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Position paper

Protecting Youth From the Risks of Electronic Cigarettes

The Society for Adolescent Health and Medicine

A B S T R A C T

The rapid increase in e-cigarette use among adolescents and young adults has led to drastic changes in patterns of nicotine consumption worldwide. The use of e-cigarettes, many of which contain high levels of nicotine, is especially harmful in this age group and is associated with increased use of cigarettes and other substances among youth. While the risks of short- and long-term e-cigarette use and secondhand aerosol exposure remain only partially understood, e-cigarettes should not be recommended for smoking cessation for youth in any circumstances given the lack of evidence for effectiveness and potential harmful physical and mental health effects. The perceptions of low e-cigarette risk of adolescents and young adults combined with few market regulations and the appeal of youth-friendly flavors, have created ideal conditions for the e-cigarette industry to thrive and place millions of youth at risk of developing an addiction to nicotine. Policies and regulations aiming to prevent youth-directed marketing and sales of e-cigarette and all nicotine delivery products are needed to protect young people. Public health-led education campaigns and educational curricula are also needed to help inform youth and families about the risks of e-cigarette use. While more research is required to determine the best ways to help youth quit e-cigarette use, adolescent health providers can play a key role in screening and counseling youth about e-cigarette use and should be adequately trained and supported to care for youth with e-cigarette addiction.

Positions

The Society for Adolescent Health and Medicine supports the following positions:

1. Advocate for policies and regulations to prevent marketing and sales of electronic cigarette (e-cigarette) products to youth.
2. Support public health–led education campaigns and educational curricula for schools, community programs, and health providers warning about the health risks of e-cigarette use by adolescents and young adults (AYAs).
3. Increase research to develop evidence-based guidelines for e-cigarette prevention and cessation for AYAs.
4. Support training for health providers to integrate screening for e-cigarette use into routine health visits for AYAs and increase the availability of evidence-based counseling and treatment resources for e-cigarette use cessation.

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Statement of the Problem

The use of e-cigarettes among AYAs is increasing worldwide [1,2]. In the U.S., e-cigarettes are the most common nicotine product used by adolescents. The prevalence of past-month e-cigarette use increased from .6% in 2011 to 4.9% in 2018 among middle school students and from 1.5% to 20.8% among high school students [2]. In Great Britain, lifetime e-cigarette use increased from 7% in 2016 to 11% in 2017 among youth aged 11–16 years [3]. Prevalence estimates of lifetime e-cigarette use across Asia include 9.3% among secondary school students in Hong Kong [4] and 4.4% among adolescents aged 15–17 years in Taiwan [5]. The rising prevalence of e-cigarette use counters the overall trend toward decreasing the use of cigarettes and many other psychoactive substances by children and adolescents [6].

These trends should be interpreted in the context of targeted marketing of e-cigarette products, the involvement of big tobacco companies in their manufacturing, and laws governing youth e-cigarette access. Historically, tobacco marketing has specifically targeted AYAs, and e-cigarette marketing has proven no different. Currently, the level of e-cigarette regulation across the world ranges from total bans to mass promotion. The

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proliferation of internet sale sites and specialized vape shops (which also sometimes carry other combustible tobacco products) are loosely regulated and represent common sources of e-cigarette access for AYAs.

E-cigarettes, also known as electronic nicotine delivery systems, contain a heating element that heats and aerosolizes e-liquids for inhalation. E-liquids usually contain nicotine, flavorings, and other chemicals, some of which are known carcinogens [7]. Fruit, mint, and candy/dessert flavor e-liquids are particularly preferred by youth [8]. There is significant variability in the size and shape of e-cigarette devices. More recently, small and discreet devices using prefilled cartridges or "pods" have become increasingly popular among youth [8]. Youth may refer to e-cigarettes by their brand name or by a variety of terms, including "vapes," "vape pens," "mods," "tanks," and "e-hookahs."

E-cigarettes are unsafe for AYAs [7] and should not be recommended for smoking cessation for individuals aged <25 years because of lack of evidence of their effectiveness in AYAs and potential harms associated with nicotine and other chemicals present in e-cigarette aerosols [9]. Recent reports of severe e-cigarette or vaping associated lung injury [10] and emerging research suggesting that e-cigarettes can interfere with lung lipid homeostasis emphasize the dangers of e-cigarette use [11].

