Oral and periodontal implications of tobacco and nicotine products

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1 | INTRODUCTION

Tobacco use is responsible for nearly 9 million annual global deaths (approximately 15% of all deaths worldwide). This is more than any other behavioral risk factor and trailing only high systolic blood pressure among all risk factors in its contribution to human mortality.1 Tobacco smoke disrupts the functioning of nearly every human organ system, causing most deaths through cancer, heart disease, and noncancer respiratory diseases.2 Health risks extend not only to the person using tobacco but to people involuntarily exposed to smoke (second-hand smoking).3 Tobacco experimentation typically begins in adolescence, often due to both social influences and tobacco marketing.4 Later in life, most adult tobacco users find themselves chemically and/or behaviorally dependent on nicotine and unable to quit tobacco use.2 Yet, despite this well-chronicled destruction, industrially produced tobacco products remain legally sold and marketed in nearly every country, well surpassing US$1 trillion in annual sales.

Owing to combined efforts of public messaging, excise taxes, social norm shifting, and numerous other tobacco control strategies, cigarette smoking prevalence in most high-income countries has declined dramatically in recent decades.25-8 However, as the current number of global deaths would indicate, substantial challenges remain. China, by far, is the single largest consumer of cigarettes and where smoking prevalence, especially among men, remains persistently high.9 Though smoking prevalence in Africa has historically been low, aggressive tobacco industry efforts on the continent have health experts projecting increased tobacco use over the coming decades.10 In countries where smoking prevalence has declined, inequalities in tobacco use and cessation have often risen, marked by widened gaps according to socioeconomic disadvantage,11,12 race/ethnicity,12 and mental illness,13 among other factors, exacerbating health inequity.

The most recent decade has also seen an expanding variety of new or emerging tobacco and/or nicotine products brought to market, most prominently electronic cigarettes (commonly called e-cigarettes). Heated tobacco products14 and nicotine-containing pouches15 are other examples of an increasingly diverse product landscape. Meanwhile, more permissive laws and regulations have broadened access to cannabis (marijuana) products. Cannabis, though not a tobacco product, is frequently consumed in combination with tobacco and by individuals who also use tobacco.16,17 Smoke from cannabis products shares many chemical properties with tobacco smoke and has been linked to health problems, including potential cardiovascular18 and respiratory19,20 impairment.

For the practicing clinician, providing sound patient recommendations requires knowledge of the general and oral health implications not only associated with smoking cigarettes but also with
cannabis and the wide range of currently available tobacco and nicotine products. Personalized, empathetic patient communication in the dental setting can enhance a patient’s motivation to quit tobacco use, and patients willing to make a quit attempt must be connected with evidence-based resources and support to achieve this tobacco-free goal. This review will provide an overview of selected tobacco and nicotine products with an emphasis on implications for periodontal disease risk and clinical management. Also presented will be strategies for tobacco use counselling and cessation support that dental professionals can readily implement in practice.

2 | CIGARETTES

Cigarette smoking elevates the risk of nearly every oral condition that dental professionals are tasked with treating and diminishes the chances of many dental treatments being successful.\(^{21-23}\) Cigarette smoking is strongly associated with heightened risk of cancer of the oral cavity or pharynx,\(^ {21,24-26}\) with evidence supporting a dose-response relationship\(^ {27}\) and synergistic risk with alcohol consumption.\(^ {24,28}\) In countries where use of chewing tobacco is uncommon, most oral cancer cases are attributable to tobacco smoking,\(^ {29,30}\) with human papilloma virus infection a growing contributor.\(^ {21}\) Apart from gingival and periodontal conditions, associations have also been reported between cigarette smoking and dental caries,\(^ {32}\) and oral pain,\(^ {33}\) with an altered oral microbiome and diminished salivary flow proposed as potential mechanisms, but with less causal certainty for these outcomes.\(^ {23,34}\)

The destructive impact of tobacco smoke on gingival tissues was formally reported as early as the mid-19th century.\(^ {36}\) Over the following 125 years, multiple clinical and population studies demonstrated strong associations between cigarette smoking and gingival disease,\(^ {36-38}\) diminished epithelial attachment and alveolar bone height,\(^ {39,40}\) and tooth loss.\(^ {41}\) These studies generally also noted greater levels of plaque and calculus accumulation among smokers,\(^ {36,38-40,42}\) leading to some academic debate at the time over whether smoking and periodontal disease associations reflected merely poor oral hygiene practices among smokers or a causal contribution of the tobacco exposure itself.\(^ {30,42}\) More recent investigations support a causal role, with large representative patient-based and population-based studies confirming a strong, consistent association of smoking with worse periodontal status.\(^ {44-48}\) Including independently of dental plaque levels and other plausible confounders, such as age, sex, and socioeconomic position.\(^ {44,49,52}\) These associations persist in prospective longitudinal analyses, demonstrating that cigarette smoking is a major risk factor for losing periodontal support over time\(^ {53-56}\) and eventual loss of teeth.\(^ {57-59}\)

