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# VAPING, NICOTINE, AND TOBACCO: NEW TRENDS, NEW CONCERNS

## DISCLOSURE STATEMENT

- The content for this self-study course was written by Carol A. Jahn, RDH, MS, an employee of Water Pik, Inc., a wholly owned subsidiary of Church & Dwight Co., Inc.
- This course was designed, developed, and produced by Water Pik, Inc.
- Water Pik, Inc. manufactures and distributes products addressed in this course.

## COURSE OBJECTIVE

This course will help dental professionals understand changes in tobacco and nicotine use, especially by youth. The impact of tobacco and nicotine use on oral and systemic health is also covered.

## LEARNING OUTCOMES

- Describe the changes in tobacco and cigarette use over the last decade
- Understand the addictive nature and potential harm of nicotine
- Identify the systemic and oral health risks of tobacco use
- Evaluate the potential risks from e-cigarettes/vaping
- Discuss the role of dental professionals in tobacco use prevention and cessation

## INTRODUCTION

The use of tobacco in the United States dates back to colonial Jamestown, where tobacco is believed to have been one of the first cash crops grown in the United States. Forty years ago, there were nearly 180,000 tobacco-growing farms in the U.S. Today, the number is around 12,000. Despite this decrease, the U.S. is still one of the largest tobacco-producing countries in the world behind China, India, and Brazil.<sup>1</sup>

Tremendous strides have been made in tobacco control over the last 55 years. Adult smoking rates have fallen from 45% in 1965<sup>2</sup> to 13.7%<sup>3</sup> today. Initiatives such as prohibiting smoking in most public places and enacting higher excise taxes have played a significant role in decreasing the number of smokers. However, some of these same initiatives may be drivers for emerging trends in tobacco and nicotine use. When considering current adult use of any tobacco product (cigarettes, cigars, smokeless tobacco, pipes, and e-cigarettes), the rate of use increases to 19.7%.<sup>3</sup> Nearly 19% of people use more than one tobacco/nicotine product.<sup>3</sup>

Today, teen use of combustible (traditional) cigarettes is at an all-time low of 5.8%.<sup>4</sup> Instead, youth have found that e-cigarettes/vaping provide a lower-cost and better-tasting alternative to combustible cigarettes.<sup>4</sup> The 2019 Monitoring the Future

survey conducted by the National Institute on Drug Abuse at the University of Michigan found that the incidence of youth vaping continues to rise among eighth, tenth, and twelfth grade students<sup>5</sup> (Table 1).

The top reasons youth cite for vaping are the flavor of the products, social reasons, or positive feelings/pleasure. Many are not aware that nicotine is in what they are vaping. The number of students indicating that they are addicted and "have to vape" more than doubled to 8.6% in 2019, up from 3.6% in 2018.<sup>5</sup>

Table 1: Teen Use of E-cigarettes/Vaping with Nicotine – 2019<sup>5</sup>

	Daily use	Use in the past month
Eighth-graders	1.9%	9.6%
Tenth-graders	6.9%	19.9%
Twelfth-graders	11.7%	25.5%

## NICOTINE ADDICTION

The 1988 Surgeon General's report concluded, "Cigarettes and other forms of tobacco are addicting." Prior to that, smoking was referred to as habitual, and cigarettes were considered socially acceptable. Thus, there was a reluctance to use the term addict due to its association with illicit drug use. Framing cigarette smoking as an addiction helped refute the tobacco industry's argument that people become smokers by their own choice.<sup>2</sup>

More people are addicted to nicotine than to any other abused substance. The effect of nicotine from a cigarette on the brain occurs within seconds of inhalation. Nicotine activates the reward pathways that regulate feelings of pleasure. As with other addictive substances, dependence upon nicotine is characterized by impaired control over drug use, compulsive use, continued use despite harm, and craving.<sup>6</sup>

Genetics play a role in risk, use, and the ability to quit.<sup>6</sup> It is estimated that 50–75% of the risk of nicotine addiction is attributable to genetic factors. Genes also influence nicotine metabolism. This impacts the number of cigarettes smoked, responsiveness to cessation medication, and the chance of successfully quitting.<sup>6</sup>

Nicotine addiction is influenced by dose and delivery. The bioavailability of nicotine is greatest via the lung or oral mucosa.<sup>2</sup> A recent study indicates that cigarettes today may contain 15% more nicotine than in 1999, potentially making them even more addictive than in the past.<sup>7</sup> The inhalation of tobacco smoke results in the intake of 1–2 milligrams of nicotine per cigarette. The average smoker takes about 10–20 puffs per cigarette. People who smoke a pack of cigarettes per day would get up to 200 hits of nicotine to the brain every day.<sup>8</sup> In comparison, the most popular brand of e-cigarettes, JUUL® provides one milligram of nicotine per puff. A JUUL® cartridge, also called a pod, provides around 200 puffs, thus delivering a similar level of nicotine as smoking a

pack of cigarettes.<sup>9</sup> For cigar, pipe, or smokeless tobacco users, the nicotine is absorbed through the mucosal membrane and reaches the brain more slowly.<sup>2,8</sup>

