

Prevention of Tobacco Use Among Medically At-risk Children and Adolescents: Clinical and Research Opportunities in the Interest of Public Health*

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Objective Cigarette smoking and other forms of tobacco use are addictive and harmful. Though no level of smoking is safe, children and adolescents who are medically at-risk due to the presence of a chronic or life-threatening disease may be especially vulnerable to these dangers. This article provides an overview of considerations in the prevention of tobacco use in this special population. **Methods** This article summarizes medical aspects of childhood chronic disease and the impact of cigarette smoking, the prevalence of tobacco screening in pediatric healthcare, and levels of prevention for individuals, families, schools, and healthcare. Recommendations for clinical services and research are also included. **Results** There are a number of reasons to prevent and interrupt the onset of smoking in medically at-risk youth. Subspecialty clinics appear to be the most likely point of entry for prevention-based work in this area. However, no one single setting will be effective in preventing and deterring use without due consideration of other settings, perspectives, and influences on smoking uptake. **Conclusions** The promise of smoking prevention to improve the health and outlook of children and adolescents with chronic or life-threatening disease is high, and additional efforts are needed for this population.

Key words children; chronic disease; chronic illness; prevention; risk behavior; smoking; substance use; tobacco control.

Introduction

The prevention of cigarette smoking and other forms of tobacco use is important for all children and adolescents, and especially so among medically at-risk youth. Their compromised health status causes them to be more susceptible to the negative consequences of smoking during childhood (Eyre, Kahn, & Robertson, 2004), and makes them more likely to suffer disproportionately from tobacco-related morbidity and mortality in adulthood (Forrest & Riley, 2004; Mackenbach, Borsboom, Nusselder, Looman, & Schrijvers, 2001).

For many children and adolescents with chronic medical conditions, normal physical, social, and psychological developmental processes are compromised (Huurre & Aro, 2002). Tobacco may further contribute to disruptions in one or more of these areas, leading to poorer outcomes (U.S. Department of Health and Human Services, 1994). Pediatric healthcare providers and provider extenders are in unique positions to assist in interrupting or delaying the onset of smoking behavior by virtue of these professionals' roles in the management of patients' primary disease (Kulig, 2005). As this management often includes frequent clinical contact with a

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knowledgeable, trusted, and well-regarded figures, opportunities for patient education and counseling concerning smoking abound and could be capitalized upon.

Unfortunately, little is known about how to prevent smoking among medically at-risk youth. Further, misperceptions about the likelihood of initiating smoking or the prevalence of smoking exist. Despite a growing body of research to the contrary, adults may falsely believe that medically at-risk youth simply would not and do not engage in this risky behavior because it would be “bad for their health” (Corkery et al., 1979). Concerns about health aside, some of these children and adolescents more closely resemble their same-age peers in this regard than is desirable (Tercyak, 2003, 2004, 2006; Tercyak et al., 2005; Tyc & Throckmorton-Belzer, 2006). Perhaps by capitalizing on concerns for their health and well-being, progress in reducing cigarette smoking among this vulnerable group may be realized via gain- (i.e., feel better) and/or loss-framed (i.e., negative health impact) health education messages.

In this article, the authors consider what is known about best practices in childhood smoking prevention and how to apply this knowledge to medically at-risk youth. The article reviews the prevalence of tobacco screening, risk factors for tobacco use, and settings for prevention efforts. In doing so, the authors identify what is not yet known about such practices in the hope of spurring additional work in this important area.

The contents of this article were derived, in large part, from a professional conference entitled “Tobacco Control Strategies for Medically At-Risk Youth” that was held at St Jude Children’s Research Hospital in Memphis, TN on October 6–8, 2005. This article is not intended to serve as a comprehensive review of the state of the science in this particular area of inquiry. Rather, it seeks to highlight relevant issues among medically at-risk populations, with reference to the empirical literature on childhood smoking. Moreover, it seeks to provide commentary on smoking prevention from the perspective of experts who attended the conference and who met to discuss and evaluate the merits of these issues as part of the conference framework.

Medical Aspects of Cigarette Smoking and Chronic Diseases

Medical advances in treatment and supportive care have changed the natural history of many chronic and life-threatening diseases of childhood. For example, children and adolescents with congenital metabolic and

hematologic diseases live longer and with improved quality of life. Due to nutritional supplements, antimicrobial therapy, and attention to pulmonary health, children with cystic fibrosis now survive into their fourth decade (FitzSimmons, 1993). Likewise, therapeutic interventions resulting from improved understanding of sickle cell disease pathophysiology have reduced morbidity and mortality related to vasoocclusive crises and their sequelae (Platt et al., 1994; Steinberg et al., 2003).

