates of cigarette smoking among twelfth-grade students peaked in the mid-1970s, with current smoking (use in the past 30 days) reaching 39% in 1976. Through 1977, the rate of daily smoking was maintained at 29%, with 19% of twelfth graders smoking half of a pack or more per day. During the years that followed, prevalence rates declined substantially, with current and daily smoking among high school seniors dropping almost 10 percentage points by 1981 (29% and 20%, respectively; Johnston et al. 2007a). After remaining relatively flat throughout the 1980s, the smoking prevalence among all youth in the United States began to rise through the late 1990s. Many economic and social factors are likely responsible for this increase in youth smoking prevalence throughout the 1990s, including the decrease in cigarette prices and the use of youth-targeted advertising and marketing by tobacco companies (Nelson et al. 1995).

In the wake of the 1998 Master Settlement Agreement between the Attorneys General and the major tobacco companies, and the resulting efforts and influx of monies from the settlement to fund research and community programs to address the health effects of smoking (e.g., American Legacy Foundation), the prevalence of youth smoking began again to decline steadily through 2006 (Johnston et al. 2007a). In 2007, however, only eighth-grade students showed continued change from the previous year in current and daily smoking (from 8.7% in 2006 to 7.1% in 2007, and 4.0% to 3.0%, respectively). Although prevalence rates are lower than ever, more than one-fifth of high school seniors in the United States were current smokers in 2007, with more than half of them reporting daily smoking (Monitoring the Future 2007).

Smoking patterns among subgroups of youth—Based on 2006 national estimates, 2.6 million (10.4%) youth aged 12 to 17 were current smokers (Substance Abuse and Mental Health Services Admin. 2007). Among high school seniors who reported smoking in the past month (21.6%), 56% were daily smokers and 27% smoked half of a pack or more every day (Johnston et al. 2007a). The rates of daily smoking were similar for males and females in twelfth grade (12.0% and 11.8%, respectively; Johnston et al. 2007a). There are, however, substantial differences in smoking prevalence among racial/ethnic groups. In comparison with black and Hispanic high school seniors, white youth have two to three times the rates of daily smoking (5.7% black, 7.0% Hispanic, 15.3% white; Johnston et al. 2007a), and nearly double the rates of current smoking among 12- to 17-year-olds (6.0% black, 8.2% Hispanic, 12.4% white; Substance Abuse and Mental Health Services Admin. 2007). Educational aspirations also remain one of the strongest discriminators of smoking among adolescents. Smoking prevalence among twelfth graders who had no plans to either attend or complete four years of college was 32.4% in 2007, compared to 19.0% for twelfth graders who planned to complete four years of college (Monitoring the Future 2007).

As the prevalence of smoking among adolescents has declined over time, its social meaning may have changed, and current adolescent smokers may be more “hard core” than were adolescents who smoked in previous decades (Chassin et al. 2007a). Chassin et al. (2007a) tested this “hardening” hypothesis among two cohorts of adolescents, one from 1980, and the other from 2001, and found that middle school adolescents who smoked in 2001 showed more “deviance proneness” than their counterparts in 1980. In addition, Chassin and colleagues (2007a) found that youth who smoked in 2001 reported smoking more cigarettes per day than did adolescent smokers in 1980, providing further support for the notion of the hardening of the adolescent smoking population. These findings also bolster the suggestion that today's youth who smoke may be more dependent on nicotine than were previous cohorts and, as a result of both increased dependence and a combination of deviant-prone risk factors, may have more difficulty stopping smoking.

Despite this potential hardening of adolescent smokers, the majority of adolescents who smoke cigarettes want to quit. Available national data indicate that half of the current smokers in

middle school reported wanting to stop smoking, and 55% had tried to quit in the past 12 months (Cent. Dis. Control Prev. 2006b,c). Almost two-thirds (62.1%) of the high school students who reported current smoking wanted to quit, and more than half reported having tried to quit smoking at least once in the previous year (Cent. Dis. Control Prev. 2006c). Although cessation attempts were reported similarly across all subgroups (i.e., gender, race/ethnicity) of current smokers, Hispanic high school students were significantly less likely to want to quit, as compared to white and black students (Cent. Dis. Control Prev. 2006c).

Although cigarette smoking accounts for the vast majority of youth tobacco use and has been the primary focus of the limited treatment development and research that exists, the use of smokeless tobacco is also problematic among youth, especially among certain subgroups. In 2006, the prevalence rate of current smokeless tobacco use (used in the past 30 days) among high school seniors was 6.1%, a reduction by almost half from when it was first reported at 11.5% in 1986 (Johnston et al. 2007a). Smokeless tobacco is used predominantly by males (11.0% versus 1.5% females) who are white (8.8% versus 3.8% Hispanic and 0.5% black) and live in nonmetropolitan statistical areas (MSAs) (24.7% versus large MSA 11.6% and other MSA 13.1%) communities in the North Central or South regions of the United States (19.3% and 17.0%, respectively, versus 11.9% Northeast and 10.3% West; Johnston et al. 2007a). An MSA is a geographic entity defined by the U.S. Office of Management and Budget as one or more contiguous counties containing a core urban area with a population of 50,000 or more. Smokeless tobacco use has a range of negative health consequences, both similar to and different from those of cigarette smoking, but also has some unique determinants to its use and implications for interventions. Our review focuses primarily on interventions for cigarette smoking, not to diminish the importance of the smokeless tobacco-use problem among adolescents, but rather as a reflection of the difference between the behavioral patterns of use and resulting interventions.

Beyond Experimentation: The Development of Smoking Behavior

Smoking among adolescents is not an “all or nothing” or unitary phenomenon. Rather, adolescents progress through stages of smoking, ranging from initial trials of smoking to more frequent but irregular use, to more regular use and dependence (Mayhew et al. 2000). As newer data analytic techniques have come into use (e.g., latent variable growth mixture modeling), researchers have started to identify trajectories of smoking behavior among adolescents that might help to describe better the heterogeneity of longitudinal patterns of use, with an eye toward identifying factors that discriminate among these trajectories (e.g., Chassin et al. 2000, Colder et al. 2001, Stanton et al. 2004). Of particular importance is identifying factors that distinguish between youth who experiment with smoking and desist after relatively few trials from youth who experiment, rapidly escalate, and become dependent smokers. Cessation interventions may become more powerful if researchers could better tailor interventions to the unique characteristics of youth in each of these distinct trajectories of use, or intervene in the window of opportunity between early trials and dependence. Early intervention is important not only for preventing the numerous, significant health problems that result from cigarette smoking and occur even in adolescence (U.S. Dep. Health Hum. Serv. 1994), but also to help reduce the risk that cigarette smoking conveys for the development of future substance use (Lewinsohn et al. 1999) and other psychological disorders (e.g., depression) as adolescents move into young adulthood (Brown et al. 1996, Kandel et al. 1986).

