

## SYNTHESIS

10/2/2020

# Vaping and COVID-19 – What We Know So Far

## Introduction

Public Health Ontario (PHO) is actively monitoring, reviewing and assessing relevant information related to Coronavirus Disease 2019 (COVID-19). “What We Know So Far” documents are intended to provide a rapid review of the evidence related to a specific aspect or emerging issue related to COVID-19.

## Key Findings

- While evidence on vaping and COVID-19 infection risk is very limited, two studies report that COVID-19 diagnosis was more likely among individuals who vape, suggesting that they are at a higher risk of COVID-19 infection.<sup>1,2</sup>
- There is evidence that vaping impacts lung function, thereby increasing the risk of COVID-19 infection and/or severity of COVID-19 outcomes.<sup>3</sup> The negative impacts of tobacco smoke on respiratory and overall health is well-documented. Individuals who vape and smoke tobacco cigarettes (dual use) may have an elevated risk due to continued exposure to burnt tobacco.<sup>4</sup>
- Use of vaping products may also pose an increased risk of COVID-19 infection through frequent hand-to-mouth contact and using these devices in social settings or sharing with others.<sup>4,5</sup> More research is needed in this area.
- Experts comment that aerosols generated by vaping products could be involved in the transmission of the virus when individuals are in close proximity of others who have been diagnosed with COVID-19 and are vaping.<sup>6</sup>
- The World Health Organization (WHO) acknowledges that the hand-to-mouth action of vaping may increase the risk of infection.<sup>7</sup> Additionally, the British Columbia (BC) Centre for Disease Control recommends staying two metres away from others and vaping outside to reduce the risk of infection. Due to the higher risk of complications of COVID-19 among individuals who vape, they recommend reducing or quitting vaping to lessen the risk.<sup>8</sup>

## Background

E-cigarettes/vapes are battery-operated devices that electronically heat a solution to create an inhalable aerosol. They do not contain tobacco, do not involve burning, or produce smoke.<sup>9</sup> However, many vaping products do contain nicotine, which comes from tobacco. E-cigarettes/vaping devices were first introduced in the early 2000s and have evolved rapidly.

While the act of using an e-cigarette is called vaping, these devices produce an aerosol (a suspension of tiny particles of liquid, solid or both within a gas, and can contain many chemicals), not vapour

(substance in the gas phase). The aerosol produced from these devices has been found to contain: propylene glycol, glycerol, flavours, carbonyl compounds, volatile organic compounds (VOCs), metals, and nicotine. A number of the chemicals found in the aerosol produced from vaping devices have known toxicity (e.g. formaldehyde).<sup>9</sup>

The 2019 Canadian Tobacco and Nicotine Survey (CTNS) found the majority of Canadians who vape (82%) use products containing nicotine and for youth (15-19 years of age), a minority indicated that they vape to reduce or quit smoking.<sup>10</sup> The CTNS also found vaping is most prevalent among Canadians aged 24 and younger. Based on the Canadian Tobacco, Alcohol and Drugs Survey 2017 in Ontario, vaping is most prevalent among youth (18%) (15-18 year-olds), young adults (21%) (19-24 year olds), males (18%) and current smokers (49%).<sup>11</sup>

The negative impacts of tobacco smoke on respiratory and overall health are well-documented. Smoking tobacco is a known risk factor for respiratory diseases, such as influenza.<sup>12,13</sup> The health impacts of vaping are less established. However, there is emerging evidence that vaping may impact the susceptibility and/or ability to recover from respiratory infections.<sup>14,15</sup> For example, e-cigarettes and vaping are associated with acute lung injury.<sup>16,17</sup> Studying e-cigarettes is an emerging and complex research area because of the diverse designs, functions and ingredients of vaping products.

The relationships between e-cigarette use/vaping and COVID-19 are still largely unknown. Determining the role of vaping in COVID-19 and related outcomes is important. If vaping is a confirmed risk factor for COVID-19 (infection or adverse outcomes), this may represent a modifiable risk factor, with opportunity to reduce risk in some individuals.

This document examines the evidence related to vaping product/e-cigarette use on the risk of COVID-19 infection and severity of outcomes.

## Methods

The development of these “What We Know So Far” (WWKSF) documents includes a systematic search of the published literature as well as scientific grey literature (e.g., [ProMED](#), [CIDRAP](#), [Johns Hopkins Situation Reports](#)) and media reports, where appropriate. Relevant results are reviewed and data extracted for synthesis. All WWKSF documents are reviewed by PHO subject-matter experts before posting.

