

## Position Statement

# Protecting children and adolescents against the risks of vaping

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### Abstract

Youth vaping presents significant risks for the health and safety of Canadian children and adolescents. This statement provides background information about vaping, vaping products, and related devices, discusses the short- and long-term harms known to be associated with their use, and offers prevention and cessation strategies for youth who vape or are at risk for starting. Youth vaping is associated with increased risk for tobacco and other substance use, mental health problems, pulmonary and cardiovascular disease, and unintentional injuries. Vaping should not be used as a smoking cessation tool for youth, due to lack of effectiveness and evidence of harm. Many preventive and treatment strategies used for tobacco cessation, including behavioural and pharmacological options, can be adapted to help youth quit vaping. Recommendations for community stakeholders and policy makers are included.

**Keywords:** *Adolescent; Cannabis; Injury; Nicotine; Substance use; Vaping*

Despite an overall trend toward stable or decreasing substance use among children and adolescents in North America over the past decade, the use of vaping devices is on the rise (1,2). This phenomenon threatens to undermine steady decreases in the use of cigarettes and other forms of tobacco thanks to decades of work by public health (3,4).

In 2019, 36% of adolescents aged 15 to 19 years reported having tried vaping at some point, with 15% having vaped in the previous 30 days. This is nearly five times more than among adults aged 25 years and older (5). Among youth who reported vaping, the majority (87%) used liquids containing nicotine (5). It is also becoming more common for adolescents and young adults who use cannabis recreationally to employ a vaping device containing cannabis (6).

Multiple factors contribute to vaping product use among youth. Individual risk factors include use by peers, curiosity, the desire to experiment, a perceived lack of harmful effects from vaping, and a history of tobacco product use. Leading

environmental risks include exposure to vaping-related marketing campaigns and easy access to vaping products at low cost (7–9). Regulatory approaches to reduce youth vaping include restricting youth-directed advertising of vaping products, banning flavoured vaping products (except tobacco flavoured), adopting a 20 mg/mL nicotine concentration limit, restricting the sale of products to adults, and restricting the use of vaping products in public places. Such regulation can impact youth vaping behaviours significantly (10–12).

Because vaping products are relatively new, their long-term health effects are still largely unknown. However, the literature increasingly suggests several short- and medium-term health risks, including vaping-related lung injuries, burns, and nicotine and cannabis use disorders.

This position statement provides an overview of vaping and related products and devices, and describes the harms associated with youth vaping. It offers preventive and cessation strategies to help protect youth against the risks of vaping, and

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concludes with recommendations for health providers, community stakeholders, and policy makers.

## VAPING PRODUCTS

Electronic vaping devices, marketed initially as smoking cessation tools, became more widely available in North America around the year 2000 (13). Many early device models looked like traditional cigarettes and had limited appeal for youth. A first surge in the popularity of vaping among youth occurred in 2013/2015, fuelled by perceived low risk (14,15), aggressive youth-directed marketing campaigns (16), and the proliferation of both pen-like and larger, complex devices delivering a wide range of youth-attracting flavours (1). A second rise in popularity occurred in 2017/19, when smaller devices shaped like USB keys, with prefilled cartridges (pods), arrived on the market (17). Youth refer to vaping devices using various terms such as 'e-cigs', 'vapes', 'pens', and 'mods', as well as commercial brand names (18).

Vaping product designs vary widely, but most have a common mechanism. A liquid-filled compartment connected to a battery-powered metal coil produces, when heated, a mix of vapour and fine particles (an 'aerosol') that is inhaled through a mouthpiece (19). Vaping liquids, commonly referred to as 'e-liquids', 'e-juice', or simply 'juice', commonly have added flavouring agents and may contain nicotine (often highly concentrated in the form of nicotine salts), or cannabis (usually with higher concentrations of tetrahydrocannabinol [THC] than traditional dried cannabis) (20). Flavourings and psychoactive substances (e.g., nicotine and THC) are dissolved in solvents that are either aqueous (e.g., propylene glycol for nicotine or flavoured products), or oil-based (for cannabis products) (20). E-liquids also contain trace amounts of many chemicals and heavy metals, including acrolein, acetaldehyde, nickel, and lead, exposure to which can be toxic or carcinogenic (21).

