



## Vaping products including e-cigarettes

Evidence summary, current as of January 2, 2020

### Purpose

This document provides healthcare providers working in cancer and primary care a brief evidence summary on vaping products, including e-cigarettes. It addresses the observed and potential health impacts of vaping products, including the development of vaping dependence, vaping's impact on youth smoking rates and vaping as a smoking cessation aid.

### Key messages

- The risk of cancer, cardiovascular disease and other health impacts associated with vaping are unknown or emerging.
- Vaping should be avoided by anyone who does not smoke. Vaping products expose users and bystanders to toxic substances, but at lower levels than tobacco smoke.
- Health professionals should ask their patients about their current or past use of vaping products, the substance(s) vaped and whether they have any symptoms of pulmonary illness (e.g., cough, shortness of breath, chest pain). Public hospitals must report incidences of vaping-related severe pulmonary disease.
- Anyone who currently uses or has used vaping products should monitor themselves for symptoms of pulmonary illness and seek medical attention if they have concerns about their health.
- There is substantial evidence showing that vaping can lead to symptoms of dependence. Vaping may increase the likelihood of youth and young adults trying tobacco cigarettes.
- Evidence for vaping as a smoking cessation aid is limited. However, there is strong evidence to recommend using medication (e.g., varenicline, nicotine replacement therapy, bupropion) and counselling either alone or in combination.
- No vaping products have been approved by Health Canada for use as a smoking cessation aid.
- Vaping might be beneficial for adult smokers who find it hard to quit using recommended smoking cessation aids.

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## Approach

A limited number of published reviews deemed to be comprehensive and relevant have provided the basis for this summary. These reviews are broadly referenced among Ontario Health's (Cancer Care Ontario) scientific partners. A search in PubMed did not find newer, similarly comprehensive reviews. However, several recently published individual studies were included following input from the expert reviewers of this summary.

## Background

Vaping products, including e-cigarettes, have been designed as an alternative to smoking tobacco.<sup>1</sup> In the health research literature, these devices are often referred to as “electronic nicotine delivery systems (ENDS).” In general, and in this document, vaping products that are mentioned usually refer to nicotine-containing products.

“Vaping” is a mode of delivery that does not produce smoke: vaping devices heat a solution or substance, which is typically held in a replaceable cartridge, to a temperature that is below the point of combustion. The heated solution or substance produces an aerosol that can be inhaled. As a result, vaping does not generate the toxic by-products of combustion that are responsible for most of smoking's toxicity.<sup>2</sup>

The main substances in vaping solutions are vegetable glycerine and/or propylene glycol, which are commonly mixed with flavourings and nicotine.<sup>1</sup> Vaping devices may also be designed to heat other substances, such as oils, dried cannabis and cannabis concentrates.<sup>1</sup> The long-term safety of inhaling vaping substances is unknown.

## Vaping in Ontario

Canada's *Tobacco and Vaping Products Act* permits adults to access vaping products that contain nicotine.<sup>1</sup> The *Smoke-Free Ontario Act, 2017* prohibits vaping in the same places where smoking is prohibited, restricts the display of vaping products in retail settings and bans the sale or supply of vaping products to persons under the age of 19.<sup>3</sup>

In terms of advertising regulations, the *Tobacco and Vaping Products Act* permits advertising and promotion of vaping products, except for advertising that suggests that products are part of an appealing lifestyle or advertising that appeals to youth.<sup>1</sup> The act also bans advertising and promotion that suggest that vaping provides health benefits, such as helping users to quit smoking.<sup>1</sup> Approval from Health Canada is required before health benefits may be promoted for specific products.<sup>4</sup> To date, no vaping products have received this approval.<sup>5</sup>

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As of January 1, 2020, the promotion of vaping products in Ontario is banned in convenience stores, grocery stores and gas stations, but with limited exceptions for informational signs and documents. It will continue to be allowed in specialty vape stores and cannabis retail stores, which are only open to people age 19 and older.<sup>6</sup>

Systematic reviews of research in tobacco control have shown that point-of-sale tobacco promotion is associated with increased smoking among youth;<sup>7-9</sup> however, the impact on youth vaping when vaping products are promoted at the point of sale is unknown.<sup>10</sup>

In 2017, 13 percent of people in Ontario age 15 and older reported ever having used an e-cigarette, but only two percent reported e-cigarette use in the past 30 days.<sup>11</sup> In the same year, 19 percent of Ontario youth ages 15 to 19 reported ever having used an e-cigarette and four percent reported e-cigarette use in the past 30 days.<sup>11</sup> A study of vaping prevalence among youth in Canada, England and the United States suggested that there was a substantial increase in vaping among youth in Canada and the United States, from 2017 to 2018.<sup>12</sup>

Cartridges for some newer products contain a high concentration of nicotine in salt form, which is believed to make high-nicotine aerosols easier to inhale<sup>12</sup> and easier for the body to absorb the nicotine.<sup>13</sup> Vaping products with a high nicotine content allow the user to absorb nicotine at rates close to rates of absorption measured with smoking.<sup>13,14</sup> These newer products are popular among youth who vape, and their emergence on the market may be associated with an increase in the prevalence and the frequency of vaping among youth.<sup>12</sup> One product that became available on the market in Canada in 2018<sup>15</sup> contains about 40 milligrams of nicotine in each cartridge or about five percent nicotine by weight.<sup>16</sup> In comparison, the European Union has limited nicotine concentrations in vaping products to 20 milligrams per millilitre or about two percent nicotine by weight.<sup>17</sup>