Nicotine Dependence in Youth

Although adolescent smokers are interested in stopping smoking, they have difficulty in achieving and maintaining abstinence (Choi et al. 2002), one of the key indicators of nicotine dependence (Am. Psychiatr. Assoc. 2000). Evidence is increasing that adolescent smokers exhibit physiological, psychological, and behavioral features of nicotine dependence (e.g.,

Colby et al. 2000, Prokhorov et al. 2005), yet there is still much debate in the literature about the dimensionality of nicotine dependence in adolescents and how dependence develops and progresses (Shadel et al. 2000). Current conceptualizations of nicotine dependence in adults suggest that dependence is a syndrome consisting of several core features, including craving, compulsion to smoke, and withdrawal (Shadel et al. 2000, Shiffman et al. 2004). This syndrome conceptualization has been adopted for youth as well (Shadel et al. 2000). Measures of nicotine dependence for adolescents have frequently assessed only limited aspects of dependence, however. For example, the modified version of the Fagerstrom Tolerance Questionnaire (Prokhorov et al. 1996, 1998) is a seven-item scale that assesses primarily behavioral features of dependence, such as how soon after waking the adolescent smokes a cigarette or whether one has difficulty refraining from smoking in places where smoking is forbidden. Other scales, such as the Hooked on Nicotine Checklist (DiFranza et al. 2002; O'Loughlin et al. 2002a, 2003), may capture more features of dependence, with items that tap into feelings of cravings, feeling like one is addicted to tobacco, or withdrawal symptoms, although the scale is still conceptualized as unidimensional. A multidimensional measure of nicotine dependence, the Nicotine Dependence Syndrome Scale (Shiffman et al. 2004), has also been modified for adolescents (Clark et al. 2005, Nichter et al. 2002), with good psychometric properties. Factors assessed by this scale include tolerance, drive, priority, and continuity of smoking. However, whether these measures predict cessation has been less well studied, and particularly whether they predict cessation above and beyond smoking rate. More frequent and higher amounts of smoking is one of the more consistent and stronger factors associated with a failure to quit among adolescents (e.g., Sargent et al. 1998, Sussman et al. 1998, Tucker et al. 2002, Zhu et al. 1999).

Biological, Behavioral, and Psychological Determinants of Youth Initiation and Cessation

That nicotine addiction can begin in adolescence has long been apparent to the tobacco industry, as reflected in their aggressive marketing to youth (Pierce 2007). With a lifetime prevalence of cigarette use at nearly 50% by twelfth grade, one could view tobacco use as a manifestation of adolescent development (Monitoring the Future 2007). However, there is good consensus among researchers that cigarette smoking among adolescents is an addictive behavior and not just one of several “problem behaviors” that might appear during adolescence. The tobacco industry, through pricing and marketing strategies, has been remarkably successful at positioning tobacco use at the intersection of adolescent psychosocial development such that youth may see tobacco use as a perfect antidote to the normal emotional and social challenges of adolescence. Cigarettes are available in homes, in local stores, have the least amount of stigma attached to their use in comparison with other illegal substances, and are a means of social bonding. In addition, the harmful effects of tobacco use are far enough into the future that youth can rationalize their current use by assuming they will stop before experiencing any serious health problems. Importantly, too, the physiological effects of nicotine can mitigate negative affect and some of the stress and storm of adolescence.

Cigarette smoking among adolescents is a complex and multidetermined behavior, controlled by a combination of interacting biological, psychosocial, and environmental influences. Numerous age-related processes come into play during adolescence that increase the risk for the development of smoking and dependence, including neuronal sensitivity to nicotine (Belluzzi et al. 2004, 2005; Cao et al. 2007), the effects of nicotine on continuing brain development (Leslie et al. 2004), cognitive-emotional responses to smoking cues and tobacco advertisements (Tercyak et al. 2002), affective and physiological stress reactivity, and an increase in emotionality, risk-taking, and impulsivity (Steinberg 2004). Along with these biobehavioral, normative changes, adolescents also experience multiple transitional events and developmental challenges, placing youth at increased risk for emotional and behavioral problems (Steinberg 2004, Steinberg & Morris 2001). This confluence of interacting and often

competing factors comes into play in important ways in understanding not only the development of nicotine dependence in youth, but also the difficulties adolescents have in stopping smoking and the challenges that researchers face in designing interventions that match the developmental stage and unique characteristics of adolescents.

Smoking cessation interventions for adolescents need to consider the range of behavioral and psychological determinants of smoking among adolescents, with special consideration given to factors that maintain smoking or that might promote or hinder cessation. A great deal is known about factors that predict the early stages of cigarette use among adolescents (e.g., Conrad et al. 1992, U.S. Dep. Health Hum. Serv. 1994), but much less is known about predicting progression from early use to nicotine dependence (Turner et al. 2004) or about predictors of cessation. Tobacco use among adolescents does not occur in a vacuum, and a variety of individual and situational factors influence adolescents' initial tobacco use, continued use, and eventual dependence. Three primary streams of influence affect adolescent tobacco use: individual or person-level variables, immediate social or normative influences, and broader environmental and cultural influences (Turner et al. 2004). We highlight here only a few of the key factors that may be important to consider in developing cessation interventions for adolescents.

Individual psychosocial and behavioral influences on smoking—Individual influence variables include demographic factors such as gender and ethnicity, with substantial race/ethnic differences in both prevalence rates, as noted above (Johnston et al. 2007a), and reasons for smoking or not smoking (Mermelstein 1999). Genetics also account for a substantial portion of smoking behavior, with some researchers estimating that genetic effects account for 56% of the variance in smoking initiation and 70% of the variance in nicotine dependence (Sullivan & Kendler 1999). Adolescents' physiological responses to smoking and nicotine are yet another potentially important predictor of escalation (Eissenberg & Balster 2000). Subjective affective and physiological responses to early trials of smoking may be associated with progression from initial use to more regular smoking (Mermelstein et al. 2007).

Cigarette smoking among adolescents is also strongly associated with a variety of comorbidities and problem behaviors, including a well-documented link with externalizing disorders (McMahon 1999). Although cigarette smoking among adolescents is also associated with attention deficit hyperactivity disorder (ADHD), it is not clear whether this association is independent of the frequently co-occurring link with conduct disorder (Baker et al. 2004). Whalen and colleagues (2003) have hypothesized that smoking among adolescents with ADHD may serve an important function by improving attentional and self-regulatory competence and helping to modulate affect. The presence of ADHD may present notable challenges to cessation interventions both in terms of skills training and in terms of addressing the potential behavioral and cognitive problems that may arise for adolescents as they try to stop smoking.