Exposure to nicotine during adolescence affects key areas of the developing brain, including the hippocampus, prefrontal cortex, and amygdala, impacting attention, learning, and memory, and can worsen impulsivity, irritability, and anxiety and mood disorders [7]. Nicotine exposure raises the risk of lifelong nicotine addiction and is associated with the increased use of alcohol and other drugs [9]. Symptoms of nicotine dependence and withdrawal can appear after only a brief period of exposure and may interfere with school, work, and sports participation [7]. Nicotine itself also has harmful physiological effects on the cardiovascular, respiratory, immune, and gastrointestinal systems because of its stimulation of acetylcholine receptors [7]. Specifically, regular e-cigarette use has been associated with increased cardiovascular risk because of a shift in cardiac autonomic balance and increased oxidative stress [12]. Although e-cigarettes have been proposed by some as a harm reduction tool to aid cigarette cessation among adults, e-cigarette use has been shown to increase the risk of future cigarette smoking in AYAs [13]. Thus, this rising prevalence of e-cigarette use may undermine decades of progress in tobacco control by promoting nicotine addiction and subsequent tobacco use among youth.

Furthermore, secondhand e-cigarette aerosols have been shown to increase particulate matter in the air, which can be harmful and lead to preclinical cardiovascular disease [12]. For instance, moderately intense vaping in bars could result in hazardous levels of exposure to formaldehyde, acrolein, benzene, and diacetyl by nonusers, all of which are known carcinogens [14].

With a myriad of global approaches to the regulation of e-cigarettes, it is essential for clinicians to effectively counsel AYAs about the risks of e-cigarettes and to advocate for policies that protect the health and well-being of this population.

Methods

This position article was based on a critical review of the scientific literature on the use and health effects of e-cigarettes among AYAs up to September 2019 using the PubMed database and a series of keywords including "e-cigarettes," "vaping," "adolescents," "young adults," "health effects," "nicotine," "addiction," "policy," and "cessation." A review of existing practice guidelines was also conducted and discussed among a multidisciplinary group of 10 expert coauthors until consensus was reached on the following positions and recommendations.

Positions and Recommendations

Position 1: Advocate for policies and regulations to prevent marketing and sale of e-cigarette products to youth

The sale of e-cigarette products should be banned for AYAs until sufficient evidence for their harm reduction benefit or effectiveness as a cessation tool is demonstrated. However, short of that, e-cigarette policies and regulations should:

a. ban all marketing of e-cigarette products reaching AYAs.
b. prohibit sale of high nicotine content and all flavored e-cigarette products known to appeal to AYAs.
c. limit e-cigarette sales to controlled settings with strict age verification policies and implement stricter control over online sales.
d. establish perimeters around schools where e-cigarettes cannot be purchased.
e. support adequate taxation rates on nicotine-containing e-cigarette products with the objective of reinvesting earnings in e-cigarette prevention and treatment initiatives for youth.
f. include e-cigarettes in smoke-free legislation and, therefore, prohibit the use of e-cigarettes where tobacco cigarette smoking is otherwise prohibited.

The increase in e-cigarette marketing targeting youth poses a threat to decades of antismoking public health campaigns by renormalizing smoking, decreasing risk perceptions, and increasing benefit perceptions of tobacco products [15]. Youth who have never used tobacco are receptive to tobacco advertising, and exposure to e-cigarette advertising is an independent risk factor for subsequent use of combustible tobacco products [16]. Current restrictions on conventional tobacco product marketing should extend to e-cigarettes, including banning the marketing of e-cigarettes via the internet, social media, outdoor media, on television, and in print form. Although the e-cigarette industry argues that high nicotine content and flavors are not meant to appeal to youth, AYAs are consistently receptive to advertisements for flavored e-liquids and, in fact, believe advertisements for flavored e-liquids target individuals of their age, not older adults [8,17]. Moreover, as e-cigarette use has consistently been associated with increased risk of future combustible tobacco use [13], federal regulatory agencies such as the Food and Drug Administration should implement stricter control over online sales of e-cigarette products with clear age verification policies.

Youth living in municipalities that have stricter tobacco and e-cigarette licensing regulations—such as a minimum age of 21 years for purchasing any tobacco or e-cigarette products—have lower rates of e-cigarette use compared with youth living in municipalities with looser regulations [18]. State and local jurisdictions should prohibit online sales and should limit the retail environment of e-cigarette sales to controlled settings with strict age verification policies. Increasing the purchase price through taxation has been shown to effectively reduce and prevent the use of conventional tobacco products and associated public health harms and should, therefore, be similarly considered for

e-cigarettes. Taxation policies should follow the best practices recommended by the World Health Organization's Tobacco Free Initiative. Increasing evidence of the impact of tobacco retail environments on smoking behaviors among youth suggests that regulations should be expanded to effectively reduce the density and proximity of tobacco retailers in school and residential neighborhoods [19]. Although research is still lacking on the optimal size of school perimeters within which e-cigarettes or tobacco products should not be available for purchase, a distance of 1,000 feet (300 m) from schools has been proposed as an effective strategy to reduce youth access to these products [20].