To identify relevant evidence on this vaping topic, systematic searches in MEDLINE, Embase, CINAHL and Scopus databases were conducted between August 30th and September 1st, 2020 by PHO Library Services. A grey literature search was conducted for the websites of key organizations (e.g., WHO, Centers for Disease Control and Prevention (CDC)). Relevant reports from PHO were also included. As this is a rapidly evolving area, to provide context, we included pre-print literature, letters to the editor, and commentaries within our searches. Hand searching of bibliographies from included articles was also completed to identify relevant studies. Two reviewers screened all titles and abstracts in duplicate, and then 50% of full text versions in duplicate. Any need for clarification was discussed among the two reviewers. An updated search was conducted on September 21, 2020 to identify any newly published literature.

As the COVID-19 outbreak continues to evolve and the scientific evidence rapidly expands, the information provided in these documents is only current as of the date of posting.

## Vaping and Susceptibility to COVID-19 Infection

No studies were identified that directly measure the relationship between individuals who vape and whether they experience an increase in risk of COVID-19 infection. Thirteen articles were identified that discuss COVID-19 susceptibility among individuals who vape.<sup>1,2,4,6,7,18-26</sup> Vaping products are relatively new; comparisons among studies are challenging because they are evolving in design, diversity of ingredients and functions.<sup>3</sup> Vaping products often contain nicotine and produce aerosol instead of smoke. The use of vaping products has been associated with lung damage.<sup>27,28</sup> Independent of nicotine exposure, particulates and flavourings in e-cigarette/vape aerosols could also potentially impair lung function.<sup>3</sup>

## Vaping Behaviour

Three articles reported vaping behaviour that may be associated with COVID-19 transmission, unrelated to inhalation.<sup>4,5,24</sup> The act of vaping involves frequent hand-to-mouth contact which may increase opportunities to contract COVID-19.<sup>4,5</sup> It is also common for individuals who vape to share devices, and to vape in a group setting and/or confined spaces.<sup>5</sup> These types of actions increase the possibility of viral transmission from hand to mouth and being in close contact with others which are known risk factors for transmission of COVID-19.<sup>4,5,24</sup> Recent data from experimental studies have found that the virus remains stable for several hours to days on surfaces, which makes it plausible for the virus to be transmitted via surfaces of vaping devices.<sup>24</sup>

## COVID-19 Diagnosis Associated With Vaping

Two identified studies analyzed relationships between vaping and COVID-19; one is a population-based analysis using individual-level data on risk factors and the second is an ecological study.<sup>1,2</sup>

Gaiha et. al.<sup>2</sup> conducted a population-based study of youth and young adults to determine whether there was an association between youth smoking, vaping and COVID-19. They found that among young people (ages 13-24 years), a COVID-19 diagnosis was five times more likely among ever users of vaping products only, seven times more likely among ever dual use of vaping products and tobacco cigarettes, and 6.8 times more likely among individuals with dual use in the past 30-days compared to youth who have never vaped before. These findings were adjusted for several major confounders, such as age, sex and obesity. The researchers concluded that COVID-19 is associated with youth use of vaping devices only and dual use of vaping devices and tobacco cigarettes. The authors suggested that their findings have implications for health care providers to screen all youth, especially those that have been infected with COVID-19, for current and a history of vaping. They also highlighted the importance of education in a variety of settings, such as schools, homes, and community-based organizations to support the learning among youth on the use of vaping products, dual use and the impact on the respiratory and immune systems. The authors highlighted the importance of dissemination of youth-focused COVID-19 prevention messaging which would include vaping and dual use.

An ecological study (observational study at the population level) pre-print by Li et. al.<sup>1</sup> indicates some jurisdictional-level correlation in vaping prevalence and proportion of COVID-19 infections and associated deaths in each United States (US) state. Although the study design has limitations and potential confounding effects (e.g., socioeconomic status, underlying health status), the findings do suggest a plausibility of association.

## Potential Role of Cell Receptors

Smoking is one predictor of an individual's likelihood of developing a viral infection, especially a respiratory infection.<sup>19,25</sup> There are hypotheses that individuals who vape would also be at increased risk of developing viral infections. More research is needed to examine these hypotheses.