The adrenaline kick from nicotine is short in duration, creating the desire to smoke another cigarette or take another vaping puff. When people stop using products with nicotine they experience withdrawal symptoms (**Table 2**). The symptoms can begin within a few hours of the last use.<sup>6</sup> This is a driving factor in why 85% of people who try to quit relapse within the first week.<sup>7</sup> In many cases, withdrawal symptoms will subside within a few weeks; however, in some people they may persist for months.<sup>6</sup>

• Irritability
• Anxiety
• Craving nicotine
• Depression
• Cognitive and attention deficits
• Sleep disturbances
• Increased appetite

Nicotine dependence in adolescence is most likely to occur within 1 year of weekly or daily use. The earlier the initiation to nicotine, the more quickly a weekly or daily habit will develop.<sup>10</sup> Some youth experimenting with smoking become addicted in as few as 100 cigarettes. This dependence can be predictive of establishing a long-term smoking habit.<sup>11</sup>

Nicotine exposure during adolescence and early adulthood can have a lasting impact on the developing brain. Nicotine may harm areas of the brain responsible for executive functioning, reasoning, decision-making skills, self-discipline, and impulse control. The result can be an increase in drug-seeking behaviors, deficits in attention and cognition, and mood disorders.<sup>10</sup>

There is a strong association between mental health disorders and cigarette smoking.<sup>6</sup> A higher prevalence of smokeless tobacco use in this group has also been found. People with a mental illness are 2 to 4 times more likely to smoke and often tend to smoke more heavily.<sup>6</sup> Smoking is highest among those with schizophrenia, bipolar disorder, and depression. People with mental health disorders are less likely to stop smoking.<sup>6</sup> There has been a belief that smoking may ease some mental illness symptoms. Emerging research contradicts this.<sup>12</sup> Instead, people with a mental health disorder who stop smoking have been shown to have improvements in depression, anxiety, stress, psychological quality of life, and positive affect compared with those who continue to smoke.<sup>12</sup>

## AVAILABLE TOBACCO AND NICOTINE PRODUCTS

Tobacco companies spend \$25 million each day in the U.S. marketing their products.<sup>1</sup> More than 49 million adults, 8 million high school students<sup>4</sup>, and 2.9 million middle schoolers<sup>4</sup> use a tobacco product<sup>3</sup> (**Table 3**). One in 4 high school seniors have used a vaping device in the last month as have 1 in 5 tenth graders and 1 in 10 eighth graders.<sup>5</sup> A little over a year ago, a new noncombustible heat-not-burn cigarette became available.

Product	Adults <sup>3</sup>	Middle & High School Students
Cigarettes	13.7%	4.3%
Cigars	3.9%	5.3%
E-cigarettes	3.2%	20.0%
Smokeless Tobacco	2.4%	3.5%
Pipes	1.0%	0.8%

Cigarette smoking is the number one cause of preventable death and disability. More men (15.6%) than women (12.0%) smoke combustible cigarettes.<sup>3</sup> Education is inversely associated with smoking as the lowest rate is among those with a graduate degree or higher (3.7%) versus the rate for those with a GED (36.0%).<sup>3</sup> Cigarette use is also high among deployed military<sup>13</sup> and military veterans<sup>14</sup> (**Table 4**). Military deployment is associated with starting to smoke and with continuing to smoke, especially in those with prolonged or multiple deployments and combat exposures.<sup>13</sup>

Marine Corps	30.8%
Army	26.7%
Navy	24.4%
Coast Guard	19.9%
Air Force	16.7%
Veterans	21.6%

The Federal Drug Administration (FDA) began regulating combustible cigarettes in 2009 including banning all flavorings with the exception of menthol. Menthol provides a minty taste that may reduce the harshness of smoking. More than 19.5 million smokers use menthol tobacco products. Minority populations

African American Smokers	85.5%
Hispanic Smokers	46.0%
Asian Smokers	39.0%
White Smokers	28.7%

smoke menthol cigarettes at a higher rate than white smokers (Table 5). Youth who smoke are more likely to smoke menthol cigarettes than older smokers. Menthol cigarettes may be harder to quit than non-menthol ones.<sup>15</sup>

**Cigars** are the second most used form of tobacco after cigarettes. There are 3 types of cigars: large cigars, cigarillos, and little cigars. Because cigars are generally puffed versus inhaled, they are often perceived as safer. However, they contain many of the same toxins and carcinogens as cigarettes and are not a safer alternative.<sup>16</sup> A large cigar contains about the same amount of nicotine as an entire pack of cigarettes.<sup>17</sup>

Cigars, cigarillos, and little cigars are available in a wide range of youth-appealing flavors.<sup>16</sup> Recent data indicates that 5.3% of middle and high school students reported current use (in the past 30 days). Teen cigar use often occurs in conjunction with the use of e-cigarettes/vaping; 17.2% of teens reported using both products.<sup>4</sup>

**Smokeless tobacco** products have expanded in recent years and now include products that do not require spitting. Without spitting, the products may be deemed a more convenient way for a smoker to consume nicotine when cigarette smoking is not possible. Smokeless tobacco products are available in many youth-friendly flavors. One new product that has attracted youth is called snus. It is a moist snuff packaged in a ready-to-use pouch that resembles a tea bag. It does not require spitting.<sup>18</sup>