Position 2: Support public health–led education campaigns and educational curricula for schools, community programs, and health providers warning about the health risks of e-cigarette use by AYAs

Specifically, public health education initiatives should:

a. include effective educational and promotional materials rigorously designed and tested with youth by adolescent and public health stakeholders and free of industry influence or bias, based on successful and evidence-based tobacco cessation approaches.
b. avoid fear-based campaigns and overly strict disciplinary consequences, for which evidence of effectiveness is lacking.
c. empower schools to create partnerships with public health and health care provider groups to develop best practices to support cessation among youth who are vaping at school.
d. reach youth and their families through a variety of settings, including online, in schools, through community organizations and at health care settings.
e. support the development of standardized labeling practices and health warnings for all e-cigarette products, especially those containing nicotine.

Youth-focused education campaigns have contributed to impressive declines in AYA cigarette smoking rates in the past three decades. Although perceptions of riskiness of tobacco cigarettes are high among youth, the perceived riskiness of e-cigarette use remains low among AYAs [6]. In fact, many AYAs are unaware that most e-cigarette products contain nicotine, often at high concentrations, signaling important knowledge gaps in this population [21]. Importantly, youth with low perceived riskiness of e-cigarettes are significantly more likely to use e-cigarettes as well as cigarettes, other tobacco products, alcohol, and other substances [22].

There is an important need for evidence-based education campaigns informing youth and their families about the true risks and consequences of e-cigarette use. Because of prior interference in effective public health messages, the e-cigarette industry should not be allowed to participate in editorial content development for antitobacco and/or anti–e-cigarette educational campaigns [23]. Previous successful campaigns from the Truth Initiative have shown that providing unbiased information and informing youth about misleading advertising messages from large tobacco companies can be highly effective in reducing rates of cigarette use. This approach could be adapted to e-cigarettes and translated into school education curricula and health promotion resources. Clear graphic warnings, which have been shown to be more effective than text-only warnings [24], on all e-cigarette products could also increase perceptions of risk and help inform youth about the actual contents of the products they are being exposed to.

Position 3: Increase research to develop evidence-based guidelines for e-cigarette prevention and cessation for AYAs

Specifically, e-cigarette research should:

a. prioritize the prevention of e-cigarette use and the development of evidence-based treatments for e-cigarette discontinuation in AYAs through behavioral and pharmacologic interventions.
b. inform evidence-based guidelines for the prevention and treatment of e-cigarette use (as well as polysubstance use), including how best to partner with schools and support youth who use e-cigarettes.
c. characterize the short- and long-term effects of e-cigarette exposure (including secondhand aerosol exposure) on the health of AYAs.

Adolescence and young adulthood, a sensitive period in brain development, is a period of enhanced vulnerability to risk taking and developing substance use disorders. In fact, although the nucleus accumbens, the center of pleasure and reward processing of the brain, is already well developed in adolescents, the prefrontal cortex, which is responsible for rational thinking and executive decision-making, continues to mature until the mid-20s. For this reason, research efforts aiming to prevent e-cigarette use among AYAs or delay its initiation are particularly important, given the potential for long-term health benefits into adulthood.

Youth who use e-cigarettes and those exposed to secondhand e-cigarette aerosols inhale not only nicotine but also several known toxicants and carcinogens traditionally found in combustible cigarette smoke [14]. The current literature identifies pulmonary, cardiovascular, neurologic, and immunologic adverse effects and suggests that there is no safe level of direct and secondhand aerosol exposure for youth; however, further research characterizing the short- and long-term effects of e-cigarette aerosols on the health and well-being of AYAs is needed [7]. This research should be free of industry involvement and include youth at every step of the process [23].

It is now well-established that e-cigarettes should not be recommended to AYAs for smoking or tobacco cessation [9]. However, there is a lack of evidence on how to treat youth presenting with an addiction to nicotine delivered primarily through e-cigarettes. Further research is critical to better understand the forces driving initiation, sustained usage, and cessation of e-cigarettes in AYAs and to elucidate evidence-based strategies aimed at reducing e-cigarette use and treating resultant nicotine dependence and addiction among youths.

Position 4: Support training for health providers to integrate screening for e-cigarette use into routine health visits for AYAs and increase availability of evidence-based counseling and treatment resources for e-cigarette use cessation

Specifically, training and capacity building for AYA health care providers should include:

a. training and educational materials to screen for, provide counseling about e-cigarette use, and support e-cigarette cessation in the context of regular, drop-in, and school-based health care.

b. training and resources for counselors and behavioral health specialists to have the tools to effectively counsel youth about e-cigarettes and refer to medical providers when indicated.