The angiotensin-converting enzyme 2 (ACE2) is the binding site for the virus causing COVID-19, facilitating its entry into the body.<sup>23</sup> There are studies that have found that nicotine (from smoking tobacco cigarettes) creates an increase in ACE2 expression in the body.<sup>20,21</sup> Given the affinity of COVID-19 for ACE2, these findings raise a concern that nicotine vaping products may also put users at greater risk of COVID-19.<sup>20-22,25</sup> ACE2 levels have also been associated with influencing disease progression.<sup>18,19</sup>

The vast majority of the studies on ACE2 and nicotine have been based on smoking tobacco. While it has been suggested that there would be a similar result among those who use other tobacco and nicotine products, such as vape products, studies are needed to confirm this hypothesis.<sup>18,20-22,25,26</sup>

Further research is needed to determine the role that vaping plays in the susceptibility to and severity of COVID-19 and the relationship with ACE2.

## Vaping, COVID-19 Severity and Outcomes

There is preliminary evidence around the potential role of smoking and/or vaping on COVID-19 infection and severity.<sup>29</sup> Three review articles highlighted indirect studies that reported individuals who vape/smoke may be at a higher risk for severe COVID-19 illness or need mechanical ventilation when compared to non-smokers.<sup>25,30,31</sup> It is hypothesized that the increased risk of contracting COVID-19 and the eventual complications among individuals who smoke/vape are due to delayed clearance of the virus.<sup>25,30</sup> Individuals who vape and smoke tobacco cigarettes (dual users) are considered to be at an increased risk of COVID-19 severe illness since they continue to be exposed to tobacco smoke.<sup>4</sup>

E-cigarette or vaping associated lung injury (EVALI) is an inflammatory response in the lungs triggered by inhaled substances.<sup>16,17</sup> EVALI was newly identified in North America in August 2019. There are concerns of possible coexisting infection with COVID-19 since many of the EVALI symptoms are similar to those of COVID-19.<sup>26,32</sup> Harrill et. al. highlighted concern that in the US, the footprint of the EVALI epidemic nearly mirrors that of current COVID-19 pandemic reported cases, thus matching regional social behavior risk with current regional pandemic risk.<sup>33</sup> EVALI risk among the population who vape represents a possible increased risk of severe COVID-19 illness.<sup>33</sup>

Public health organizations and medical experts around the world are raising concerns that those who smoke and/or vape may be at higher risk for COVID-19 infection susceptibility, severity, and adverse outcomes.<sup>8,34-39</sup> Recently, the CDC reported that adults between 20-44 years of age comprised 20% of COVID-19 hospitalizations in the US.<sup>18,40</sup>

More evidence is needed to determine the impact of vaping on the lungs and whether this impact increases an individual's susceptibility to COVID-19 infection and severity of COVID-19 illness.<sup>26,32</sup>

## Aerosol and COVID-19 Transmission

No studies were identified that directly measure the relationship between aerosol from vaping products and increased risk of COVID-19 infection. However, there is evidence for COVID-19 transmission via

aerosols.<sup>6,23</sup> There is also evidence highlighting the potential for aerosol transmission for other respiratory illnesses such as Middle East Respiratory Syndrome-associated coronavirus (MERS-CoV), Ebola virus<sup>41</sup> and influenza.<sup>42</sup>

The predominant mode of transmission of COVID-19 is via respiratory droplets during close, unprotected contact.<sup>23</sup> Aerosols may be generated during aerosol generating medical procedures (AGMPs), which may increase the risk of transmission.<sup>23</sup> Therefore, it is plausible that the aerosols generated from vaping products may increase COVID-19 transmission.

The WHO acknowledges that there is no evidence about the relationship between vaping and COVID-19, they suggest that given COVID-19 affects the respiratory tract, the hand-to-mouth action of vaping may increase the risk of infection.<sup>7</sup> Additionally, the BC Centre for Disease Control states that while we do not know if one can contract COVID-19 from e-cigarette aerosol, they recommend staying two metres away from others and vaping outside to reduce the risk of infection. They also suggest, that due to the higher risk of complications of COVID-19 among individuals who vape, they recommend reducing or quitting vaping to reduce the risk.<sup>8</sup> This is concerning as the prevalence of e-cigarette use among Canadian youth has increased substantially between 2013 and 2019.<sup>43</sup>

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