Like cigars, smokeless products are absorbed through the oral mucosa and are often perceived as less harmful than cigarettes.<sup>19</sup> In addition to nicotine, smokeless tobacco has been found to contain numerous cancer-causing chemicals.<sup>19</sup> Smokeless products have been shown to cause oral, esophageal, and pancreatic cancer. They also increase the risk of death from heart disease and stroke.<sup>19</sup>

White, male high school students are the biggest users of spit tobacco at 7.2%.<sup>20</sup> In adults, men continue to use at a higher rate than woman, 6.6% versus 0.5%.<sup>20</sup> Nearly 4% of young adult users, those aged 18–25 years, use at least 1 other tobacco product in addition to spit tobacco.<sup>20</sup>

**Hookahs** became popular many years ago in Persia and India. The hookah may be called a water pipe or shisha. It is often smoked in groups. Hookah bars are popular with college students with use ranging from 22-40% in this demographic.<sup>21</sup> The tobacco used in a hookah is generally flavored. Some nontobacco products are also available for use with hookahs. Although promoted as safer, many such products contain carbon monoxide and other toxic agents.<sup>21</sup>



Figure 1: Example of Hookah

The modern hookah typically has a head with holes in the bottom, a metal body,

a water bowl, and a flexible hose with a mouthpiece<sup>21</sup> (Figure 1). The tobacco in a hookah is exposed to high heat from burning charcoal. Newer forms of electronic hookahs that turn nicotine into an aerosol have also been introduced but little is known about them or their safety.<sup>21</sup>

Smoking tobacco in a hookah is not safer than smoking a cigarette. In addition to the nicotine, because of the way the hookah is smoked, the user may absorb more toxic substances than cigarette smokers do. One hour-long session of hookah smoking involves about 200 puffs versus 10-20 puffs from 1 cigarette. As well, the amount of smoke inhaled is about 90,000 milliliters compared to 500–600 milliliters with a cigarette. Hookah smokers may be at the same risk for oral cancer, lung cancer, esophageal cancer, and reduced lung function as cigarette smokers.<sup>21</sup>

### E-Cigarettes/Vaping Devices

are products that deliver nicotine but not tobacco in the form of an aerosol (Figure 2). Developed in China, e-cigarettes entered the U.S. market around 2007 and since 2014 has been the most common tobacco/nicotine device used by teens.<sup>22</sup> In 2011, only 1.4% of high school students reported using an e-cigarette with in the last 30 days.<sup>10</sup> It was not until the brand JUUL® (Figure 3) entered the market in 2016 that use among teens rapidly increased.<sup>22</sup> JUUL's sleek design and reduced odor had youth appeal. It also makes the device easy to conceal from teachers and parents.<sup>22</sup>



Figure 2: Example of an e-cigarette



Figure 3: The JUUL® brand

Vaping increased 78% between 2017 and 2018. In addition to nicotine, THC vaping has become popular with 3.9% of eighth

Reason	Percentage
To experiment and see what it is like	60.9%
Because it tastes good	41.7%
To have a good time with friends	37.9%
To relax or relieve tension	37.4%
To feel good or get high	29.0%
Because of boredom	28.7%
Because it looks cool	15.2%
Because I'm hooked	8.1%
To help me quit regular cigarettes	6.1%
Because regular cigarette use is not permitted	3.3%



graders, 12% of tenth graders and 14% of high school seniors reporting they vaped THC within the past month in 2019.<sup>5</sup> Teens try e-cigarettes for a variety of reasons, including more than 60% who do it to experiment and see what it is like<sup>5</sup> (Table 6).

A recent systematic review found that flavored e-cigarette products are attractive to both youth and young adult users. Flavoring was found to play a large role in product appeal as well as product enjoyment. Importantly, flavors, especially fruit and candy, were shown to decrease the perception that e-cigarettes are harmful.<sup>23</sup>

A recent study found that teen vaping leads to future combustible cigarette use. The data showed that teens did not use vaping as a cigarette substitute but instead used both products more frequently as they got older.<sup>24</sup> This supports the results of a 2016 study that found eleventh and twelfth grade e-cigarette users were 6.17 times more likely to begin smoking combustible cigarettes as a never e-cigarette user. The investigators also found that e-cigarette users were more likely to smoke a hookah, pipe, or cigar.<sup>25</sup> This data may relate to findings from the *Journal of Adolescent Health* study which found that onset of cigarette smoking is 3 times more likely in young adults (6.3%) than it is among adolescents (1.9%).<sup>26</sup>

The long-term health risks, systemic and oral, from e-cigarette use is largely unknown. While vaping products do have fewer toxins and carcinogens than combustible cigarettes do, the impact on health from some of the ingredients in vaping liquid is yet to be seen. Emerging research indicates that e-cigarettes may put users at risk for developing chronic lung disease,<sup>27</sup> cardiovascular disease,<sup>28</sup> and lung and bladder cancer.<sup>29</sup> One of the greatest risk with vaping products is exposure to nicotine. Vaping nicotine may cause long-term changes to the developing brain as well as create a new generation of nicotine addicts.<sup>10</sup>