Different techniques or 'vape tricks' (e.g., making smoke rings or patterns) may enhance the vaping experience (22) but have been shown to increase risk for severe and problematic vaping in youth (23). Techniques such as 'ghosting' (holding aerosol in the lungs for several seconds, making it apparently 'disappear') allows discrete use in public places where vaping is expressly forbidden (such as school classrooms [22]). 'Dripping' is the technique of leaking an e-liquid directly onto the heating coil for direct inhalation of the aerosol produced, which can cause stronger psychoactive effects but also increases risk for injuries from contact with a burning liquid (24). 'Dabbing' refers to heating highly concentrated cannabis products to create an aerosol, which is also considered a form of vaping (25). Using these terms in clinical practice can allow clearer and more effective discussions with youth who vape.

## HARMS ASSOCIATED WITH VAPING

### Pulmonary and cardiovascular risks

Research has shown that youth who vape are exposed to many chemicals, both from aerosols inhaled directly (first-hand) and passive (second-hand) exposures (26). Several irritating and some carcinogenic substances can also cause chronic cough, bronchitis, asthma exacerbation, and decreased exercise tolerance (27). Because vaping products are relatively new, their carcinogenic risks over the longer term compared with other tobacco or cannabis products are unknown. However, several studies have raised concerns about vaping as a long-term risk factor for poor cardiovascular health (28).

Between August 2019 and March 2020, nearly 3000 cases of vaping product use-associated lung injury (VALI) were reported in Canada and the USA, of which approximately 15% were in youth under the age of 18 years (29). VALI is a sterile inflammatory pneumonitis caused by inhaling the fine chemicals found in vaping aerosols, which triggers a pulmonary immune response (30). Clinical presentation includes cough, chest pain, and shortness of breath that can be severe and lead to hospitalization, or even death (31,32). VALI presents with diffuse pulmonary infiltrates on chest x-ray and nonspecific abdominal and constitutional symptoms that may lead to diagnostic delays and misdiagnosis (31). VALI is a diagnosis of exclusion made in the absence of an infectious etiology. While vitamin E acetate (found in several cannabis-containing e-liquids sold on the black market) has been identified in several severe cases, other chemicals that have yet to be identified may present similarly. VALI has occurred in individuals who had only used nicotine-containing products (29).

### Unintentional injuries and ingestions

Two national surveys of Canadian paediatricians conducted in 2015 and 2019 revealed a significant number of severe vaping-related injuries or ingestions requiring medical attention in children and youth (33,34). Mishaps included ingesting e-liquids, which caused acute gastrointestinal symptoms and other symptoms of nicotine toxicity (e.g., tachycardia, headache, and dizziness). Most of these incidents occurred in children under the age of 5. The importance of mandatory child-proof packaging and containers for liquid nicotine products to prevent ingestion is established by evidence and cannot be overstated (35). There are also several reports in the paediatric literature of severe burns to face and head (sufficient to cause morbidity and scarring) and ocular injuries (leading to enucleation and/or vision loss in some cases) due to device malfunctions (36–38). Other vaping hazards include driving or riding a bicycle under the influence of THC, which can alter cognition and proprioception significantly (39).

### Problematic use

Many of the harms associated with vaping stem from the psychoactive substances found in most e-liquids (40). These are nicotine and THC primarily, although other substances, such as stimulants, opioids, and hallucinogens, can also be consumed using a vaping device (20). Nicotine is a particularly addictive substance due to its rapid onset and intense stimulation of reward pathways in the brain (41,42). THC, a liposoluble substance, triggers the brain's reward circuitry in a similar but slower, more prolonged manner (43).