Treatment progress has also improved the lifespan and quality of life of children and adolescents with autoimmune diseases like diabetes and rheumatoid arthritis. In pediatric diabetes, the development of genetically engineered insulin, glucose monitoring devices and standardization of treatment approaches have decreased disease-related complications (Atkinson & Eisenbarth, 2001). However, suboptimal regulation of blood glucose increases the risk of life-threatening complications of hypoglycemia, ketoacidosis, and micro- and macrovascular disease in these young people. Similarly, in children with juvenile rheumatoid arthritis, nonsteroidal antiinflammatory drugs and disease modifying antirheumatic drugs have dramatically improved symptom control, while novel biologic response modifiers like tumor necrosis factor inhibitors have reduced joint destruction (Ilowite, 2002).

Finally, progress in therapy for childhood cancer, once a near death sentence, represents one of the most remarkable success stories of the last century. Following contemporary therapy, 70% or more of children and adolescents become long-term survivors (Ries et al., 2002), although many experience chronic or late-occurring health problems resulting from the cancer or its treatment that become clinically apparent decades later (Oeffinger & Hudson, 2004).

Common to all of these diagnostic groups is an enhanced vulnerability to cardiovascular and or respiratory dysfunction resulting from disease- and/or treatment-induced factors. Specific groups are also at increased risk of infection and cancer, which predispose them to early mortality. The improved longevity in these and other medically at-risk populations underscores the need for preventive measures to avoid or reduce the health consequences of tobacco use.

Pediatric Chronic Disease Trajectories

The disease trajectory in pediatric chronic illnesses may be characterized by an acute or indolent symptomatic presentation that ultimately leads to diagnosis, initiation of therapeutic interventions, and variable degrees of disease and symptom control. In most, the treatment goal is

to control symptoms, optimize function and quality of life, and reduce disease- and treatment-related morbidity.

The exception to this paradigm is childhood cancer, in which disease eradication is the primary objective. The disease course in children and adolescents undergoing treatment for neoplastic and nonneoplastic chronic diseases commonly involve one of periodic acute exacerbations related to infection, cardiovascular compromise, pulmonary insufficiency, or metabolic aberrations. In some cases, these events may be potentially life-threatening, as in the child or adolescent with cystic fibrosis who present with pneumonia and pulmonary insufficiency or the pediatric patient with type 1 diabetes who develops ketoacidosis. Between exacerbations or, in the case of cancer, after completion of therapy, patients may have few or no symptoms. However, subclinical injury from the chronic illness or its treatment may increase vulnerability to specific physiologic and pathologic changes.

Whereas progress in treatment and supportive care have dramatically reduced mortality related to acute exacerbations and treatment toxicity of chronic disease, over time, disease- and/or treatment-induced vital organ dysfunction, immunodeficiency, and carcinogenesis take their toll. These chronic effects enhance the risk of life-threatening (stroke, coronary artery and peripheral vascular disease, pulmonary and renal insufficiency, infection, and cancer) and life-altering (vision loss, altered body image, chronic pain, and infertility) complications during adulthood. Examples include the development of anthracycline cardiomyopathy in the adult surviving childhood cancer, premature coronary artery disease in adults with juvenile-onset diabetes, or lymphoma in an adult with refractory juvenile rheumatoid arthritis treated with tumor necrosis factor inhibitors.

Vulnerabilities

Tobacco use poses significant health risks in children and adolescents with chronic disease. Cigarette smoking damages airway cilia and irritates respiratory mucosa, which serve as important defense barriers against respiratory pathogens in children and adolescents on immunosuppressive therapy for cancer or juvenile rheumatoid arthritis. The resulting inflammatory response may manifest acutely with a productive cough or chest pain. Or, it may manifest chronically with a decline in pulmonary function in children with cystic fibrosis, or an increased risk of acute chest syndrome in those with sickle cell disease (Britto et al., 1998; Young, Rachal, Hackney, Uy, & Scott, 1992).