In 2019, vaping THC resulted in nearly 3,000 hospitalizations and 68 deaths. Most of those afflicted were found to have vitamin E acetate, an additive in some THC vaping products, in lung fluid samples. Vitamin E acetate is found in many foods and cosmetic products and is available as a dietary supplement. When used in these type of products, vitamin E acetate is not harmful. However, when inhaled as an aerosol it can interfere with normal lung functioning.<sup>30</sup>



Figure 4: Example of tank-based e-cigarette



Figure 5: The Puff Bar – disposable e-cigarettes

In January of 2020, the FDA instituted a ban on any flavored, cartridge-based e-cigarette product.<sup>31</sup> This left a loophole for tank-based refillable devices (Figure 4) and newer disposable products such as Puff Bars (Figure 5). Puff Bars mimic the look of the popular JUUL® brand and are disposable. Therefore, the ban does not apply to this product, and Puff Bars are available in many youth-preferred flavors such as sour apple, menthol, mango, and lemonade.<sup>32</sup>

Heat-not-burn products have been widely available internationally including in Canada, Japan, and numerous countries in Europe. They were developed by tobacco companies as a response to increased regulation of combustible cigarettes. According to Phillip Morris International, 9.7 million people use heat-not-burn products.<sup>33</sup>

On January 8, 2019, the FDA authorized heat-not-burn cigarettes in U.S. market.<sup>34</sup> A heat-not-burn product is considered a noncombustible cigarette. Because since the product heated is tobacco, it is regulated as a combustible cigarette. It is different from an e-cigarette because it heats the tobacco to over 600° F. This creates an inhalable nicotine-containing tobacco aerosol.<sup>33</sup>

The aerosol from these products is generally considered to contain lower levels of toxins than traditional cigarettes. Yet that does not mean they are safe.<sup>34,35</sup> Other ingredients in the product may pose a health hazard, and the products do contain nicotine.<sup>34</sup> There is no data to indicate whether switching to this product from a combustible cigarette will reduce the risk of a tobacco-related disease. While the FDA has cleared them for sale in the U.S., they are not FDA approved, nor are they considered an FDA-approved tobacco cessation device.<sup>34</sup>

Both Philip Morris and RJ Reynolds have launched heat-not-burn products in the U.S market. The products appear to have limited availability at this time. The Philip Morris Brand, IQOS (Figure 6), has a sophisticated, high-tech look likely to appeal to teens and young adults. Since the product is regulated as a cigarette, the tobacco plugs will not be available in flavors except for menthol.<sup>35</sup>



Figure 6: The IQOS heat-not-burn cigarette

## THE HEALTH CONSEQUENCES OF TOBACCO

Each year, nearly half a million people die prematurely from a smoking-related illness. More than 10 times as many people in the U.S. have died prematurely from smoking than have died in all the wars fought by the U.S. Cigarettes have been causally linked to diseases of nearly every organ of the body<sup>2</sup> (Table 7). Smoking compromises the immune system and often results in overall poor health. People who smoke report more absenteeism

Table 7: Cancers and Chronic Diseases Causally Linked to Smoking<sup>2</sup>

Cancers	Chronic Diseases
Oropharynx	Stroke
Larynx	Blindness, cataracts, age-related macular degeneration
Esophagus	Congenital defects from maternal smoking; orofacial clefts
Trachea, bronchus, lung	Periodontitis
Acute myeloid leukemia	Aortic aneurysm; early abdominal aortic atherosclerosis in young adults
Stomach	Coronary heart disease
Liver	Pneumonia
Pancreas	Atherosclerotic peripheral vascular disease
Kidney and ureter	Chronic obstructive pulmonary disease (COPD), tuberculosis, asthma, and other respiratory effects
Cervix	Diabetes
Bladder	Reproductive effects in women, including reduced fertility
Colorectal	Hip fractures
	Ectopic pregnancy
	Male sexual function, erectile dysfunction
	Rheumatoid arthritis
	Immune function
	Overall diminished health

Table 8: Health Consequences Causally Linked to Exposure to Secondhand Smoke<sup>2</sup>

Children	Adults
Middle ear disease	Stroke
Respiratory symptoms, impaired lung function	Nasal irritation
Lower respiratory illness	Lung cancer
Sudden infant death syndrome	Coronary heart disease
	Reproductive effects in woman including low birth weight

from work and increased health care costs and utilization.<sup>2</sup> Secondhand smoke is a causative agent for cancer, respiratory, and cardiovascular disease. It harms the developing fetus and adversely affects infants and children<sup>2</sup> (Table 8).