Although their short-term effects are different, both nicotine and THC have been shown to impact brain development and increase risk for problematic use of both licit and illicit substances (44–46). In fact, vaping has been independently associated with increasing risk for future tobacco and cannabis use regardless of past exposure to traditional cigarettes (47,48). Also, the younger the age of onset for nicotine or cannabis use, the greater the impact on future risk for substance use disorders. Efforts to prevent youth vaping could have lifelong benefits (49).

Consuming high amounts of nicotine when vaping, sometimes called 'dosing', can lead to nicotine toxicity, a syndrome characterized by intense abdominal pain, nausea, vomiting, palpitations, hand tremors, headaches, difficulty concentrating and, in severe cases, seizures and arrhythmia (50). Similarly, high potency cannabis products can lead to adverse, acute mental health effects such as paranoia and psychotic symptoms (51). The development of nicotine or THC dependence through repeated vaping can cause withdrawal symptoms when a youth tries to quit or cannot access vaping products (46,52). Withdrawal symptoms include intense cravings, irritability, nervousness, depressed mood, headaches, and insomnia. Such symptoms may appear after only a few weeks of use and can be highly problematic. They can interfere with normal youth health and functioning, and be a barrier to cessation (53,54).

### Mental health

Vaping has been associated with high-risk behaviours and adverse mental health outcomes, notably depression and suicidality (55,56). While the mental health risks of vaped nicotine or THC may be similar to those of smoked or ingested forms of either substance (56–58), the high nicotine and THC concentrations found in vaping products (often two to five times higher than smoked products) could amplify these risks (59,60). The cross-influences of both substances, which are often also combined with use of alcohol and other drugs, have been associated with increasing risk for developing serious mental health conditions, such as major depressive disorder, generalized anxiety, bipolar disorder, and schizophrenia (61,62). However, the role of vaping as a risk or cause of specific mental health problems is still unclear.

## SCREENING AND BRIEF INTERVENTION

Paediatric health care providers (HCPs) should address the risks of vaping with all the adolescents they see. Prevalence studies conducted in school settings have suggested that discussions should take place starting at age 12 years, or earlier when appropriate (63). After explaining the benefits (and limits) of confidentiality, an HCP should ask about vaping behaviours, informally at first and then, when appropriate, using an assessment tool, which many young people prefer to direct questioning (64). Standardized screening tools for alcohol and substance use behaviours, such as Screening to Brief Intervention (S2BI) (65) or Car-Relax-Along-Forget-Friends-Trouble (CRAFTT) (66), can be adapted to direct vaping discussions.

For example, S2BI uses one validated question that can be adapted to vaping: 'In the past year, how many times have you used a vaping device?' Using terms familiar to youth or commercial brand names may elicit more information than the term 'vaping device' (54). For youth who have tried vaping, ask follow-up questions (Table 1) to assess which products and substances are being used, the individual's motives and contexts for using, frequency, intensity, and finally, level of motivation to cut down or quit. Using a standardized scale for nicotine dependence (e.g., the Hooked on Nicotine Checklist [67]) or diagnostic criteria for cannabis use disorder (CUD) in the Diagnostic and Statistical Manual of Mental Disorders (DSM-5) (68) can elucidate the degree of vaping-related nicotine and/or cannabis dependence.

Pending the development of validated vaping-specific tools, a five-step algorithm used for tobacco cessation—the 5 As: Ask, Advise, Assess, Assist, and Arrange—is a helpful framework for a counselling intervention on vaping (69). For more on the 5 As, see Strategies to promote smoking cessation among adolescents (70). Additional tips are found in Counselling adolescents and parents about cannabis: A primer for health professionals (71).

After **asking** about vaping, HCPs should **advise** youth not to start (or to cut down or quit) vaping, and share common health risks associated with it, such as VALI. They should also **assess** each youth's motivation to cut down or quit. The use of a 10-point scale allows for an exploration of motives from the youth's perspective (i.e., 'On a scale from 1 to 10, how motivated are you to cut down or quit vaping?') with 10/10 indicating the highest level of motivation. Based on the response, clinicians should then offer to **assist** the effort, through behavioural or (when indicated) pharmacological strategies and supports. Finally, providers should **arrange** an appropriate follow-up plan, involving family members or specialists when appropriate.