Other common health concerns observed in these medically at-risk populations that tobacco use may further exacerbate are suboptimal nutrition, poor growth, osteopenia, reduced functional status, and poor quality of life (Oeffinger & Hudson, 2004; Verma, Clough, McKenna, Dodd, & Webb, 2001). Long-term injury of the vascular endothelium related to smoking may contribute to excess mortality from strokes in adults with sickle cell disease (Platt et al., 1994), and coronary artery disease in individuals with type 1 diabetes (Moy et al., 1990). Thus, compared to healthy peers, children and adolescents with chronic disease are more vulnerable to tobacco-related health risks that become more significant with advancing age.

Prevalence of Tobacco Screening in Pediatric Healthcare

Optimal tobacco prevention strategies involve messages from multiple sources delivered over time. While interventions may come from within and outside the healthcare system, office-based prevention plays a critical role. Over 70% of adolescents visit a physician each year, and many professional organizations recommend annual tobacco prevention and cessation counseling for child and adolescent patients (American Academy of Family Physicians & Commission on Public Health and Scientific Affairs, 1992; American Academy of Pediatrics & Committee on Psychosocial Aspects of Child and Family Health, 1988; Elster & Kuznets, 1994; Green, 1994; U.S. Preventive Services Task Force, 1996). While no adolescent-specific guidelines exist, most groups advocate the “5As” strategy, which has been found to be effective at controlling smoking among adults (Glynn & Manley, 1989).

The “5As” include: Asking all patients about tobacco use; Advising smokers to stop smoking; Assessing the willingness of smokers to make a stop smoking attempt; Assisting those who are interesting in stopping; and Arranging follow-up is the final step. These steps have been targeted to children and adolescents in recent publications; however, the U.S. Department of Health and Human Services has yet to verify that this approach is equally effective in young people (Fiore et al., 2000; Klein & Camenga, 2004; Pbert et al., 2003).

Physician screening and counseling for tobacco use is far below desired levels. The most representative data come from the National Ambulatory Medical Care Survey (NAMCS). In the 1991 and 1996 surveys, physicians self-reported identifying an adolescent’s smoking status in 72.4% of visits. Counseling occurred in only 1.7% of all visits and 16.9% of visits by adolescents identified as

smokers. Adolescents with asthma (the only chronic condition studied) were almost four times as likely to be counseled as those without asthma, but even adolescents with asthma were counseled in only 4.2% of visits (Thorndike, Ferris, Stafford, & Rigotti, 1999). In this analysis, primary care physicians were more likely to address tobacco use than were specialists. A later study that combined 1997–2000 NAMCS data with National Hospital Ambulatory Medical Care Survey data reported a higher rate of counseling (Rand, Auinger, Klein, & Weitzman, 2005). Adolescents were counseled at 8.5% of acute visits and 13.3% of well visits. Like the previous study, older adolescent age was associated with a higher likelihood of tobacco counseling (Rand et al., 2005; Thorndike et al., 1999).

The quality of physician counseling [based on adherence to the 5As and a National Cancer Institute (NCI) guideline] was investigated in New York State (Klein, Levine, & Allan, 2001). Physicians were most likely to report Asking adolescents about smoking (91%) and Assessing motivation to stop smoking among smokers (81%). They were less likely to report Assisting with setting a stop smoking date (34%) or Arranging follow-up (28%). Physicians familiar with the NCI guideline provided higher quality counseling than those who were not. Other factors associated with better performance included being a family practitioner (rather than a pediatrician), spending more time with the adolescent, and spending time alone with the adolescent. It is not known if these findings would hold true for other pediatric healthcare providers.

A recent randomized trial demonstrated significant improvement in clinician counseling for tobacco following a 1-day educational intervention; tobacco screening improved from 71% to 85%. Counseling improved from 65% to 83–88%. Importantly, the 1-day training provided most of the improvement, and no additional gain was noted from the addition of in-office tools and protocols (Ozer et al., 2005).

In addition to the “5As,” different approaches to tobacco prevention in the pediatric healthcare setting have been considered. Such approaches have incorporated computer-based interventions, peer counseling, and newsletters into office-based prevention efforts (Hollis et al., 2005; Patten et al., 2006; Pbert et al., 2006a; Stevens et al., 2002). Yet, these too require further research and study to fully understand their effectiveness.