Tobacco smoke contains more than 7,000 chemicals, and at least 69 of them are known to cause cancer.<sup>2</sup> A person who smokes is 25 times more likely than a never smoker to develop lung cancer.<sup>2</sup> Lung cancer is the most common cause of cancer death among men and women.<sup>2</sup> Smoking is also a causative factor in colorectal cancer, the fourth most diagnosed cancer, and is responsible for the second largest number of cancer deaths.<sup>2</sup> Smoking also increases the risk of dying from cancer and other diseases in cancer patients and survivors.<sup>2</sup>

Cigarette smoking is responsible for 85–90% of all cases of COPD, which encompasses chronic bronchitis and emphysema.<sup>2,36</sup> Many people with COPD will have symptoms of both chronic bronchitis and emphysema.<sup>36</sup> More than 15 million people have been diagnosed. There are many more who have it and do not know it.<sup>36</sup> It appears women may be more susceptible to COPD and may have a more severe case at a younger age.<sup>36</sup> COPD is treatable but not curable. It causes serious long-term disability and is a leading cause of death by disease in the U.S.<sup>36</sup> Since 2000, more women than men have died from COPD.<sup>36</sup>

Cardiovascular disease (CVD) claims the lives of more people over the age of 35 who smoke than lung cancer.<sup>2</sup> Current smoking is associated with a threefold greater risk of sudden cardiac death in comparison to the risks for never smokers.<sup>2</sup> Women who smoke have a 25% greater risk of developing heart disease versus male smokers.<sup>37</sup> People who smoke are also at a higher risk of having a stroke.<sup>2</sup> Tobacco use in adolescence and young adulthood has been shown to cause early abdominal aortic atherosclerosis in young adults. These lesions have been shown to be more severe and advanced than lesions in coronary arteries.<sup>2</sup>

Other health conditions related to smoking include rheumatoid arthritis, adverse reproductive and pregnancy outcomes, erectile dysfunction, age-related macular degeneration, and diabetes.<sup>2</sup> The risk of developing diabetes is 30–40% higher in people who smoke versus nonsmokers. The relationship appears dose-dependent, with the heaviest smokers having the greatest risk.<sup>2</sup>

Women have additional health risks related to smoking. A 2015 study followed women who were diagnosed with breast cancer for 11 years and found that smoking at the time of diagnosis was associated with breast cancer specific and other cause mortality.<sup>38</sup> For the development of human papilloma virus (HPV) driven cervical cancer, smoking has been shown to be a significant co-factor in its development.<sup>39</sup> Smoking has also been shown to delay the regression of HPV-related cervical lesions and increase the risk of a persistent cervical HPV infection.<sup>40</sup>

Millions of Americans, especially children, are exposed to secondhand smoke; most often at home. Children exposed to second-hand smoke are at greater risk for sudden infant death syndrome, respiratory infections, ear problems, and more severe asthma.<sup>41</sup> Children exposed to secondhand smoke throughout childhood had 31% higher mortality rate from COPD compared to those not exposed.<sup>42</sup> Adults exposed to 10 or more hours per week of secondhand smoke had an increased risk of mortality<sup>42</sup> (Table 9).

Table 9: Adults Exposed to 10+ Hours/Week Secondhand Smoke and Increased Mortality<sup>42</sup>

All mortality	9%
Ischemic heart disease	27%
Stroke	23%
COPD	42%

Smokeless tobacco products are linked to death and disability worldwide. Each year, smokeless products contribute to 250,000 deaths and a loss of 6 million disability-adjusted life years. In 2010, smokeless tobacco contributed to more than 62,000 deaths globally from cancers of the oropharynx, larynx, and esophagus. During the same time frame, the product was associated with more than 200,000 deaths from ischemic heart disease. Males accounted for three-quarters of the deaths.<sup>11</sup>

Cigars, hookahs, and e-cigarettes are perceived as a safer alternative to cigarettes, but they carry real and potential health risks.<sup>21,22,44</sup> Primary cigar smoking (no history of cigarette smoking) is associated with oral cancer, esophageal cancer, pancreatic cancer, laryngeal cancer, lung cancer, heart disease, and aortic aneurysm. The level of inhalation was found to be a factor in the risk for lung cancer but not for oral, esophageal, and laryngeal cancers.<sup>44</sup>

## IMPACT ON ORAL HEALTH

Cigarette smoking is a well-established risk factor for periodontal disease and tooth loss. Recent data indicates that cigarette smoking increases the risk for periodontal disease by 85%.<sup>45</sup> A dose-response relationship between smoking and periodontal disease has been observed, with the heaviest smokers having the highest disease severity.<sup>46</sup> People who smoke have been shown to have a less favorable healing response following periodontal surgery.<sup>46,47</sup> Younger adult smokers (19–30 years of age) often have a higher prevalence and severity of periodontitis than young nonsmokers. The periodontal cost of smoking has been calculated as 27 years of disease progression. This means that a 32-year-old smoker has periodontal attachment loss similar to that of a 59-year-old nonsmoker.<sup>46</sup>

Smoking has been shown to have a negative impact on the healing and clinical outcomes of implants.<sup>48</sup> Regular cigar smoking adversely affects periodontal health.<sup>44</sup> The impact of hookah use and e-cigarettes on oral health has not been determined. A recent study found that the aerosols produced by e-cigarettes were toxic to oral epithelial cells in vitro.<sup>49</sup>