Many health providers feel unprepared to counsel AYAs about e-cigarettes [25]. Evidence-based training should be provided to all health care providers, including primary care, school-based, and behavioral health specialists regarding the harmful health effects of e-cigarette use. This training should be integrated into medical and allied health undergraduate and postgraduate training program curricula to inform providers and trainees about the latest research in this area. The use of free and existing evidence-based prevention and education materials should be encouraged.

Routine screening for tobacco use, including e-cigarettes in the context of primary care and school-based health care, has been recommended by several professional associations worldwide. Evidence-based frameworks building on motivational interviewing principles, which have been used successfully in youth with cigarette use, can be adapted to the context of e-cigarette use and disseminated to all health care providers working with AYAs. Asking about secondhand smoke and aerosol exposure should also be a routine part of clinical screening and exposure prevention counseling.

Finally, provider education should include information on how to identify nicotine dependence and withdrawal symptoms in AYAs and referral resources for addiction treatment and cessation programs. When possible, providers working with AYAs should be trained to care for AYAs with e-cigarette use and resultant nicotine dependence and addiction and have access to the latest evidence-based recommendations, including information about pharmaceutical treatments, such as nicotine replacement therapy, and non-pharmaceutical methods. Nicotine replacement therapies have been shown to be safe and effective and should be approved for over-the-counter purchase by adolescents to increase access. Other medications such as bupropion and varenicline are not yet approved for use in youth under the age of 18 years, and further efficacy trials are needed [7].

Summary

In less than a decade, e-cigarettes have emerged as the primary source of nicotine use among AYAs in many countries worldwide. Although the harms of e-cigarette use and secondhand aerosol exposure remain only partially understood, e-cigarettes should not be recommended for smoking cessation for AYAs, given the lack of evidence of effectiveness, potential effects on brain development and physical health, and risk for increased use of tobacco products and other substances. Concerted efforts between health providers, public health experts, AYAs, researchers, policy makers, and community partners are critical to prevent new addiction and to curb this new substance use epidemic among youth.

Prepared by:

Nicholas Chadi, M.D., M.P.H.
Division of Adolescent Medicine, Sainte-Justine University Hospital Center, Montréal, Quebec, Canada

Deepa R. Camenga, M.D., M.H.S.
Yale School of Medicine, New Haven, Connecticut

Sion K. Harris, Ph.D.
Division of Adolescent/Young Adult Medicine, Harvard Medical School, Boston Children's Hospital, Boston, Massachusetts

Abbey Masonbrink, M.D., M.P.H.
Children's Mercy Hospital, University of Missouri-Kansas City School of Medicine, Kansas City, Missouri

Nicola J. Gray, Ph.D.
International Association for Adolescent Health, NCD Child, UK Association for Young People's Health, London, United Kingdom

Seth Ammerman, M.D.
Alliance Medical Center, Healdsburg, California

Matthew Meyers, M.D., M.P.H.
Division of Adolescent and Young Adult Medicine, University of California, San Francisco, San Francisco, California

Swati Bhave, M.D., D.C.H.
Dr. D.Y. Patil Medical College, Pimpri & Dr. D.Y. Patil Vidyapeeth and Association of Adolescent and Child Care in India (AACCI), Pune Maharashtra, India

Hoda S. Abdel Magid, M.H.S., Ph.D.
Department of Health Research & Policy, Stanford University Stanford, California

Jonathan D. Klein, M.D., M.P.H.
Department of Pediatrics, University of Illinois at Chicago, Chicago, Illinois