Perhaps one of the most commonly reported relationships with adolescent smoking is the one with negative affect or depressive symptoms. Theoretical, empirical, and anecdotal evidence suggest a compelling link between mood and smoking among adolescents. Like adults, adolescent smokers report smoking in response to stress and as a way to boost their moods or to control anger (Chassin et al. 2007b, Kassel et al. 2003, Mermelstein 1999). Indeed, one of the most commonly proposed hypotheses about the mood-smoking relationship, for both adults and adolescents, is that individuals smoke as a form of self-medication, hoping to relieve their negative affect (Carmody 1989, Khantzian 1997, Lerman et al. 1996, Wills & Cleary 1995). Thus, negative affect or depressive symptoms may prospectively predict smoking or increases in smoking level, and persistently high levels of smoking may also predict increases in depressive symptoms among adolescents (Windle & Windle 2001). Negative affect, such as

perceived stress (Sussman et al. 1998) and depressive symptoms (Zhu et al. 1999), have also predicted failure to quit smoking for adolescents.

Nicotine is well accepted as a potentially powerful mood regulator in terms of its effects on the brain's neural circuits (Brody 2006, Lerman et al. 1996, Pomerleau & Pomerleau 1984, Pontieri et al. 1996). For adolescents, who are in a critical phase of brain development and refinement of emotional regulation, the effects of nicotine on mood regulation and brain circuitry may be especially potent (Jamner et al. 2003).

There is also growing evidence for an association between affect dysregulation and cigarette use in adolescence. Wills and colleagues (2006) found that poor emotional control was positively related to the frequency of cigarette use in adolescents as well as to other substance use. Deficient emotional regulation has also predicted progression from experimentation to regular cigarette smoking (Novak & Clayton 2001). These relationships between smoking and affect regulation among adolescents are compelling when one considers the challenges of stopping smoking on top of the normative mood fluctuations in adolescence (Arnett 1999).

Interpersonal influences on smoking—Social influences also remain one of the more powerful predictors of adolescent smoking, for both initiation and progression (Kobus 2003). Adolescents are more likely to smoke if their close friends smoke (Chassin et al. 1984, Kobus 2003). Parents also exert substantial influence on adolescents' smoking behavior, with much evidence supporting a link between parent smoking and progression to regular smoking among adolescents (Chassin et al. 1998a,b). Interpersonal influences may be particularly important for adolescents in stopping smoking. Having parents who smoke may hinder cessation among adolescents (Chassin et al. 1996, Zhu et al. 1999), as does having peers who smoke (Ticker et al. 2002). Stanton et al. (2006) found that one of the strongest predictors of cessation among a large sample of Australian high school students was whether adolescents had actively engaged other students in trying to quit as well, which suggests one strategy for future interventions to help counter the negative influence of smoking peers.

Environmental influences on smoking—The broad social and cultural environments play a substantial role in adolescents' smoking progression and include such factors as tobacco advertising, marketing, and media influences, as well as no-smoking policies, restrictions on youth access to cigarettes, and prices of cigarette products. There is consistent evidence that higher cigarette prices discourage smoking initiation, decrease smoking rate, and encourage cessation (Liang et al. 2003), and that adolescents are more responsive to price than are adults (Chaloupka 1999). Compared with experimenters and lower-rate smokers, adolescents who are more frequent smokers appear particularly sensitive to price (Emery et al. 2001, Liang & Chaloupka 2002). Price effects may occur through a number of mediating mechanisms (Liang et al. 2003), but they may create an impetus for adolescents to consider cessation as well as create a broader social environment more supportive of cessation attempts.

Tobacco Use and Cessation in the Context of Neurocognitive Development

Cigarette smoking and smoking cessation among adolescents also need to be considered in the context of normative neurocognitive development in adolescence. Adolescence is a time of neurodevelopmental plasticity and change (Steinberg 2004, 2007), and changes in the structure and function of the brain during adolescence are likely to significantly affect behavior and psychological functioning (Spear 2000). The prefrontal regions of the brain (home of executive functions) show gradual change in structure and function during adolescence (Casey et al. 2000) and are not fully developed until later in young adulthood (Steinberg 2007). However, the more socioemotional neural network matures closer to puberty and may well drive much of adolescent decision making (Steinberg 2007). Thus, self-regulatory skills do not mature as

quickly as those that regulate reward mechanisms. Bechara (2005) has proposed a neurocognitive model for drug addiction that posits competition between an impulsive and a reflective neural system. This imbalance is normative in adolescents, and Steinberg (2007) summarizes multiple lines of evidence for the relative lack of an effective cognitive control system in adolescence based on these competing, but interactive, neural systems.

Are adolescents developmentally competent to engage in the complex array of coping skills (including planning, anticipating high-risk situations, and problem solving) that are required to sustain abstinence from smoking? Steinberg (2007) maintains that although logical reasoning abilities are mostly developed by age 15, the immature psychosocial capacities of adolescents (including delay of gratification, impulse control, emotional regulation, and resistance to peer influence) may undermine efforts or plans that are needed to resist risky behaviors. Steinberg (2007) further suggests that when adolescents are emotionally aroused, the cognitive control network is not yet strong enough to exert control. Thus, when one considers the emotional overlay of withdrawal symptoms following smoking cessation (which include increases in anger, irritability, difficulties concentrating, and increases in dysphoria) combined with this relatively weak cognitive control capacity, the risk for relapse or failure to quit smoking becomes great. Considering these neurocognitive developmental factors in adolescents, competent engagement in coping skills and appropriate decision making is possible, but only when conditions are optimal (Steinberg 2007). Optimal conditions include low peer and other social influences, for example. Challenges for cessation interventions for adolescents thus include helping adolescents to maintain emotional control and reducing deleterious social influences.

Understanding Nicotine Addiction in Youth: Challenges for Cessation

Biological, behavioral, and social factors converge during adolescence to promote smoking and the development of dependence and, potentially, to work against effective self-regulation and smoking cessation. A variety of liabilities, including both normative neurobiological developmental factors (e.g., immature frontal-limbic connections, immature frontal lobe development) and social influences, in combination with both normative and nonnormative patterns of emotional dysregulation in adolescence, present challenges for researchers to consider in developing interventions. These developmental considerations suggest that interventions need to take into account the appropriate cognitive and emotional level of the adolescent and adjust coping skill recommendations to match these abilities. In addition, many of the challenges faced by adults when trying to stop smoking, including withdrawal distress and social adjustments that need to be made in dealing with friends and families who smoke, are heightened for adolescents because of their relative lack of control over their environments compared to adults, their increased emotional lability, and the relative importance of social and interpersonal adjustments during this developmental period. Thus, interventions for adolescent smokers may need to be both more comprehensive in their consideration of factors that influence successful cessation as well as presented in an appealing, understandable, and accessible manner for youth.