Laboratory-based and clinical studies offer insight to potential mechanisms of action, providing evidence that tobacco smoke exposure impairs the protective host response to the dental plaque biofilm while additionally heightening the production of potentially destructive inflammatory cytokines and enzymes.\(^ {60,61}\) Furthermore, distinct microbial patterns between the plaque biofilm of tobacco smokers and nonsmokers have been characterized, suggesting a more pathogenic profile.\(^ {62,63}\) The gingival vascular response to plaque bacteria is impeded in tobacco smokers via mechanisms still under study but which may include suppressed angiogenesis or vasoactive smoke constituents.\(^ {64}\) Finally, tobacco smoking appears to diminish the reparative capacity of periodontal cells, including fibroblasts, osteoblasts and cementoblasts, reducing the ability to form new tissue and potentially impeding responsiveness to periodontal therapy.\(^ {65,66}\) Whereas whole tobacco smoke is clearly damaging to oral cells and tissues, deciphering which of the many components of tobacco smoke are most responsible for these effects is challenging. A recent review of the in vitro evidence concluded that nicotine, the highly addictive chemical, was alone unlikely to be cytotoxic to oral tissues at physiologic levels.\(^ {67}\)

Implications for the practicing clinician go beyond the need to expect a higher occurrence of adverse periodontal conditions among cigarette-smoking patients. The predictability and overall success of periodontal treatments will be lessened among tobacco-smoking patients.\(^ {58,65}\) Smoking is associated with worse outcomes following nonsurgical debridement,\(^ {70-72}\) open surgical debridement,\(^ {73,74}\) bone grafts,\(^ {75}\) guided tissue regeneration,\(^ {76}\) and periodontal plastic surgery.\(^ {77}\) Smoking is similarly a risk factor for dental implant failure.\(^ {78,79}\) The clinician must identify and document the tobacco use status of all patients. Though tobacco use is not a contraindication for providing surgical or nonsurgical periodontal therapy, patients must be informed of the elevated risk of less favorable treatment outcomes. This conversation should be embraced as an opportunity to assess (and enhance) the patient’s motivation to quit smoking and for the clinician to fulfill a professional responsibility to provide supportive, empathetic advice to quit and connect the patient with evidence-based tobacco cessation support, as discussed in Section 8 of this review.

3 | SMOKLESS (SPIT) TOBACCO

The term smokeless tobacco has been used to cover a wide variety of noncombustible tobacco products that are held in the mouth or chewed.\(^ {80}\) This includes areca nut products, such as betel quid (paan), gutka, and mainpuri in South and Southeast Asia, where the consumption of these and similar products has been strongly associated with oral cancer.\(^ {80,81}\) These smokeless products contain high levels of tobacco-specific nitrosamines, believed to be highly carcinogenic,\(^ {82}\) in contrast to low-nitrosamine snus products consumed in Sweden, which most existing epidemiologic studies have not associated with oral cancer.\(^ {80,82}\) In the United States, oral moist snuff is the predominant form of smokeless tobacco used,\(^ {83}\) more often among younger men in rural communities.\(^ {84}\) In 2017, the United States Food and Drug Administration estimated that a product standard to mandate low nitrosamine content in US smokeless tobacco products would prevent 12 700 cases of oral cancer over 20 years\(^ {85}\); however, the proposed standard was not implemented. Other health effects linked to smokeless tobacco use include cancers of the esophagus and pancreas, and plausibly, but less conclusively, adverse cardiovascular outcomes and cancers of the lung and cervix.\(^ {80}\)
Among noncancer oral health conditions associated with use of moist snuff or chewing tobacco, oral mucosal lesions, including hyperkeratotic or erythroplakic lesions, are commonly found even among young users.\textsuperscript{86-89} Gingival recession and periodontal attachment loss have been reported near the areas where smokeless tobacco is held in the mouth,\textsuperscript{86,87} as well as dental erosion and gingival recession.\textsuperscript{88,89} A positive association with severe active periodontal disease was found in the large, representative National Health and Nutrition Examination Survey in the United States.\textsuperscript{90} For the dental professional, assessing smokeless tobacco use status and offering cessation support tailored to quitting smokeless products is a critical component of care and may help patients successfully quit.\textsuperscript{91}

### 4 | CIGARS AND PIPES

Relative to cigarettes, fewer studies evaluate periodontal health outcomes associated with use of other combustible tobacco products. However, given similarities in the toxicologic profiles of cigarette and cigar smoke,\textsuperscript{92} it is reasonable to expect adverse oral health effects. In the United States, cigars are the non–cigarette product among adults used most (4% prevalence), and use prevalence among young adults aged 18-24 years is more than threefold higher (14%).\textsuperscript{93,94} Dental professionals must ask their patients about all forms of tobacco use and be particularly mindful that the oral health risks of any combustible products are likely to resemble those of cigarette smoking.