## TREATMENT APPROACHES

### Behavioural strategies

Behavioural strategies used for youth to treat tobacco or cannabis dependence (or both) should be considered first-line

**Table 1.** Assessment questions for youth who report using a vaping product or device

Questions	Rationale
<p><b>Product information</b></p> <ul style="list-style-type: none"> <li>• What type and brand of vape are you using?</li> <li>• Where and how do you obtain your cartridges, pods, or vaping liquid?</li> <li>• Do they come from a legitimate vendor, or could they be black market products?</li> </ul>	<p>Early data suggest that illicit market products are associated more strongly with VALI and other vaping-related harms. Elicit and report product-level information for public health authorities in cases of vaping-related injury or illness.</p>
<p><b>Vaping substances</b></p> <ul style="list-style-type: none"> <li>• What type of cartridge or liquid do you usually use? Are there others you sometimes use?</li> <li>• Do they contain nicotine? THC? Flavouring?</li> <li>• Do you know the concentration (or milligram content) of nicotine or THC in the cartridge or liquid you use?</li> </ul>	<p>Vaping nicotine and THC place youth at risk for nicotine and CUD, and products with higher concentrations of either appear to carry greater risk for VALI.</p>
<p><b>Motives</b></p> <ul style="list-style-type: none"> <li>• How old were you when you started vaping?</li> <li>• Why did you start?</li> <li>• Why do you continue to vape? What are the downsides of vaping you've experienced?</li> </ul>	<p>Early-onset substance use is associated with greater lifetime risk for substance use disorders. Examining the reasons for vaping can inform motivational interviewing and cessation counselling.</p>
<p><b>Context</b></p> <ul style="list-style-type: none"> <li>• How long after you wake up do you first vape?</li> <li>• Are you vaping at home, in school, or at work?</li> <li>• Do you vape alone? Or with friends or family?</li> </ul>	<p>Context can inform cessation counselling.</p>
<p><b>Frequency and intensity</b></p> <ul style="list-style-type: none"> <li>• How many days per week/times per day are you vaping? Do you vape regularly throughout the day?</li> <li>• How long does a cartridge last? How many cartridges do you go through in a typical week?</li> <li>• Or, how much liquid do you use in a typical day or week?</li> </ul>	<p>Frequent use places youth at risk for withdrawal symptoms, requiring support planning.</p>
<p><b>Vaping-related harms</b></p> <ul style="list-style-type: none"> <li>• Have you tried quitting?</li> <li>• How long were you able to go without vaping?</li> <li>• What happens when you stop? Do you experience cravings (strong feelings that you want to use again) or other negative feelings?</li> <li>• If vaping nicotine: Do you experience symptoms of nicotine withdrawal (i.e., irritability, depressed mood, difficulty concentrating, feeling restless, increased appetite)?</li> <li>• If vaping THC: Do you experience negative impacts from use, or symptoms of cannabis withdrawal (i.e., anxiety, hostility, difficulty sleeping, low appetite, depressed mood)? <ul style="list-style-type: none"> <li>◦ Have you ever experienced episodes of persistent vomiting?</li> <li>◦ Have you ever experienced symptoms of paranoia and/or heard voices or seen things that weren't really there?</li> </ul> </li> </ul>	<p>Cessation attempts can be hampered by cravings and other withdrawal symptoms. For nicotine, symptoms can be reduced with pharmacotherapy.</p>

Note: Using vaping terms familiar to youth is advised

Adapted from reference (54).

THC Tetrahydrocannabinol; VALI Vaping-associated lung injury.

therapies for youth who vape (72). Some examples include individual or peer group counselling, motivational interviewing, cognitive-behavioural therapy, contingency management, mindfulness-based interventions, as well as app- and

web-based approaches (40,54). A description of behavioural strategies that can be adapted for vaping cessation can be found in Strategies to promote smoking cessation among adolescents (70).