## PREVENTION AND CESSATION

More than 3 out of 5 U.S. adults who have ever smoked cigarettes have quit.<sup>50</sup> While the benefits are greater when stopping tobacco use earlier in life, it is never too late to quit smoking.<sup>50</sup> Quitting reduces the risk of premature death and can add as much as a decade to life expectancy.<sup>50</sup> Quitting reduces the risk of many cancers as well as the risks of cardiovascular diseases and chronic respiratory diseases<sup>50</sup> (Table 10). In addition to improved health status, quitting enhances well-being and quality of life.<sup>50</sup>

The majority of smokers want to quit, and each year, many make an attempt to quit.<sup>50</sup> Yet only one third use FDA-approved cessation medications.<sup>50</sup> Nicotine replacement therapy (NRT)

Table 10: Disease Risk Reductions from Smoking Cessation<sup>50</sup>

<b>Cancer</b>	<ul style="list-style-type: none"> <li>• Lung</li> <li>• Laryngeal</li> <li>• Oral and oral pharynx</li> <li>• Esophageal</li> <li>• Pancreatic</li> <li>• Bladder</li> <li>• Stomach</li> <li>• Colorectal</li> <li>• Liver</li> <li>• Cervical</li> <li>• Kidney</li> <li>• Acute myeloid leukemia</li> </ul>
<b>Cardiovascular Diseases</b>	<ul style="list-style-type: none"> <li>• Heart attack morbidity and mortality</li> <li>• Stroke morbidity and mortality</li> <li>• Sudden cardiac death</li> <li>• Subclinical atherosclerosis</li> </ul>
<b>Chronic Respiratory Diseases</b>	<ul style="list-style-type: none"> <li>• COPD</li> <li>• Asthma</li> </ul>

products are available both over-the-counter and by prescription. They are available in patches, gum, nasal sprays, inhalators, and sublingual tablets/lozenges. A 2018 Cochrane Database review found that NRT increased the rate of successfully quitting by 50–60%.<sup>51</sup> The review also found NRT worked with or without counseling.<sup>51</sup> Data also indicates that using a nicotine patch and another type of NRT such as a gum or lozenge increase the success rate by 15–36% versus using one type of NRT alone.<sup>52</sup>

Pharmaceutical agents that are nicotine receptor partial agonists have also been found to enhance quitting.<sup>53</sup> The most widely available product in North America is varenicline, commercially known as Chantix®. This drug used at the standard dose has been found to be two to threefold more effective than unassisted quit attempts.<sup>53</sup>

Behavioral support in person or via the telephone can increase the success of quitting for people using smoking cessation medications.<sup>50,54</sup> Increasing amounts of behavioral support appear to increase the chance of success by 10–20%.<sup>54</sup> A wide variety of platforms from in-person counseling to text messaging and web-based interventions can be used effectively.<sup>50</sup>

## THE ROLE OF THE DENTAL PROFESSIONAL

Helping patients quit using tobacco is beneficial for overall health, including oral health. Smoking cessation reduces the risk of early disease and death.<sup>50</sup> Many patients may also be concerned about stained teeth and bad breath. Focusing on the patient's value of aesthetics may be a motivator for ceasing to smoke. Quitting improves periodontal health.<sup>55</sup> A large cohort study of more than

23,000 participants found that people who stopped smoking had a reduction in tooth loss, and after 10–20 years the risk of tooth loss approached that of a never smoker.<sup>56</sup>

Evidence indicates that dental professionals who incorporate behavioral intervention into the oral examination may increase the rate of cessation of both cigarette smokers and users of smokeless tobacco.<sup>57</sup> The periodontal exam and/or the oral cancer screening may be an ideal time to discuss smoking cessation. For those who are interested and motivated to quit, the Centers for Disease Control and Prevention has numerous resources to help people quit.<sup>58</sup>

Regular dental hygiene care, dental exams, and daily self-care are key to helping people who smoke manage their periodontal health. There are no contraindications for providing periodontal therapy to people who smoke. Because smoking can impair the immune response, people should be advised that they might not respond as well to treatment as a nonsmoker. Former smokers' response to therapy has been shown to be similar to that of never smokers.<sup>46</sup> Therefore, smoking cessation should be considered as part of the periodontal treatment.

## SELF-CARE

Meticulous daily oral hygiene consisting of toothbrushing and interdental cleansing is critical for those who use tobacco and/or nicotine products. The toothbrush is the most common and often the only means of daily oral self-care used by many people. What is often neglected is interdental cleaning. Many people find the use of string floss challenging, resulting in low compliance.

The evidence on string flossing for improving gingival health is weak.<sup>59,60</sup> This is shocking to many dental professionals who have witnessed firsthand the benefits of flossing. Flossing does work for those who can do it correctly.<sup>61</sup> However, it is a skill not easily mastered by those who are not dental professionals; thus it does not work for many people.<sup>62</sup> Lang et al. looked at typical brushing and flossing habits of people in the Detroit area. They found that although over 95% of people reported brushing at least once a day, around 33% reported flossing daily. When the investigators looked at the number of people who could perform acceptable flossing skills, the number dropped to 22%.<sup>62</sup> This inability to perform flossing at a level high enough to produce a health benefit is likely the biggest factor behind the weak evidence on flossing for plaque and gingivitis reductions. When done well and regularly, flossing works. The reality is that it does not work for most people because of a lack of expertise or motivation.