In sum, screening and counseling for tobacco use in pediatric clinical settings remains suboptimal, although it seems to be improving. Structured educational

interventions have been moderately successful in improving screening in primary care. Data in pediatric subspecialty practice are sparse, but suggest that prevention activities are also suboptimal even for adolescents who are medically at very high risk from tobacco exposure. Strategies that have proven effective in improving tobacco counseling in primary care will likely be effective in subspecialty practice as well, although there may be a need to target the approach for the more complex, team-based care typically provided in these settings. For example, it is not uncommon for chronically ill youth to come into contact with physicians, nurses, nutritionists, psychologists, social workers, health educators, and child life specialists. To the extent that one of these professionals could assume a lead role on addressing tobacco control issues, other members of the healthcare team could provide follow-up support as needed.

Social and Psychological Risk Factors for Tobacco Use

As noted by Tyc and Throckmorton-Belzer (2006), the prevalence of smoking among medically at-risk youth is comparable to that of their healthy peers. For example, rates of smoking reported for adolescents with asthma are 20–55%, 8–31% among those with diabetes, and 15% among those with juvenile rheumatoid arthritis. At question is how this came to be, and if the smoking-related social and psychological risk factors studied in the general population (e.g., exposure to friends and family members who smoke, rebelliousness and risk taking, psychological stress and distress, and cognitive predisposition) apply to this special population as well? Answers to these questions are just beginning to emerge, and primarily come from a handful of studies conducted with youth with asthma (Tercyak, 2003, 2006; Zbikowski, Klesges, Robinson, & Alfano, 2002), cancer (Tyc, Hadley, & Crockett, 2001; Tyc, Lensing, Klosky, Rai, & Robinson, 2005), and diabetes (Tercyak, 2004; Tercyak et al., 2005).

For many young people, smoking is a socialized behavior that unfolds over time in a relatively predictable sequence: from nonsmoking and intending to remain smoke-free, to nonsmoking but being willing to try smoking, to trying smoking for the first time, and beyond (Mayhew, Flay, & Mott, 2000). Available research on children with asthma, cancer, and diabetes has not fully assessed the sequence of smoking acquisition for medically at-risk youth, and this remains an understudied issue. On the surface, the sequence appears to mirror that among healthy children, but this remains to be seen.

Further, the available literature suggests that children at-risk may smoke for similar reasons to their healthy peers (e.g., advancing age, low knowledge about the harms of smoking, the presence of psychological stress, exposure to smoking at home, and among friends). But the context in which these risk factors occur are likely affected by the presence of chronic disease itself. For example, stress among these children and their parents may be greater than in the general population, and these children's levels of independence and autonomy may exceed that of their peers—both owing to increased responsibility and demands inherent in managing a pediatric chronic disease. Here too, more information is needed to understand how these unique aspects affect smoking uptake and progression over time.

It is also important to recognize psychosocial uniqueness among chronically ill youth, and to better understand how this uniqueness may affect smoking risk and behavior. For example, medically at-risk children often miss school and may have fewer social interactions with peers. Chronic illness can also impact upon parent-child interactions, including parental limit setting, disciplining, and monitoring. Finally, many children with chronic conditions find a second home (a medical home) within the health care system, and ultimately rely upon providers in those settings for advice and guidance about a range of life stresses. The implications of these phenomena could be explored in greater detail as they relate to the potential onset and exacerbation of smoking.

Levels of Prevention for Individuals, Families, Schools, and Healthcare

Although tobacco prevention with a special population is a relatively new area, many of the central tenets of tobacco prevention are still likely to apply. These include encouraging medically at-risk children and adolescents to live smoke-free, providing them with education about the social and psychological causes of smoking, and coordinating the delivery of antismoking messages among individual, family, school, and healthcare settings (Centers for Disease Control and Prevention, 1994).

The challenges, of course, include identifying the settings in which medically at-risk children and adolescents might be most receptive to these messages, knowing which messages yield the greatest effects, and understanding the prevention and delivery methods that yield maximal benefit. Prevention efforts must be placed in context and augmented by a range of additional tobacco control strategies at multiple levels of engagement

noted previously. In order to better understand how to craft effective prevention initiatives, it is necessary to review existing strategies in different settings. This section highlights, with specific examples, where there are natural intersections among levels of prevention and children with chronic disease. Subsequently, heuristic frameworks are also offered that may be useful in organizing levels of prevention for this special population within and across systems, and in conceptualizing outreach at each level.