For youth who are reluctant to cut down or quit, harm reduction strategies may be considered, although evidence supporting this approach is lacking. Advice might include replacing vaping products from illicit or unverified sources with legal products, switching to products with lower concentrations of THC or nicotine, and avoiding combining vaping with other substance use (i.e., tobacco smoking, alcohol, caffeinated energy drinks, or other drugs).

### Pharmacological strategies

One prefilled nicotine cartridge can contain the equivalent in nicotine of one to two packs of cigarettes (5). Nicotine replacement therapy (NRT) using patches, gums, and lozenges, has been shown to be safe for youth, though evidence of effectiveness for smoking and vaping cessation in youth has been mixed (73). NRT may be considered to help reduce withdrawal symptoms and nicotine cravings (54), but always in combination with non-pharmacological (i.e., behavioural) strategies (73). Instructions for NRT use in youth are described in Table 2 (54,73,74).

Bupropion (sustained release) and varenicline have improved smoking cessation rates in adults, but evidence for their effectiveness in youth is inconclusive (75). If used, bupropion should always be combined with NRT and behavioural strategies, and varenicline should only be considered in youth aged 17 years and older (54). Due to concerns about the safety and effectiveness of bupropion and varenicline use in paediatrics, HCPs should seek guidance from an experienced adolescent or addiction medicine specialist before prescribing either medication (54).

Evidence for the effectiveness of pharmacology in treating cannabis dependence and managing withdrawal in motivated youth is limited, but growing (76). Three different agents, N-acetylcysteine (77,78), gabapentin (79), and oxytocin (80) have been the focus of a small number of studies, with promising results, but optimal strategies for use in youth are unknown. Other potential agents include topiramate and naltrexone, though more research is needed (81). The use of pharmacological grade THC products, such as nabilone, in lieu of cannabis-containing vaping products, has been reported, but also requires further study (81).

## RECOMMENDATIONS

To help protect children and youth from the harms of vaping **health care providers should:**

1. Not recommend vaping as a smoking cessation or harm reduction strategy. There is no reliable evidence that vaping is an effective smoking cessation strategy for youth.
2. Address the issue of vaping pre-emptively with youth and families seen in practice. Vaping, smoking, and problematic cannabis use are related paediatric problems.

3. Routinely assess youth for vaping, with evidence-based screening tools when needed.
4. Educate youth and families about the risks of:
  - exposure to first- and second-hand vaping aerosols,
  - ingesting vaping substances,
  - malfunctioning vaping devices, and
  - using unregulated vaping products.
5. Use behavioural strategies that have proven effective for controlling misuse of other substances to help teens reduce or quit vaping: specifically, motivational interviewing, individual or group counselling, and mobile or online resources, reminders, and reinforcements.
6. Consider offering nicotine replacement therapy (NRT, using patches, gum, or lozenges)— but always in combination with behavioural strategies— for youth with nicotine dependence or who are experiencing withdrawal symptoms from nicotine-containing vaping product use.

Emerging evidence suggests that interventions led by community stakeholders such as schools, local public health, and youth organizations can have a significant positive impact on preventing and reducing youth vaping (17,72). While information on specific models is lacking, the following general recommendations are supported by the available evidence (82,83):

### Community stakeholders should:

1. Educate youth about the risks of vaping through educational curriculums and local health initiatives geared to youth. These should involve public health experts and be free from industry influence or bias.
2. Support schools in restricting vaping product use and exposure, including appropriate consequences for vendors and youth who break such rules.
3. Facilitate access to health and counselling services for youth instead of basing interventions on disciplinary or monetary consequences.

Regulations at all levels of government have significantly reduced tobacco smoking (84–86). As per Canada's Tobacco and Vaping Products Act and recommendations from many allied health organizations and guidelines (72,87–89), the following recommendations are made to Canadian government and regulatory bodies. These recommendations should be supported by systems and funding directed specifically toward them.