References

[1] Yoong SL, Stockings E, Chai LK, et al. Prevalence of electronic nicotine delivery systems (ENDS) use among youth globally: A systematic review and meta-analysis of country level data. Aust N Z J Public Health 2018;42:303–8.
[2] Gentzke AS, Creamer M, Cullen KA, et al. Vital signs: Tobacco product use among middle and high school students — United States, 2011–2018. MMWR Morb Mortal Wkly Rep 2019;68:157–64.
[3] Bauld L, MacKintosh AM, Eastwood B, et al. Young people's use of e-cigarettes across the United Kingdom: Findings from five surveys 2015-2017. Int J Environ Res Public Health 2017;14:973.
[4] Chen J, Ho SY, Leung LT, et al. School-level electronic cigarette use prevalence and student-level tobacco use intention and behaviours. Sci Rep 2019;9:1690.
[5] Chang H-C, Tsai Y-W, Shiu M-N, et al. Elucidating challenges that electronic cigarettes pose to tobacco control in Asia: A population-based national survey in Taiwan. BMJ Open 2017;7:e014263.
[6] Johnston LD, Miech RA, O'malley PM, et al. Monitoring the future national survey results on drug use, 1975-2018: Overview, key findings on adolescent drug use. Ann Arbor: Institute for Social Research, University of Michigan; 2019. Available at: http://www.monitoringthefuture.org/pubs/monographs/mtf-overview2018.pdf. Accessed February 11, 2019.
[7] U.S. Department of Health and Human Services. E-cigarette use among youth and young adults: A report of the Surgeon General. Atlanta, GA: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health; 2016. Available at: https://e-cigarettes.surgeongeneral.gov/documents/2016_SGR_Full_Report_non-508.pdf. Accessed June 3, 2018.
[8] Nguyen N, McKelvey K, Halpern-Felsher B. Popular flavors used in alternative tobacco products among young adults. J Adolesc Health 2019;65:306–8.
[9] National Academies of Sciences Engineering and Medicine. Public health consequences of e-cigarettes. Washington, DC: Health and Medicine Division;

2018. Available at: http://nationalacademies.org/hmd/Reports/2018/public-health-consequences-of-e-cigarettes.aspx. Accessed June 2, 2018.
[10] Siegel DA, Jatlaoui TC, Koumans EH, et al. Update: Interim guidance for health care providers evaluating and caring for patients with suspected e-cigarette, or vaping, product use associated lung injury — United States, October 2019. MMWR Morb Mortal Wkly Rep 2019;68:919–27.
[11] Madison MC, Landers CT, Gu B-H, et al. Electronic cigarettes disrupt lung lipid homeostasis and innate immunity independent of nicotine. J Clin Invest 2019;129:4290–304.
[12] Moheimani RS, Bhetraratana M, Yin F, et al. Increased cardiac sympathetic activity and oxidative stress in habitual electronic cigarette users. JAMA Cardiol 2017;2:278.
[13] Soneji S, Barrington-Trimis JL, Wills TA, et al. Association between initial use of e-cigarettes and subsequent cigarette smoking among adolescents and young adults: A systematic review and meta-analysis. JAMA Pediatr 2017;171:788–97.
[14] Logue JM, Sleiman M, Montesinos VN, et al. Emissions from electronic cigarettes: Assessing vapers' intake of toxic compounds, secondhand exposures, and the associated health impacts. Environ Sci Technol 2017;51:9271–9.
[15] Roditis M, Delucchi K, Cash D, Halpern-Felsher B. Adolescents' perceptions of health risks, social risks, and benefits differ across tobacco products. J Adolesc Health 2016;58:558–66.
[16] Pierce JP, Sargent JD, White MM, et al. Receptivity to tobacco advertising and susceptibility to tobacco products. Pediatrics 2017;139:e20163353.
[17] McKelvey K, Baiocchi M, Ramamurthi D, et al. Youth say ads for flavored e-liquids are for them. Addict Behav 2019;91:164–70.
[18] Astor RL, Urman R, Barrington-Trimis JL, et al. Tobacco retail licensing and youth product use. Pediatrics 2019;143:e20173536.
[19] Magid HSA, Halpern-Felsher B, Bradshaw P, et al. Tobacco retail environment and alternative tobacco product use among teens. J Adolesc Health 2019;64:S17–8.
[20] Myers AE, Hall MG, Isgett LF, Ribisl KM. A comparison of three policy approaches for tobacco retailer reduction. Prev Med 2015;74:67–73.
[21] Boykan R, Messina CR, Chateau G, et al. Self-reported use of tobacco, e-cigarettes, and marijuana versus urinary biomarkers. Pediatrics 2019;143:e20183531.
[22] Cooper M, Loukas A, Case KR, et al. A longitudinal study of risk perceptions and e-cigarette initiation among college students: Interactions with smoking status. Drug Alcohol Depend 2018;186:257–63.
[23] Institute of Medicine. Scientific standards for studies on modified risk tobacco products. Washington, DC: The National Academies Press; 2012. Available at: https://doi.org/10.17226/13294. Accessed November 21, 2019.
[24] Francis D, Mason N, Ross J, Noar S. Impact of tobacco-pack pictorial warnings on youth and young adults: A systematic review of experimental studies. Tob Induc Dis 2019;17:41.
[25] Pepper JK, McRee A-L, Gilkey MB. Healthcare providers' beliefs and attitudes about electronic cigarettes and preventive counseling for adolescent patients. J Adolesc Health 2014;54:678–83.