Heuristic Frameworks

The social-ecological model uses systems theory approach to consider individual change within the framework of social change. It examines the relationship between developing individuals and the settings in which they function. There is a hierarchy of influences—with the broadest category including society, social structure, or policy. Other influences include the community (laws, policies, norms, culture, and media), as well as local and interpersonal components (social networks, families and neighbors, peers). The final influence consists of an individual sphere (behaviors, attitudes, beliefs, and others). Movement along the continuum in the direction of individualization yields greater specificity and (consequently) greater influence between individuals and environments (Brown, 2002).

Complementary to this perspective is the family system illness model—a psychosocial typology to address the interaction of the biological and psychosocial worlds presented to families dealing with chronic illness or disability (Rolland, 1994). The typology focuses on three primary dimensions: time phases (e.g., chronic), illness type (e.g., childhood), and family system functioning (e.g., family behavior patterns). The utility of this model is that it provides a clear and comprehensive framework for clinicians to conduct family assessments, plan treatments, and deliver service in a range of healthcare settings. How does one place the strategies for preventing tobacco use in the larger context of healthcare approaches? In the US, programs for medically at-risk youth are most often targeted at the individual level. These programs focus on the special needs of those with chronic conditions and are addressed subsequently.

Individual: Strategies for Improving Decision Making

Among the many approaches for patient education and counseling are combinations of strategies to increase effectiveness of counseling and to capitalize

upon the strength of professionals as health experts (U.S. Preventive Services Task Force, 1996). Nonetheless, many child and adolescent programs underutilize screening, education, and counseling and lack “process” information about decision making—all of which are needed to change behaviors such as smoking and to improve health outcomes (Hollen, 1998). If assessed in subspecialty care programs, programs often focus on risk behavior outcomes (Hollen, 2000a,b). Subspecialty care programs also inadequately assess tobacco and related substance use outcomes, as well as decision making. Using decision making as a mediator of risk behaviors and risk motivation as a moderator framed within the context of the chronic disease could be helpful for counseling adolescents (Hollen, 1998; Sussman, 2005).

Healthcare professionals may assume that the process of decision making is sufficiently taught in schools or homes, and need not be a part of programs for medically at-risk youth. Enhancing decision making is continually recommended by school-based risk prevention program investigators (Barkin, Smith, & DuRant, 2002; Epstein, Griffin, & Botvin, 2002; Griffin, Scheier, Botvin, & Diaz, 2001; Payton et al., 2000; Taal & Sampaio de Carvalho, 1997). A 2001 review of secondary health education state curriculum frameworks from 10 states revealed that 6 of 10 frameworks had sections on alcohol, tobacco, and other drugs (ATOD), but only three of these ATOD sections addressed the mediator of decision making (Wyrick, Wyrick, Bibeau, & Fearnow-Kenney, 2001). Although it was estimated in 2001 that about 75% of elementary schools in the US have adopted the Drug Abuse Resistance Education (DARE) Program (which has decision making as an emphasis), several studies have found that the elementary program alone is ineffective (Smith, 2001). Junior and high school programs exist, but most schools do not use them and further large-scale testing of the DARE Program is ongoing (Smith, 2001). Based on a recent review of the literature, it is believed that adolescents may have less competence in decision making in the areas of advice seeking, evaluation, and goal setting (Byrnes, 2002).

Early decision-making skills, often learned in the home and at school, need reinforcement and practice within a meaningful context for children and adolescents with special needs. For example, the use of “Choices for Tomorrow: Decision Making as a Life Tool,” a generic intervention supplement can enhance decision-making skills among adolescents (Hollen, 1998). That intervention was initially developed for childhood cancer survivors, yet is recommended for use with healthy or

chronically ill adolescents. Its development was guided by health and decision-making frameworks, and developmental and cognitive psychology. The module includes a curriculum, a 17 min life-action video, a participant’s workbook, and two outcome measurements. Use of this or similar decision making tools in addition to content on smoking prevention creates a more comprehensive program.