Opportunities and Challenges for Youth Tobacco-Cessation Interventions

As described in previous sections, a sizeable proportion of youth smokers, even infrequent smokers, exhibit signs of nicotine addiction, and most are likely to continue smoking into adulthood. That youth smoking persists into adulthood does not reflect a lack of motivation to quit; the majority of youth smokers want to quit and make serious attempts to do so (Marshall et al. 2006). Similar to adults, most young smokers attempt to quit without using available behavioral and pharmacological treatments (Cent. Dis. Control Prev. 2006a, Curry et al. 2007b). Avast and robust evidence base for the effectiveness of behavioral and pharmacological interventions for adult smokers drives an imperative to encourage adults to

utilize evidence-based treatments when attempting to quit (Fiore et al. 2000). Is there a sufficient evidence base to take the same approach with youth smokers?

Although meager in comparison with the adult cessation treatment literature, there is a growing evidence base for youth cessation treatments. Published treatment outcome studies evaluating interventions for youth cessation date back to the mid-1970s (Thompson 1978), but the cumulative evidence base still includes fewer than 50 experimental studies and even fewer randomized controlled trials. However, there are now two published meta-analyses of youth cessation interventions that cover studies conducted through mid-2006 (Grimshaw & Stanton 2006, Sussman et al. 2006) as well as several systematic reviews (Garrison et al. 2003, McDonald et al. 2003, Sussman 2002). Also encouraging are 12 publications of experimental studies since the meta-analyses. This emergent research provides an appropriate base from which to inform youth cessation treatment theory, research, and practice.

Conceptual Underpinnings of Youth Cessation Interventions

With the exception of three published trials of pharmacotherapy, youth cessation treatments comprise behavioral programs most often offered in group formats in school settings. Most publications do not explicate a specific overarching conceptual framework, but that does not mean that the interventions lack conceptual guidance, and it is possible to classify conceptually the program components utilized in the behavioral treatments. The Cochrane Collaborative Review distinguished among studies that used the transtheoretical model of change, psychosocial interventions focused on motivational enhancement and behavioral management, and pharmacological interventions (Grimshaw & Stanton 2006). The review notes that several studies included aspects of all three intervention models. The transtheoretical ("stages-of-change") model describes a series of five stages of readiness for cessation, ranging from not even thinking about quitting to initiating cessation and achieving long-term abstinence. Each stage of change is associated with different cognitive and behavioral process (Prochaska et al. 1992). Sussman et al's (2006) meta-analysis articulated three nonoverlapping treatment theories: social influence, cognitive-behavioral, and motivational enhancement. Social influence models emphasize social interactions and peer relationships that can facilitate or undermine cessation efforts and ways to counter tobacco industry strategies that influence youth tobacco use. Motivational enhancement focuses on increasing salient reasons for youth to quit smoking and addresses youth concerns and ambivalence about tobacco-use cessation. Cognitive-behavioral treatment focuses primarily on learning coping skills and problem-solving strategies for understanding and disrupting patterns of tobacco use, dealing with tobacco-use cravings, resisting social pressures to use tobacco, and managing stressful situations.

Regardless of how the conceptual underpinnings are categorized, it is clear that the content of behavioral interventions targeting youth cessation mirrors the content of programs for adults (Curry et al. 2007a). A comprehensive review of theories underlying evidence-based behavioral treatment for tobacco-use cessation is beyond the scope of this review. The most commonly applied theoretical models in tobacco-cessation research include value expectancy theories, social cognitive theory, and the transtheoretical model (Curry et al. 2003, Glanz et al. 2002). It is not uncommon to draw on concepts from several theoretical perspectives when creating an overarching intervention model (Curry et al. 2008). In general, theoretical models informing behavioral interventions for tobacco-use cessation share two common themes: (*a*) individuals must be sufficiently motivated to attempt cessation; and (*b*) they must have, and perceive that they have, the requisite skills and supports to initiate and maintain cessation. Thus, behavioral interventions typically target smokers' motivation, self-efficacy, skills, and social support.

Two of the most common intervention paradigms that derive from these conceptual underpinnings are motivational interviewing (Miller & Rollnick 2002) and skills training (Elder et al. 1999). Together, they offer a range of strategies targeting perceptions of personal risk from tobacco use, outcome expectations for quitting or remaining a smoker, self-efficacy, coping and problem-solving abilities, and enlisting social support. Motivational interviewing offers concrete strategies for working with smokers to enhance motivation for quitting and resolve ambivalence. This is accomplished by helping individuals articulate both their concerns about and their reasons for quitting. According to Miller & Rollnick (2002), the active ingredients of motivational interviewing are providing feedback, enhancing personal responsibility, giving advice along with a menu of options, supporting self-efficacy, and providing a nonconfrontational and supportive context. Skills training is a commonly used cognitive-behavioral treatment approach. Unlike motivational interviewing, which is used to increase individuals' motivation or desire to quit, skills training is used with individuals who are actively working on cessation. The core components of skills training include (*a*) training to identify and cope with high-risk situations associated with tobacco use, (*b*) modifying cognitive expectancies and attributions associated with smoking, (*c*) teaching stress management skills, and (*d*) modifying general lifestyle activities (Elder et al. 1999).

Although these skills-training components are likely critical ingredients for cessation interventions, they need to consider the background self-regulation abilities of adolescents, given the youth's stage of neurocognitive development and social context. The cognitive skills required for successful behavior change include the ability to identify and self-monitor behavioral patterns, anticipate problem situations, develop and prepare plans for handling high-risk situations, and remember both the plan and the need to take action in the future (Mermelstein 2003). Consider as well the overlap of youth who smoke and have ADHD or other comorbidities, and the challenge becomes one for intervention developers to modify more traditional coping-skills training to meet the unique characteristics of adolescent smokers.

Promising Intervention Models and Channels

Overall treatment effectiveness—Meta-analysis of high-quality experimental studies provides the optimal synthesis of treatment effectiveness. The recently published Cochrane Collaborative Review, “Tobacco cessation interventions for young people” (Grimshaw & Stanton 2006), applied stringent eligibility criteria to identify 15 studies for review. A separate meta-analysis published by Sussman and colleagues (2006) used more lenient selection criteria and included 48 studies. Because of different inclusion and exclusion criteria and different categorizations of interventions, direct comparison of the two meta-analyses is not possible.

In the aggregate, compared with control conditions (randomized and nonrandomized), youth tobacco-cessation treatment significantly increased the likelihood of cessation. The Sussman et al. (2006) analysis reported a 2.9% absolute advantage in quitting and a 46% increase in the probability of quitting with treatment in comparison with no treatment. When analyzed separately, treatment approaches that were described as cognitive-behavioral, motivation enhancing, social influence, and the stages-of-change or transtheoretical model all had relatively higher quit rates in comparison with control conditions. Moreover, the review concluded that behavioral programs consisting of at least five sessions had relatively higher quit rates than did less-intensive programs.