### Government and regulatory bodies should:

1. Include vaping when and wherever smoke-free policies apply.
2. Limit the sale of vaping products to controlled settings where minors are not allowed (such as vape shops), strictly regulate online sales and ensure that online retailers have

**Table 2.** Nicotine replacement therapy for vaping cessation

Characteristics	Nicotine replacement product (e.g., patch, gum, lozenge, spray)
Mechanism	Full agonist that binds to nicotinic cholinergic receptors
Clinical indications	<ul style="list-style-type: none"> <li>• Daily vaping of nicotine-containing products</li> <li>• Withdrawal symptoms or cravings that interfere with cessation attempts</li> <li>• Hospitalization or other circumstances that preclude vaping</li> </ul>
Dose and administration	<p>Combining a nicotine patch with a short-acting nicotine product to reduce breakthrough cravings is recommended.</p> <p><b>Nicotine patch (for maintenance dose):</b> Apply to skin on a hairless area between the neck and waist, every 24 h (change site daily).<sup>*</sup> Dose based on the amount of nicotine used per day, calculated by volume <i>and</i> concentration of e-liquid:</p> <ul style="list-style-type: none"> <li>• 0–25 mg of nicotine salts: 7 mg patch</li> <li>• 25–50 mg of nicotine salts: 14 mg patch</li> <li>• 50–100 mg of nicotine salts: 21 mg patch</li> </ul> <p>Use maintenance patch for 4–6 weeks, then switch to the next lowest dose patch for 2–4 weeks. Continue weaning until patient is able to resist cravings using behavioural strategies alone.</p> <p><b>Short-acting nicotine<sup>†</sup> (for breakthrough cravings):</b> Gum: Use one piece (2 mg or 4 mg) every 1–2 h. Chew gum slowly until taste is apparent, then ‘park’ it between gums and cheek for optimal absorption. Chew intermittently for about 30 minutes. Lozenge: Use one lozenge (1, 2, or 4 mg) every 1 to 2 h Nicotine inhalers and oral or nasal sprays are also available but their use in youth is discouraged due to risks for misuse and reinforcing effects (54,73)</p>
Other considerations	Nicotine replacement products are available over the counter but should always be prescribed because they are covered by both public and private insurance plans until age 18.

<sup>\*</sup>Patches can be worn during the day only or overnight, and the latter may help reduce morning cravings. Local skin reactions are seen in some patients and may be treated by rotating the patch site or using a mild topical steroid. <sup>†</sup>In adults smoking cigarettes, 4 mg gum and lozenges have typically been recommended for patients whose first cigarette is within 30 minutes of waking. Otherwise, 2 mg gum or lozenges are recommended. How these recommendations might apply to youth who vape is unclear. In general, however, treatment should begin with more frequent use of short-acting nicotine products, followed by increasing intervals between doses (e.g., one piece of gum or a lozenge every 1–2 h for weeks 1–6, then every 2–4 h for weeks 7–9, and every 4–8 h for weeks 10–12).

Adapted from references (54,73,74).

- strict age verification policies, and meaningfully increase enforcement mechanisms to prevent the sale of unregulated vaping products.
- Ban the sale of all flavoured vaping products.
- Establish perimeters around schools where vaping products cannot be purchased or used.
- Prohibit youth-oriented sponsorship or marketing strategies for all vaping products, along with claims of vaping-related health benefits.
- Strengthen and enforce standard health warnings for all vaping products, packaging, and advertising.
- Ensure that all vaping products are sold in child-proof packaging or containers.
- Adopt a 20 mg/mL nicotine concentration limit for all vaping products. Several provincial and international jurisdictions have already adopted such limits (12), and limit THC concentrations in vaping products.
- Ensure that NRT and other medications used to help reduce vaping frequency or aid cessation are available to youth at no cost.
- Tax vaping products and designate proceeds to support vaping prevention and treatment initiatives.
- Support research on vaping prevalence and trends, as well as prevention and treatment strategies.

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