Changes in learning styles of technology-literate children, adolescents, and their parents warrants the use of technology to disseminate healthcare information (D’Alessandro & Dosa, 2001; Norum, Grev, Moen, Balteskard, & Holthe, 2003). According to a 2004 report by the Economics and Statistics Administration and the National Telecommunications and Information Administration, more than half of US households have computers (62%) and Internet connections (55%) (U.S. Department of Commerce, Economics and Statistics Administration, & National Telecommunications and Information Administration, 2004). The rate of Internet penetration in rural and urban areas is 54 and 55%, respectively (U.S. Department of Commerce et al., 2004). By 2000, 98% of public schools had Internet access (Cattagni & Westat, 2001). In 2001, about 90% of 5- to 17-year-olds used computers at school and 66% of 9- to 17-year-olds used the Internet in that year (Debell & Chapman, 2003). Today’s children and adolescents grow-up in a technology-rich society, and that aspect may play a key role in gaining and sustaining their interest in tobacco prevention initiatives.

Interactive behavior change technologies (IBCTs) may be a solution to primary care practice in which there is “too much to do in too little time” (Glasgow, Bull, Piette, & Steiner, 2004), as well as subspecialty care practice. Computer-assisted, interactive programs for smoking prevention are sorely needed for medically at-risk youth and may effectively extend healthcare. Several approaches to interventions for medically at-risk youth are currently being tested. For example, several computer games have been developed. However, the number of health-related programs of this nature is limited and continued piloting and testing of technology and behavior programs for children and adolescents with special needs is greatly needed to capture their interest and maximize learning affiliated with subspecialty care.

New programs for tobacco use prevention should aspire to meet established review standards set out by such resources as the Cochrane Library (Foxcroft, Ireland, Lister-Sharp, Lowe, & Breen, 2003; Sowden, Arblaster, & Stead, 2003) or the CDC’s Programs-that-Work.

The latter includes rigorous study design and reduction in behavior, in addition to knowledge and attitude change (Collins et al., 2002). Within the school-based prevention program literature, it is generally accepted that a change in knowledge is linked to a change in behaviors by a change in attitude. Many programs have influenced knowledge, some have influenced attitude, but few have influenced behavior. It is well-known that most school-based programs have had modest or short-lived results; however, some successful programs are now available. In 1996, among the recommendations from experts for new directions in adolescent risk prevention programs and health promotion research were targeting co-occurring risk behaviors and extending interventions to the family, peer group, and the community (DiClemente, Ponton, & Hansen, 1996). Similar developmental and etiologic patterns for all substances and similarities in treatment strategies warrant collaboration of investigators (DiClemente et al., 1996).

Family: Strategies for Family-based Smoking Prevention

Although families are known to be influential in relation to youth smoking (Chassin, Presson, & Sherman, 2005b), there is little evidence for tobacco use prevention strategies based upon family frameworks for the medically at-risk.

What is known about the influence of families is from healthy populations (Thomas, Baker, & Lorenzetti, 2007). Family Matters, a successful universal intervention related to adolescent smoking, points to the importance of parenting strategies (Bauman et al., 2000, 2001, 2002; Ennett et al., 2001). Family Matters is designed for adolescents 12- to 14-years old and their families and involves a series of mailed booklets and telephone calls by health educators. An evaluation of over 1000 adolescents and their families reported statistical changes in substance-specific aspects of the family and reduced smoking onset. It is interesting to consider how this type of approach might be incorporated within the 5As noted previously. For example, parents could ask their children about their intentions to initiate smoking, even if the child has a chronic medical condition. Positive communication is a main principle of healthy family relations (Olson, 1993). Parents can also advise their children not to initiate tobacco use; parental disapproval of smoking has been related to lower smoking intentions by adolescents (Engels & Willemsen, 2004).

However, disapproval is not enough when advising children and adolescents who are becoming self-governing

persons. For healthy development in areas such as decision making, parenting strategies are advocated that include reasoning and discussion (Baumrind, 1991, 1996; Steinberg & Morris, 2001). Such positive parenting practices are also associated with less intention to smoke (Engels & Willemsen, 2004), initiation of smoking (O'Byrne, Haddock, & Poston, 2002), and smoking on the part of adolescents (Shek, 1997). Further, these parenting practices also have important implications for adolescent decisions not to smoke when in the company of their peers—a well-known influence on youth smoking (Avenevoli & Merikangas, 2003). Such parenting practices have been shown to be related to fewer intentions to smoke if their best friend offered a cigarette (O'Byrne et al., 2002).

One of the best things that parents can do is to be nonsmoking role models. Children are more likely to smoke if their parents smoke (Conwell et al., 2003; Taylor, Conard, Koetting, Haddock, & Poston, 2004). Further, if parents do not smoke, their discussions about smoking with their children will be more effective in preventing or reducing smoking over time (Chassin et al., 2005b).