With regard to medication, there was insufficient evidence for the effectiveness of pharmacological treatments with youth smokers. It is interesting to compare these general conclusions to those meta-analyses of adult cessation programming (e.g., Fiore et al. 2000). Findings are consistent in favor of cognitive-behavioral elements (e.g., problem solving, coping skills training) and multisession programs. Perplexing is the lack of support for the effectiveness of pharmacotherapy among youth smokers compared with the overwhelming

findings of effectiveness among adult smokers. This relatively lower effectiveness of pharmacotherapy for adolescents may be the result of differences between adolescents and adults in the pharmacokinetics of cessation medications, patterns of dependence, behavioral patterns of smoking, and the relative importance of social influence factors, compared to physical dependence factors and withdrawal, for adolescents. In comparison with adults, adolescents report much greater variability in smoking patterns (Mermelstein et al. 2002), a factor that might work against the more stable state of nicotine that is achieved by adult smokers and that is often better addressed by some pharmacotherapies (e.g., nicotine patch). Factors that typically predict success with pharmacotherapy for adults (e.g., number of cigarettes per day) also are not consistently predictive of success with nicotine-replacement therapy for youth (Franken et al. 2006). These contrasting findings point to the need for research that is more focused on the pharmacokinetics of therapies and comparison with behavioral smoking patterns for youth. Equally important, though, may be the overwhelming contribution of social influence factors in the ability of youths to quit. Pharmacotherapies fail to address the contextual reasons for smoking and relapse, and these factors may have greater relevance for youth cessation than for adult cessation.

Our search of the literature revealed 12 experimental studies published between 2003 and 2007 that were not included in either of the meta-analyses (Helstrom & Hutchison 2007, Horn et al. 2007, Joffe et al. 2005, Mermelstein & Turner 2006, Muramoto et al. 2007, Patten et al. 2007, Pbert et al. 2006, Rodgers et al. 2005, Stotts et al. 2003, Sun et al. 2007, Walsh et al. 2003, Woodruff et al. 2007). Two studies evaluated pharmacotherapy, either bupropion (Muramoto et al. 2007) or nicotine replacement (Stotts et al. 2003). Findings in the bupropion study were mildly encouraging, but the advantages of pharmacotherapy in this population are yet to be established. Muramoto and colleagues (2007) found significant increases in biochemically confirmed short-term abstinence (seven-day point prevalence) among youth taking 300 mg of bupropion daily compared to both 150-mg and placebo conditions throughout a 26-week follow-up period. However, there were no drug effects on long-term abstinence (confirmed 30-day prolonged abstinence). Stotts et al. (2003) recruited long-term smokeless tobacco users to evaluate nicotine patches. Over a one-year follow-up, there were no significant differences in rates of abstinence from smokeless tobacco between active and placebo patch conditions. However, when the active and placebo patch conditions were combined, they outperformed a usual-care control group with regard to smokeless tobacco use. Neither patch condition resulted in significantly higher abstinence from all forms of tobacco; quitting smokeless tobacco did not result in less use of tobacco overall. A nonrandomized open-label trial came to the same conclusion regarding the lack of efficacy of nicotine patch treatment for adolescent smokers (Hurt et al. 2000).

Five recent studies evaluated behavioral programs in general populations of adolescents using two-group designs comparing individually delivered treatment to no treatment or very brief intervention (Pbert et al. 2006, Rodgers et al. 2005, Sun et al. 2007, Walsh et al. 2003, Woodruff et al. 2007). Each of these studies reported significant treatment effects, lending support to the conclusion from the Sussman et al. (2006) meta-analysis that youth tobacco-cessation treatment significantly increases the likelihood of quitting. Of the remaining five studies, three were essentially “horse-race” studies comparing two different interventions and did not include a no-treatment control group. Joffe et al. (2005) compared two different nationally distributed behavioral programs (NoT on Tobacco versus Kickin' Butts). Patten et al. (2007) compared a home-based Internet-delivered treatment to a four-session health clinic-based intervention. Neither study reported significant treatment effects. In contrast, Mermelstein & Turner (2006) compared a group treatment (NoT on Tobacco) with and without a Web- and telephone-based adjunct. Results at a three-month follow-up showed significantly higher quit rates in the group-plus-adjunct condition.

Two other studies evaluated motivational enhancement interventions in teens who did not present voluntarily for cessation treatment. In one study, teens who had been arrested or required to appear in court for a variety of offenses were given the option to participate in a diversionary program (Helstrom & Hutchison 2007). The other study recruited participants for treatment who presented for care for any reason in an emergency room in a suburban, university-affiliated hospital (Horn et al. 2007). Neither study reported significant treatment effects.

Treatment settings—The impact of youth cessation interventions depends not only on the effectiveness of treatment but also on the potential reach of interventions to the target population (Glasgow et al. 2006). Given that the vast majority of adolescent smokers attend school, it is not surprising that most youth cessation interventions have been evaluated in school-based settings (either classroom or school clinics). Other settings include outreach at shopping malls and amusement parks (Lipkus et al. 2004) and worksites that have large youth employee populations, such as grocery stores (Stoddard et al. 2005). The Sussman et al. (2006) review calculated the net treatment effect for program settings that included the classroom as well as school and medical clinics. Results showed significant treatment effects for both the classroom and school clinics but not for the medical clinics.

It would be unwise to dismiss the healthcare setting as important to expanding the reach and impact of youth cessation efforts. According to the 2006 National Health Interview Survey, more than 86% of youth aged 11 to 17 years had at least one contact with a health care professional in the previous year (Bloom & Cohen 2007). There is wide consensus, including American Academy of Pediatrics preventive care guidelines, that providers of healthcare to youth and adolescents are uniquely poised to facilitate youth cessation and so should routinely screen for tobacco use and provide advice and assistance based on the Public Health Service clinical practice guideline for treating tobacco use and dependence (Friend & Colby 2006, Klein & Camenga 2004, Pbert et al. 2003, Prokhorov et al. 2003). Two recent studies are encouraging in their findings that multisession behavioral interventions delivered to youth smokers in either school-based (Pbert et al. 2006) or community-based (Hollis et al. 2005) health care settings can significantly increase rates of smoking cessation. School nurses delivered a behavioral intervention one-on-one in the school health clinic, demonstrating the feasibility of using front-line youth health care providers to facilitate smoking cessation. In the community-based intervention, youths' health care providers provided brief advice to quit smoking; the behavioral support comprised an interactive computer program accessed at the health clinic and brief telephone follow-up counseling. Disseminating these encouraging findings to youth health care settings is important because recent summaries of current practices regarding tobacco cessation indicate that although pediatricians and family physicians routinely screen for tobacco use, they seldom provide assistance and follow-up to identified smokers (Friend & Colby 2006, Pbert et al. 2003).