## **Observed and potential harms**

### **Toxicity**

As substances are heated in a vaping device, some toxic substances (including known carcinogens), such as acrolein, formaldehyde and fine particulate matter, are produced, but at substantially lower levels than tobacco smoking.<sup>2</sup> A few small clinical studies and animal models examining vaping substances found that they can cause DNA damage.<sup>2</sup>

### **Outbreak of vaping-related lung disease**

An outbreak of vaping-related lung disease throughout the United States continues to be investigated, as of the date of this summary.<sup>18</sup> The Centers for Disease Control and Prevention (CDC) in the United States stated that the cases have clinical similarities and has identified vitamin E acetate, which is used to thicken vaping

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substances, as the primary chemical of concern.<sup>18</sup> Most patients reported a history of using vaping products containing tetrahydrocannabinol (THC).<sup>18</sup> Since August 2019, the CDC has been providing frequent updates that can be accessed from its homepage that show an increasing number of cases and deaths.<sup>18</sup> In its update on December 27, 2019, the CDC stated that 2,561 lung disease cases and 55 deaths linked to using vaping or e-cigarette products have been identified.<sup>18</sup>

In Canada, as of December 27, 2019, 14 lung disease cases related to vaping have been reported to the Public Health Agency of Canada.<sup>19</sup> Four reported cases are from Ontario, five are from Quebec, two are from New Brunswick and three are from British Columbia.<sup>19</sup> A description of a recent case in Ontario has been published in the Canadian Medical Association Journal.<sup>20</sup>

Health Canada has issued an advisory for anyone who currently uses or has used vaping products to monitor themselves for symptoms of lung disease and seek medical attention if they have concerns about their health.<sup>21</sup> More information is available from the Government of Canada's webpage, "[Vaping-associated lung illness](#)."<sup>19</sup>

Ontario's Minister of Health has issued a Minister's Order that requires public hospitals to provide the Chief Medical Officer of Health with statistical, non-identifying information related to incidences of vaping-related severe lung disease.<sup>22</sup>

## Health effects including chronic diseases and risk of dependence

The long-term health impacts of vaping, including the risk of cancers and cardiovascular diseases, are unknown.<sup>2</sup> However, there is emerging evidence of respiratory effects associated with vaping. In a 2019 review, a small number of cross-sectional studies found that youth and adults who vaped had an increased risk of respiratory symptoms, such as chronic coughing, phlegm and asthma exacerbations.<sup>23</sup>

In terms of second-hand exposure, vaping increases airborne concentrations of particulate matter and nicotine in indoor environments and, therefore, exposure to bystanders. However, concentrations of particulate matter and nicotine are lower with vaping than tobacco smoking.<sup>2</sup>

There is substantial evidence that vaping products can lead to symptoms of dependence, and that vaping may increase the likelihood of youth and young adults trying tobacco cigarettes.<sup>2</sup> A few studies suggest that youth and young adults who vape may go on to smoke cigarettes more frequently and use a greater number of cigarettes.<sup>2</sup> Another study suggested that increased vaping from 2017 to 2018 has coincided with a considerable increase in Canadian youth who smoke tobacco.<sup>12</sup> In addition, a 2017 Canadian survey found that youth who reported using cannabis and youth who reported using alcohol in the past 12 months were more likely to have used e-cigarettes in the past 30 days.<sup>24</sup>

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Because many vaping products contain nicotine, the health risks associated with using nicotine must also be considered. Nicotine is highly addictive and can increase the risks of cardiovascular events (e.g., heart attack, stroke) in people with pre-existing cardiovascular disease.<sup>2</sup> Nicotine can harm the development of brain circuits related to attention, learning and susceptibility to addiction in youth,<sup>25</sup> which may have future consequences for educational attainment and success in life.

Other safety concerns or potential hazards associated with vaping devices include faulty batteries, which can cause explosions leading to blast injuries. Poisoning can also occur if skin is exposed to too much nicotine or if children accidentally ingest vaping substances.<sup>26</sup>

## Vaping as a smoking cessation aid

Evidence for vaping as an effective smoking cessation aid is inconclusive according to reviews from the Smoke-Free Ontario Scientific Advisory Committee,<sup>27</sup> Public Health Ontario,<sup>28</sup> the Ontario Tobacco Research Unit (OTRU),<sup>29</sup> and the National Academies of Sciences, Engineering and Medicine in the United States.<sup>2</sup> Two recent large randomized clinical trials in England and New Zealand, which were published in 2019, found that e-cigarettes in combination with other products or supports served as an effective smoking cessation aid for some smokers.<sup>30,31</sup> The study in England found that many participants were still using e-cigarettes after one year, and researchers from both studies emphasized that participants should ideally stop using e-cigarettes altogether.<sup>30,31</sup>

Public Health England suggests that the availability of vaping products has helped a substantial number of smokers in England successfully quit smoking.<sup>32</sup> The smoking cessation service, provided through the United Kingdom's National Health Service, provides advice on how to use vaping products to quit smoking.<sup>33</sup>

OTRU has suggested that while evidence on the use of vaping products as a cessation aid continues to develop, their lower level of toxicity may be helpful as a harm reduction strategy for adult smokers who have had trouble quitting.<sup>34</sup> However, OTRU notes that many smokers who use e-cigarettes also smoke tobacco cigarettes and therefore remain at risk of smoking-related illnesses.<sup>34</sup>

## Additional resources

[Health Canada](#) and [the Ontario Tobacco Research Unit](#) have resources that can help health professionals advise patients and the general population on the health effects of vaping.

The Training Enhancement in Applied Counselling and Health (TEACH) has a free webinar on e-cigarettes, intended for health professionals to increase their knowledge. The webinar can be found on the [TEACH archive](#), dated May 15, 2019.

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