Parental monitoring of adolescents' activities and having house rules about not smoking are other strategies. Lifetime smoking is less for adolescents whose parents monitored them more (Shakib et al., 2003). Monitoring the opportunities to obtain cigarettes may be especially helpful; accessibility and availability of tobacco products influence smoking initiation (Chaloupka, 2003). Having rules about smoking in one's home also decreases the likelihood of adolescents being smokers (Farkas, Gilpin, White, & Pierce, 2000). Finally, warm, accepting, and supportive relationships between parents and children provide a positive environment for development (Eisenberg, Olson, Neumark-Sztainer, Story, & Bearinger, 2004). Children and adolescents who have such connections with their parents are less likely to smoke, whereas those whose parents are unengaged are more likely to smoke (Chassin et al., 2005a; Radziszewska, Richardson, Dent, & Flay, 1996).

When considering medically at-risk youth, characteristics of the condition or illness may influence the aforementioned family interactions. The characteristics of the illness, specifically the age of onset, the potential outcome, and/or degree of incapacitation, as delineated by Rolland (1994) may influence parent-child relationships. When there is a diagnosis of a chronic or life-threatening illness during childhood or adolescence, parents may perceive their children as more vulnerable to health risks. For example, when compared to those

without cancer, parents of children and adolescents with cancer report having more worries about their child's health (Davies, Noll, DeStefano, Bukowski, & Kulkarni, 1991). This may lead these parents to be over-involved in the lives of their children. Families of adolescents with type 1 diabetes often do relatively less in promoting the development of independence among their members (Lawler, Volk, Viviani, & Mengel, 1990; Seiffge-Krenke, 1998). This parental over-involvement is thought to be detrimental to the development of autonomy or self-governance across time (Holmbeck et al., 2002). Further, it suggests that parents may need guidance in facilitating their children's development of responsibility for their health behavior, including tobacco use.

School: Strategies for Delivery of School-based Smoking Prevention

Helping children and adolescents avoid experimentation with and initiation of cigarette smoking is a high priority in the public health sphere. Both the school system (see Thomas and Perera, 2006 for a comprehensive review) and the healthcare system are well-positioned to address this issue. These systems—systems that children regularly interact with—have the opportunity to actively implement prevention programs. However, it is crucial not only to encourage the establishment of such programs, but also to evaluate and improve their effectiveness for those who are medically at-risk.

School-based smoking prevention programs experience greater popularity than success. A meta-analysis conducted by Rooney and Murray (1996) of school-based smoking prevention programs published between 1974 and 1991 found programs to have limited effects even under optimal conditions. The results suggest that the average reduction in smoking is around 0.10 standard deviation units. Another review of school-based programs by Thomas (2002) examined 76 randomized controlled trials using a narrative systematic review. The review identified a lack of evidence regarding the effectiveness of smoking prevention interventions and in many studies no effect at all. Among the more exemplary prevention interventions is the Hutchinson Smoking Prevention Project (HSPP). The results of HSPP point the same way, in that no long-term effects were observed (Peterson, Kealey, Mann, Marek, & Sarason, 2000). These studies provide the foundation for the growing sentiment that while school-based intervention programs have the unique potential to reach youth, they are falling short.

However, school-based prevention programs provided by school nurses could be a key to addressing smoking issues more successfully. Studies indicate that nurses are not only interested and willing (Hamilton, O'Connell, & Cross, 2004; Reinert, Carver, & Range, 2005), but also capable and effective to address this challenge (Miller, Gillespie, Billian, & Davel, 2001; Pbert et al., 2006b). School nurses are well-positioned to deliver such interventions as they typically have a long-term relationship with students and are considered to be a credible source of information and advice.

With respect to those who are medically at-risk, one way to better reach those students might be to selectively focus on children known to the school system as having health impairments. These students often have access to specialized or ancillary services (e.g., resource teachers and classrooms), and those would be appropriate opportunities to incorporate an enhanced antismoking component to the student's curriculum.

Healthcare: Strategies for Delivery of Healthcare-based Smoking Prevention

Similar to interventions performed in schools, interventions implemented in healthcare settings remain to be proven. Healthcare settings provide a rich opportunity for the delivery of tobacco prevention information from a credible and trustworthy source. The limited research on practice-based prevention interventions includes a study by Stevens and colleagues (Stevens et al., 2002); an intervention delivered through pediatric primary practices found no significant tobacco prevention effects. A later study led by Curry et al. (2003) employed a randomized controlled trial of family-based smoking prevention in managed-care and reported null effects as well. Thus, empirical data are scant and expert opinion is often used to develop guidelines (Pbert et al., 2003).