Innovative intervention channels—Several innovative channels for delivering cessation support to youth smokers warrant further investigation, preferably using sufficiently powered randomized trials with long-term outcome assessment. Outreach telephone counseling, particularly through national and state quitline portals, has very high potential reach to youth smokers (Tedeschi et al. 2005). Although outreach telephone counseling has been included as a treatment component in some studies (e.g., Lipkus et al. 2004), and 44% of state quitlines in the United States report specialized teen cessation protocols (Cummins et al. 2006), there are no published randomized trials of the effectiveness of quitlines for youth callers.

Not surprising, there are several technology-based platforms, including PC-based expert systems (Hollis et al. 2005), Internet programs (Dallery et al. 2007, Mermelstein & Turner 2006, Patten et al. 2007, Woodruff 2001, Woodruff et al. 2007), and cell-phone text messaging

(Rodgers et al. 2005). The potential reach of these interventions to youth smokers is also extraordinarily high. According to the Pew Internet and American Life Project, in 2004, 87% percent of U.S. teens age 12–17 reported using the Internet, with 51% reporting daily use. Prevalence of Internet use increased with age from 60% of sixth graders to 94% of eleventh and twelfth graders (Lenhart et al. 2005). Cell phone ownership was reported by 45% of teens in 2004, and 33% reported text messaging with a cell phone (Lenhart et al. 2005). A 2007 updated survey found that 63% of teens had their own cell phone (Macgill 2007).

To date, one study (conducted in New Zealand) has evaluated cell phone text messaging as a cessation program modality (Rodgers et al. 2005). Participants received regular personalized messages centered on a planned quit date. Messages were personalized to participant characteristics as assessed at baseline. The program sent five messages per day during the week before the quit date and the four weeks following. Outgoing free text messaging capability began on their quit date so that participants could text message others for social support. Other text message platforms included matching with quit buddies, phone-based opinion polls, and outreach messages to generate tips for coping with cravings.

Computer- and Internet-based programs permit real-time assessment of constructs such as sociodemographic characteristics, motivation to quit, and smoking patterns that can be used to provide tailored interventions (Curry 2007). Video technology allows attention-grabbing graphics and movies of teen testimonials to enhance the appeal and relevance of the interventions (Hollis et al. 2005). In one recently evaluated program, the Internet-based intervention was provided through a “virtual world.” As described by the investigators, “… participants can see each other as 3-dimensional figures (i.e., avatars) on their computer screens, move around in the ‘world’, and have real-time discussions with each other” (Woodruff et al. 2007, p. 1773). The program, entitled “The Breathing Room,” was set in a mall-like location with virtual storefronts that supported the counseling components (e.g., an art gallery to introduce tobacco advertising effects and a pharmacy for discussion of pharmacotherapy). Up to four youth together participated with an online counselor so there were opportunities for peer-to-peer interaction during treatment. Short-term results from a randomized evaluation with 136 adolescent smokers recruited from high schools are mildly encouraging. Prevalent abstinence rates at the postintervention follow-up favored the intervention group (35% versus 22%, $p < 0.01$), but there were no differences in abstinence rates at the 12-month follow-up (37% and 38%, respectively). Note that lack of long-term effects was due to increases in prevalent abstinence in the control group; the prevalent abstinence rate in the intervention group was virtually unchanged over time. Given the episodic nature of much youth smoking, the similarity in prevalent abstinence rates at end of treatment and 12 months should not be interpreted as sustained abstinence. The outcome paper did not report long-term abstinence rates. It is important to note that the ultimate dissemination of Internet cessation programs for youth is not yet reliable. Several years ago, one research group conducted an Internet search for online teen cessation programs and found that the key words “teen quit smoking” led to a number of teen pornography sites (7 out of the top 20) in one search engine (Elliott et al. 2001). Two years later, a study found only one pornographic site in the top 30 hits (Koo & Skinner 2003). This study also reported, however, that fewer than half of the sites identified through an Internet search were relevant to youth cessation.

E-technology can also extend the reach of traditional behavioral approaches to tobacco-cessation treatment. Contingency management based on biomarkers of tobacco use abstinence has shown some promise for youth smoking cessation in small-scale trials (Krishnan-Sarin et al. 2006, Roll 2005), although its effectiveness has not yet been established in a large-scale randomized trial with long-term outcome. Recently, investigators have completed a successful pilot test of the implementation of a voucher reinforcement system for youth cessation in which youth make twice-daily Web-camera video recordings of themselves providing a breath carbon

monoxide sample and send the video and electronic breath sample readings to a centralized smoking cessation clinic. Abstinent participants then receive vouchers that can be used for purchases at various Internet vendors (Dallery et al. 2007, Glenn & Dallery 2007).

Mandatory treatment—We are unaware of circumstances under which adult smokers can be mandated to attend tobacco-cessation treatment programs. In contrast, youth tobacco users can be mandated to participate in treatment, usually as a consequence of violating school rules or community ordinances against purchase, use, or possession (i.e., purchase, use, and possession laws). Often treatment is offered to youth violators as an alternative to paying a monetary fine (Jason et al. 2007); these are called tobacco diversion programs. A national survey of nearly 600 community-based youth cessation programs found that for 9% of the programs, all participants were youth who were mandated to treatment, and an additional 35% of programs had both mandatory and voluntary participants (Curry et al. 2007a). Among the latter programs, 58% of participants on average were mandated.

There are no randomized studies of the impact of mandated treatment on youth cessation. One pilot study evaluation of a tobacco-diversion program in Minnesota surveyed 73 youth who opted to pay a fine and 39 youth who elected to participate in the diversion program (Lazovich et al. 2001). As the numbers indicate, the majority (65%) of youth elected to pay fines. Interviews conducted within 30 days of their initial citation found higher self-reported abstinence from smoking among those who paid the fines (23%) compared with those who attended the tobacco-diversion program (5.1%). Notably, youth who elected to participate in the tobacco-cessation program were more likely to report longer smoking histories and higher nicotine addiction scores, both of which are associated with greater difficulty quitting. As we have noted elsewhere (Curry et al. 2007a), motivation theory suggests that mandated treatment participation would undermine intrinsic motivation to quit and therefore diminish treatment effectiveness. Given the prevalence of mandated cessation treatment, further studies are warranted to ensure that mandated treatment does not have unintended negative consequences for youth cessation.

Challenges for Building the Evidence Base

A review of the youth cessation literature reveals the significant challenges in conducting treatment trials with youth smokers. These hurdles relate to study design, assessment and validation of smoking status, recruitment, retention, and human subjects' requirements. There are several excellent analyses of these issues with regard both to youth cessation and prevention research (Backinger et al. 2003, Flay & Collins 2005, Grimshaw & Stanton 2006, Mercer et al. 2007, Mermelstein et al. 2002). Here we touch briefly on three key issues: recruitment of sufficient numbers of youth for adequate statistical power, institutional review board (IRB) requirements, and retention of youth cohorts for longitudinal follow-up.