The Waterpik® Water Flosser (**Figure 7 and 8**) has been shown to be an easy and effective alternative to string floss.<sup>64-68</sup> In a University of Nebraska study, the Water Flosser was paired with a manual or a power toothbrush, and both were compared to traditional manual brushing and flossing. Regardless of toothbrush type, the addition of a Water Flosser, once daily

with plain water, to either a manual or power brushing routine was a more effective alternative to string floss for the reduction of bleeding, gingivitis, and plaque.<sup>64</sup> Likewise, Rosema et al. found the Water Flosser twice as effective as string floss at reducing gingival bleeding.<sup>65</sup>



Figure 7: Waterpik® Aquarius Water Flosser



Figure 8: Waterpik® Cordless Advanced Water Flosser®

The biofilm-removing capabilities of the Water Flosser were evaluated in a study conducted at the University of Southern California Center for Biofilms. Eight teeth were extracted from a patient with advanced periodontal disease. Pretreatment scanning electron microscopy (SEM) images of the teeth found they were colonized by a luxuriant biofilm appearing several micrometers thick (**Figure 9**). The teeth were water flossed for 3 seconds at a medium pressure (70 psi) setting. Post-SEM images found that water flossing removed up to 99.9% of plaque biofilm<sup>61</sup> (**Figure 10**). The researchers concluded that the shear hydraulic forces produced by a Water Flosser with 1,200 pulsations per minute at medium pressure can significantly remove biofilm from tooth surfaces.<sup>69</sup> A single-use plaque study found that people who added a Water Flosser to manual toothbrushing removed 74% of whole mouth plaque compared to 56% removed by manual brushing and flossing, making the Water Flosser 29% more effective.<sup>67</sup>



Figure 9: Before treatment with the water flosser, Gorur et al.<sup>5</sup>

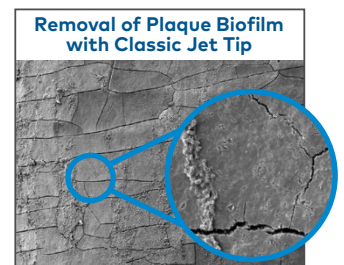


Figure 10: Tooth surface after a 3-second treatment with the Water Flosser, Gorur et al.<sup>5</sup>



There is a new entry to the self-care market that has added a water flossing function to the toothbrush handle. Waterpik® Sonic-Fusion® is a flossing toothbrush that combines the power of a sonic toothbrush with the efficacy of water flossing (Figure 11). This new tool allows patients to add water flossing to toothbrushing with the touch of a button.




Figure 11: Waterpik® Sonic-Fusion®

A recent 4-week study found that the Waterpik® Sonic-Fusion was twice as effective as manual brushing and string floss for removing plaque and reducing bleeding and gingivitis.<sup>70</sup> Sonic-Fusion has earned the ADA Seal of Acceptance.<sup>71</sup>

The Water Flosser is supported by more than 75 published scientific studies and over 5 decades of use by the public. Both countertop and cordless models have earned the ADA Seal of Acceptance<sup>64</sup> (Box 1). Despite this, skepticism about product

Box 1: ADA Seal Statement on Waterpik® Water Flosser



"The ADA Council on Scientific Affairs Acceptance of the Waterpik® Water Flosser is based on its findings that the product is safe and has shown efficacy for removing plaque along the gumline and between teeth and helping to prevent and reduce gingivitis, when used as directed."

safety and efficacy persists. Some dental professionals believe the product cannot be used at higher pressure settings; others feel it increases probing depth or destroys the attachment.

A recent study by Goyal et al. evaluated the effect of the Water Flosser on gingival and epithelial tissue at multiple pressure settings, including the highest settings: 9 and 10. Assignment of 105 subjects was made to 1 of 3 groups: 1) manual brushing and water flossing, 2) manual brushing and string flossing, and 3) manual brushing only. For the manual brushing and water flossing group, subjects increased the pressure setting on the Water Flosser over the course of the 6-week study. The primary outcome measured was clinical attachment levels (CAL) as assessed from the cemento-enamel junction and probing pocket depth (PPD). At 6 weeks, those in the Water Flosser group showed an improvement in CAL and a reduction in PPD (Figure 12 and 13). These changes exceeded those in the manual brushing and string flossing group and the manual brushing only group. All subjects received oral examinations at baseline, 2 weeks, 4 weeks, and 6 weeks. All subjects were negative for oral lesions, trauma or any other abnormal findings at each visit. The investigators concluded that the Water Flosser is safe to use at all pressure settings, and the results should alleviate concerns especially regarding high pressure setting that the Water Flosser may negatively impact gingival health or epithelial tissue.<sup>72</sup>

The findings from Goyal et al. support those concluded in a 2015 literature review, which found no data to support that the Water Flosser is detrimental to oral health. The review looked at a wide range of studies. It covered topics such as trauma to soft tissue, penetration of bacteria into the sulcus, probing depth and bacteremia.<sup>73</sup>