One of the advantages of technology in healthcare for users is that they can explore potential scenarios, simulate real world experiences, approach sensitive topics more easily, and allow practice of new skills—as well as provide evaluation data more quickly and reliably (Gustafson, Bosworth, Chewning, & Hawkins, 1987). Moreover, the Socratic (interactive) method is currently preferable over the didactic approach (Sussman, 2005). The wide availability of CDs, DVDs, and the Internet present opportunities for the development of creative educational strategies appropriate for use in medical clinics. This technology is particularly well-suited for use with small groups or individuals during short-time

intervals or for more extended learning through home follow-up.

Prevention remains a substantial challenge. Further research is required to better grasp what is effective and what is not. An expanded multi-setting, transdisciplinary approach could be promising, though may be resource-intensive. In addition, more subtle analyses focusing on other characteristics of the target audience (i.e., school absence, frequency of doctor visits, health status) will provide researchers with a greater understanding of the more intricate relationships. The few healthcare-based studies addressing smoking prevention and other risk-taking behaviors among medically at-risk youth that have been conducted have not yet been fully informative about these issues (Hudson & Findlay, 2006; Tyc & Throckmorton-Belzer, 2006) and underscore the need for more research in this area.

Summary and Recommendations

A multitude of factors contribute to morbidity caused by childhood chronic diseases, including smoking and other forms of tobacco use. Organ senescence in aging patients may accelerate presentation of health conditions characterized by subclinical injury or organ dysfunction resulting from chronic disease treatment, and genetic or familial characteristics may also enhance susceptibility to specific health risks. Health behaviors, including smoking, may also increase the risk of specific health complications predisposed by chronic disease. Preventive services are particularly important for medically at-risk youth because they are at higher risk for adverse health outcomes related to practicing health risking behaviors.

Based on the information in this review, we offer the following recommendations to promote study in the prevention of tobacco use in chronically ill populations (Table I). First, epidemiologic investigations of prevalence, pattern, and social and behavioral correlates among children with chronic diseases are needed. Second, there is a need for the consideration and revisiting of conceptual and theoretical models that could guide and inform understanding the nature of tobacco use among medically at-risk children. These models could also shed light on how to improve forecasting of smoking behavior and behavior change by including variables specific to the childhood chronic illness experiences. Next, efficacy studies in this high-risk population are necessary to prevent the onset of tobacco use and to control use in experimenters, specifically targeted to this population. Fourth, opportunities for the levels of prevention

Table I. Recommendations to Promote Study in the Prevention of Tobacco Use Among Medically At-risk Youth

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| 1. | Epidemiologic investigations: Prevalence, pattern, social, and behavioral correlates |
| 2. | Theoretical models to guide prevention efforts |
| 3. | Efficacy studies to prevent and control tobacco use |
| 4. | Consideration of the levels of prevention (individuals, families, schools, and healthcare) |
| 5. | Greater support and resources for implementation of programs |

(individuals, families, schools, and healthcare) highlighted in this work to contribute equally to the control of tobacco should be explored. This could be accomplished through increased patient and parent education programs, healthcare provider training programs and school-based efforts oriented to increasing awareness and understanding of effective measures. Lastly, greater support and resources are necessary for the implementation of programs designed to address one or more of the issues noted earlier. While these recommendations are broad, they have shown success in addressing tobacco control issues in healthy populations. The need now is to target existing programs to the health concerns of this special population to realize similar success. If left unchecked, the trajectory of smoking behavior among children with chronic illness may extend into adulthood, continue to complicate disease management, and contribute to disability (Schmitz, Kruse, & Kugler, 2007).

As noted throughout, delivery of care and systems models are available to guide and inform the development of programs to prevent tobacco use among those medically at-risk. Many open questions exist concerning who should deliver smoking prevention services to the members of this special population, what services should be delivered, where should service delivery take place, the optimal timing of delivery, the specific effects of chronic disease on children's risk factor profile and profile management. These opportunities exist in both clinical and research contexts, and fulfilling their potential is in the best interests of both patients' and the public's health.

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