When conducted in defined settings where rates of recruitment can be estimated (e.g., schools), between 2% and 10% of youth smokers will sign up for treatment (Backinger et al. 2003). With the average high school enrollment at 800 students (U.S. Dept. Education 2003) and estimating an overall smoking prevalence across grades at 15%, this translates to recruiting between 2 and 12 smokers per school. Similar challenges apply to recruiting youth smokers for treatment in medical settings, although health care providers may be stronger motivators for treatment than are school personnel. Nonetheless, one sees quickly that cluster-randomized trials with multiple sites are necessary for adequate rigor and statistical power, designs that are expensive and logistically complex. Community-based recruitment is no less challenging, even in settings where large numbers of youth naturally congregate. For example, Lipkus and colleagues (2004) recruited in 11 shopping malls spread across four states and screened more than 13,000 youth aged 15–18 years to enroll 402 smokers in their treatment study.

Clearly, we need creative approaches to enroll youth in cessation treatment studies. One approach to enhancing treatment demand is to implement pretreatment interventions aimed at increasing youth motivation for cessation prior to enrolling them in formal cessation programs. For example, a recent study explored the feasibility of using a “vanity and oral health issues” approach to motivate youth attending a continuation high school in rural California to join a tobacco-cessation group (Semer et al. 2005). In this innovative study, youth smokers attending a school-based health fair could have their picture digitally modified to simulate facial wrinkling or oral cancer disfigurement. Students received a hard copy color photograph. In addition, each participant received an oral cancer screening by a county school nurse. Among health fair participants, 57% of regular smokers signed up for treatment, and 65% of those who signed up participated in the full treatment program. This combined yield of 37% of youth smokers engaging in treatment is considerably higher than the 2% to 10% average participation rate.

Many researchers report that difficulties with recruitment stem primarily from IRB's requirements that they obtain active parental consent for youth to participate in their studies. Active parental consent obviously requires contacting youths' parents, explaining the research aims and requirements, and obtaining written or oral consent for their child to participate. The term “passive consent,” which is often referred to when active consent is not obtained, is not a formal IRB option. Rather, researchers need to obtain a waiver of parental consent from their IRBs. The strategy of sending advance mailings to parents informing them about the research and providing the opportunity for them to request exclusion of their child from the study can allay IRB concerns that the waiver of consent would leave parents uninformed and unable to decide whether their child can be a research participant. This strategy describes passive consent.

Tigges (2003) reviewed methodological issues associated with use of active parental consent in research related to adolescents' risky behaviors and documented its effect on participation rates, costs, and selection bias. There is evidence that active consent excludes up to 70% of eligible youth, and these youth are more likely to be minority or to have the highest rates of risky and problem behaviors. Aggressive strategies for obtaining active consent typically cost $20 to $25 per youth and still can exclude more than half of a target population. Although federal regulations allow for waivers of parental consent, half of the respondents to a national survey of IRB administrators indicated that they never granted parental waivers (Wagener et al. 2004). The Institute of Medicine released a report in 2004, entitled “The ethical conduct of clinical research involving children,” (Field & Behrman 2004) that recommended that IRBs consider waivers of parental permission under three conditions: the research is important to the health and well-being of adolescents, the research cannot be conducted reasonably without a waiver, and the research involves a treatment that an adolescent can consent to receive under state laws. In a survey of researchers conducting studies of tobacco-cessation interventions with adolescents, 62% reported requesting a waiver of parental consent, and 62% of the requests were granted (Diviak et al. 2004). The reasons cited in their waiver applications were consistent with the Institute of Medicine recommendations: teen participation in the study involved minimal risk, it would be difficult to recruit sufficient numbers of teens if parental permission was required, recruiting with active parental consent would result in a less representative sample, and the responses of teens needed to be confidential from parents and school administrators. Parental waivers of consent appear to be possible, but certainly are not easy to obtain or consistently granted across different IRBs.

Even with recruitment of sufficient numbers of participants into their research, investigators are further challenged by high attrition. Of the 13 studies included in the Cochrane Collaborative Review (Grimshaw & Stanton 2006) that reported loss to follow-up information, eight lost at least 33% of their participants by six months. Loss to follow-up rates are no better among the 12 experimental studies published after the Cochrane review; six of nine studies for

which follow-up rates could be determined lost at least one-third of their participants. The best follow-up rates are reported for studies conducted in health care settings (Brown et al. 2003, Hollis et al. 2005), where investigators presumably can take advantage of the health care organization's patient-tracking efforts. It is both disappointing and surprising that the vast majority of treatment outcome papers describe little about the efforts made to retain their cohorts (or in some cases do not even describe retention rates). Thus, it is difficult to ascertain the extent to which high rates of loss to follow-up are inherent in youth studies or avoidable with effective retention strategies. One of the best examples of cohort retention is described by Peterson and colleagues, who conducted a smoking prevention project that had more than 90% cohort retention during a 15-year follow-up period (Peterson et al. 2000). They had the advantage of enrolling youth in their cohort when they were in the third grade and obtained multiple tracking contacts from the youths' parents. However, they describe approaches that could be adapted as best practices in research with older youth, including collecting addresses of parents or other adults who could be contacted for tracing purposes; using U.S. postal service forwarding and address correction services to find youth and later young adults who have moved; and using publicly available databases and online people search engines.

To summarize, a sufficient number of good quality youth cessation intervention studies now exist to provide evidence-based recommendations based on rigorous meta-analyses. We can say confidently that behavioral interventions increase the chances of youth smokers achieving successful cessation. With regard to intervention components, it appears that motivational enhancement and cognitive-behavioral approaches are efficacious with youth as well as adult smokers. Currently, there is no evidence that nicotine-replacement treatment aids youth cessation. Results from one study of bupropion are mildly encouraging, at least with regard to short-term outcomes. Overall, however, the evidence base for youth cessation treatment is quite modest. Many innovative studies have been compromised by challenges in recruiting sufficient numbers of youth, obtaining approval for waivers of parental consent, and high attrition in longitudinal data collection. As we note below, these challenges provide important insights for future directions in youth cessation interventions.

Future Directions

Youth tobacco cessation is a dynamic and growing area for treatment research. We are heartened by the progress in developing and evaluating effective behavioral interventions for youth tobacco cessation and, at the same time, humbled by the need to accelerate this progress. There are clearly many opportunities to move the field forward. We highlight four possible areas for future work: (*a*) bridging the fields of adolescent development and treatment design, (*b*) matching treatments to optimal intervention points based on knowledge gained from identifying developmental trajectories of smoking behavior, (*c*) gaining a greater understanding of effective treatment processes and treatment moderators, and (*d*) building demand for evidence-based cessation treatments.