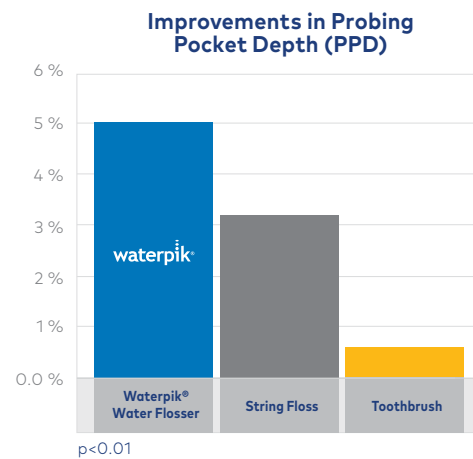
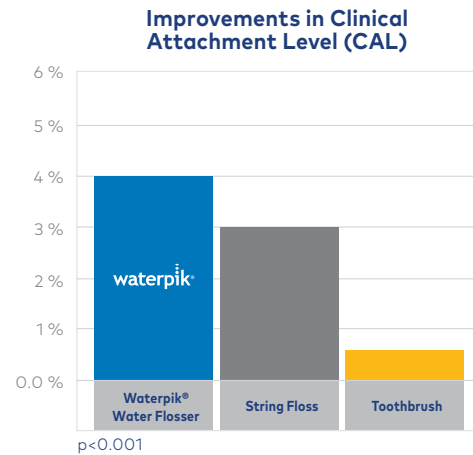


Figure 12 & 13: CAL improvement in periodontal maintenance patients, Genovesi et al.<sup>42</sup>

## SUMMARY

As cigarette smoking declines, the popularity of other tobacco/nicotine products has increased. The use of more than 1 product has also become more common. Dental professionals need to talk with patients about the addictive nature of nicotine and advise them about both the oral and general health risks associated with tobacco/nicotine use.

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Here are the questions you will need to answer on the post-test.  
Testing and delivery of certificate is available **ONLY** electronically.

1. **Since 1965, adult cigarette smoking rates have:**
  - a. Increased to 60%
  - b. Decreased to less than 14%
  - c. Stayed the same
2. **Which product is preferred by teens today?**
  - a. Cigarettes
  - b. Smokeless tobacco
  - c. Cigars
  - d. E-cigarette/vaping
3. **More people are addicted to nicotine than to any other abused substance. The nicotine content of cigarettes is 15% higher than in the past.**
  - a. Both statements are true.
  - b. The first statement is true, and the second statement is false.
  - c. The first statement is false, and the second statement is true.
  - d. Both statements are false.
4. **Nicotine exposure in adolescence may harm areas of the brain responsible for:**
  - a. Executive function and reasoning
  - b. Decision making skills
  - c. Self-discipline and impulse control
  - d. All of the above
5. **People with mental health disorders are:**
  - a. More likely to smoke
  - b. More likely to be heavy smokers
  - c. Less likely to quit
  - d. All of the above
6. **Cigarette smoking is higher in deployed military troops and military veterans.**
  - a. True
  - b. False
7. **Menthol cigarettes are:**
  - a. Allowed by the FDA
  - b. Used at higher rate by minority populations
  - c. Used by youth more than older adults
  - d. All of the above
8. **Concerning youth e-cigarette use, the products' flavors:**
  - a. Play a large role in product appeal and enjoyment
  - b. Decrease the perception that vaping is harmful
  - c. Are a big reason that teens try vaping
  - d. All of the above
9. **Which is true about the new heat-not-burn cigarettes? They are:**
  - a. Banned by the FDA
  - b. Safer than regular cigarettes
  - c. Have a high-tech look that appeals to youth
  - d. Do not contain tobacco or nicotine
10. **What percentage of all cases of COPD is cigarette smoking responsible for?**
  - a. 85–90%
  - b. 50–65%
  - c. 25–40%
  - d. 5–20%
11. **People who are currently smoking have a reduced risk of sudden cardiac death compared to people who have never smoked.**
  - a. True
  - b. False
12. **Regarding HPV-related cervical cancer risk, smoking:**
  - a. Is a significant co-factor in the development of HPV-driven cervical cancer
  - b. Delays the regression of HPV-related cervical lesions
  - c. Increases the risk of a persistent cervical HPV infection
  - d. All of the above
13. **People who smoke have a less favorable healing response to periodontal therapy.**
  - a. True
  - b. False
14. **People who use nicotine replacement therapy to help them quit have a higher success rate of quitting.**
  - a. True
  - b. False
15. **The Water Flosser has been shown to be more effective than string floss for:**
  - a. Removing plaque
  - b. Reducing gingivitis
  - c. Reducing bleeding
  - d. All of the above



## OBTAINING CONTINUING EDUCATION CREDITS

### Credits: 3 hours

Please consult your state or provincial board of dentistry if you have questions about the acceptance of CE credits.

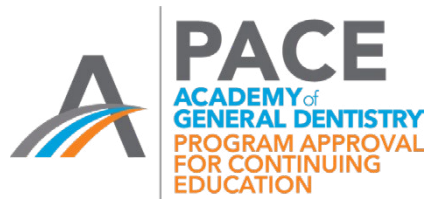
Credits can be obtained **ONLY** online by clicking on this link:

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Questions should be sent to:  
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