Bridging Research on Adolescent Development and Cessation Treatment

Interventions for youth tobacco cessation are largely modifications of successful approaches used with adults. Although treatment developers often note that the interventions are “tailored” to adolescents, this tailoring usually reflects modifications to the formatting or surface appeal of intervention elements (e.g., use of age-appropriate graphics, designs, marketing) rather than tailoring to match the cognitive-developmental stage of the youth. A striking disconnect exists between what we know about social and cognitive development and challenges from the adolescent development literature and youth smoking-cessation intervention design. Clearly, there are more opportunities here for cross-fertilization between these fields. For example, youth cessation interventions may want to address more directly some of the self-regulation challenges and cognitive skills of adolescence. To date, most interventions have remained

highly focused on specific strategies for not smoking, with relatively little attention to some of the key determinants of smoking, such as management of negative affect, impulsivity, or decision-making skills. More intensive consideration of some of these more general self-regulatory skills may be needed for improving cessation rates and preventing relapse. Modifying intervention materials and techniques to better match the developmental stages of youth is also important. Adolescents are also a developmentally heterogeneous group, and better tailoring to age or developmental level may be useful. Older adolescents, particularly those moving toward emerging adulthood (18–21 years of age), may have unique challenges for cessation that arise with their numerous life transitions, and may require even different approaches and vehicles for intervention.

Optimizing Intervention Points Based on Trajectories of Youth Tobacco Use

Thus far, most interventions for adolescents have focused on the ends of the smoking continuum—either prevention of initiation or cessation with youth who are already likely addicted smokers with difficulty quitting. As researchers are better able to identify key subgroups of youth who are most vulnerable to rapidly escalate in their smoking, then researchers can aim to interrupt progression from experimentation to dependence. Some of these interventions may involve more innovative approaches to changing both the social context and meaning of smoking to youth. For example, the use of peer leaders or key influential peers as a way to reach out informally and discourage smoking among adolescents may show some promise (Stanton et al. 2006, Starkey et al. 2005). In addition, as researchers gain a better understanding of the time course for the development of dependence, it may be possible to target interventions better to the window of opportunity between initial trials and nicotine dependence.

Focus on Treatment Processes and Treatment Moderators

Researchers have paid relatively little attention to understanding the mechanisms or processes within youth cessation interventions, an understanding that may help improve the next generation of interventions. What elements result in greater change? For example, although most youth cessation interventions incorporate self-management strategies, we know little about whether adolescents actually use these approaches or whether they are related to outcome. Identifying treatment moderators is also an important next step for the field. Potential moderators include not only youth participant characteristics (e.g., gender, ethnicity, socioeconomic status, educational aspirations, comorbidities), but social context as well (e.g., parental smoking, peer smoking, environmental policy characteristics). Beyond identifying possible moderators, it would also be helpful to know how a moderator works.

Building Demand for Cessation Interventions

Across all ages, use of tobacco-cessation interventions remains low (Cent. Dis. Control Prev. 2006a, Curry et al. 2007b). Recent efforts have focused on applying market research principles and methods to foster demand for treatment. For example, the National Tobacco Cessation Collaborative (2007) outlined several core strategies for increasing the use of evidence-based tobacco-cessation treatments. These strategies highlight the importance of viewing young smokers as consumers and taking a fresh look at quitting from their perspective; of marketing and promoting cessation products and services in ways that reach young smokers where they are; and of systematically measuring, tracking, reporting, and studying quitting and treatment use to identify opportunities and successes. Qualitative studies of youth beliefs and preferences for tobacco-cessation treatment provide some insight into their low rates of interest in treatment, such as erroneous beliefs that nicotine replacement causes cancer, lack of self-identity as a smoker, and the belief that treatments are for older, addicted smokers (Amos et al. 2006, MacDonald et al. 2007, Molyneux et al. 2006, O'Loughlin et al. 2002b).

Unfortunately, these studies provide little in the way of concrete suggestions for alternative approaches, as most youth say that the only thing that would help them is willpower. We encourage future research to examine the effectiveness of marketing strategies to promote high-reach channels for smoking-cessation treatment, such as cell phone text messaging, Internet programs, and telephone quitlines.

In many ways, research on youth tobacco cessation is in its own adolescence; the field has moved beyond the first-generation studies and evaluation of initial trials of cessation approaches to a second generation of more rigorously designed randomized controlled trials. It is important that we ensure continued investment in this area because it is one of our best hopes for our children's future.

Summary Points

1. Tobacco use and dependence is a chronic, relapsing disease that begins early in life. More than one-fifth of high school seniors in the United States were current smokers in 2007, with more than half of them reporting daily smoking.
2. A variety of liabilities, including both normative neurobiological developmental factors (e.g., immature frontal limbic connections, immature frontal lobe development) and social influences controlled by a combination of interacting biological, psychosocial, and environmental influences, in combination with both normative and nonnormative patterns of emotional dysregulation in adolescence, present challenges for researchers to consider in developing interventions.
3. The majority of youth smokers want to quit and make serious attempts to do so, but most youth attempt to quit without using available treatments.
4. The content of behavioral interventions targeting youth cessation mirrors the content of programs for adults and includes motivational enhancement and cognitive behavioral strategies.
5. The number of good-quality youth cessation intervention studies is sufficient to say confidently that behavioral interventions increase the chances of youth smokers achieving cessation and that motivational enhancement and cognitive behavioral approaches are efficacious with youth.
6. There is no evidence that nicotine-replacement treatment aids youth smoking cessation, and only one study of bupropion has been conducted, with mildly encouraging results.
7. Overall, the evidence base for youth cessation treatment is quite modest, in part because many studies have been compromised by challenges in recruiting sufficient numbers of youth, obtaining approval for waivers of parental consent, and high attrition in longitudinal data collection.

Future Issues

1. How can we better connect research on adolescent social and cognitive development research to youth cessation intervention design?
2. How can we harness youth engagement with technology to extend the reach and impact of youth cessation interventions?
3. Is it possible to target youth cessation interventions at transition points in their trajectories of tobacco use initiation, for example by targeting the window of opportunity between initial experimentation and nicotine dependence?

4. What are the effective mechanisms or processes within youth cessation interventions, including treatment moderators, such as sociodemographic characteristics and aspects of the social context, and treatment mediators, such as changes in expectancies, motivation, and skills?
5. Can we effectively apply market research principles and methods to foster greater youth demand for treatment?

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Glossary

AIDS	acquired immune deficiency syndrome
CDC	Centers for Disease Control and Prevention
FDA	Food and Drug Administration (United States)
MSAs	metropolitan statistical areas
ADHD	attention deficit hyperactive disorder
IRB	Institutional Review Board