A longitudinal evaluation of the Baltimore Longitudinal Study of Aging found that cigar and/or pipe users had more missing teeth and more sites with severe loss of attachment and advanced recession compared with nonsmokers.\textsuperscript{95} Another longitudinal study evaluated tooth loss risk and alveolar bone loss in cigar and pipe smokers.\textsuperscript{96} These authors reported that cigar and pipe users were at a higher risk of tooth loss than nonsmokers were and that more calculus and interdental bone loss were observed in cigar and pipe users than in nonsmokers.\textsuperscript{96} An earlier cross-sectional analysis of this same male veteran population in the United States had reported greater accumulation of plaque and calculus in cigar/pipe smokers than in nonsmokers after adjusting for age.\textsuperscript{97} However, when compared with cigarette smokers, cigar/pipe users had lower accumulations of plaque and calculus and less alveolar bone loss.\textsuperscript{97} These studies were limited to older, male, predominantly white populations and often grouped cigar and pipe users together. Two nationally representative (United States) cross-sectional studies have considered exclusive groups of cigar and pipe users. In the first, more severe periodontal disease was observed among cigar smokers compared with nonsmokers, but small sample sizes precluded a detectable difference between cigar and cigarette users.\textsuperscript{98} More recently, cigar-product users and pipe users were both at higher odds of self-reporting gum disease diagnosis and treatment than non-tobacco users were.\textsuperscript{99} To our knowledge, no studies have examined possible differences in oral health effects by type of cigar, such as premium cigars versus cigarillos or cigarette-like small cigars.

### 5 | HOOKAH

Use of a hookah, also referred to as a tobacco waterpipe or narghile, dates back several centuries and is a cultural norm in many countries of North Africa and the Middle East. In other parts of the world, the popularity of hookahs has recently increased, particularly among youth and young adults.\textsuperscript{100-102} Often perceived as less harmful than cigarette smoking,\textsuperscript{100} hookah smoke contains levels of volatile organic compounds, ultrafine particles, nicotine, and carbon monoxide matching or exceeding cigarette smoke.\textsuperscript{103,104} Epidemiologic studies have associated hookah use with respiratory and cardiovascular diseases.\textsuperscript{105}

Several cross-sectional studies compare periodontal and peri-implant health of hookah smokers with both cigarette smokers and nonsmokers. One study found higher plaque index, increased bleeding on probing, and more sites with attachment loss and probing depth greater than 3 mm in hookah users compared with nonsmokers, with no difference in these parameters between hookah users and cigarette smokers.\textsuperscript{106} Another evaluation similarly identified greater marginal bone loss and more missing teeth among hookah users than among nonsmokers and reported comparable periodontal status between hookah and cigarette smokers.\textsuperscript{107} In a third study, increased periodontal bone loss and greater prevalence of vertical bone defects were found in hookah users than in nonsmokers.\textsuperscript{108,109} Few studies have evaluated peri-implant health in hookah users. A recent review of case-control studies reported worse peri-implant inflammatory parameters and more implant sites with deep probing depths, bleeding on probing, and peri-implant bone loss among hookah users than among nonsmokers.\textsuperscript{110}

Nearly all of the aforementioned research was conducted in Saudi Arabia, where use patterns and the hookah product itself might differ from the rest of the world, limiting generalizability. In countries where hookah use is often infrequent and primarily a behavior of young adults, there is a dearth of research evaluating periodontal health outcomes. In one cross-sectional evaluation in the United States, hookah use was observed almost exclusively among younger people, who self-reported gum disease at a similar prevalence as tobacco never-users.\textsuperscript{99}

### 6 | CANNABIS

A decades-long trend in several countries has seen increasingly liberalizing laws and attitudes around the use of cannabis (marijuana) products for medicinal and recreation use. With policies favoring decriminalization and creation of legal commercial marketplaces, use of cannabis products has risen. Cannabis is the most commonly used recreational drug worldwide after tobacco and alcohol.\textsuperscript{111} In the United States, 46% of residents aged 12 years and older reported lifetime cannabis use in 2019,\textsuperscript{112} with the largest increases in current use observed among older adults.\textsuperscript{113} Given the high use prevalence, the frequent consumption in combination with tobacco and/
or by individuals who also use tobacco,\textsuperscript{17} and the potential for periodontal harm from cannabis smoke itself.\textsuperscript{114} the practicing clinician should anticipate encountering cannabis-using patients on a regular basis and be prepared to manage potential oral and periodontal complications.

A limited number of epidemiologic studies have evaluated the association between cannabis use and periodontitis. Using data from the Dunedin Multidisciplinary Health and Development Study birth cohort in New Zealand, cannabis use measured between ages 18 and 26 years was associated with greater odds of experiencing 3 mm or more clinical attachment loss between ages 26 and 32 years, including after controlling for tobacco use and other sociodemographic and behavioral risk factors.\textsuperscript{115} Following this same cohort to age 38 years confirmed the positive association between cannabis use and declining periodontal health.\textsuperscript{116} Using data from the Aboriginal Birth Cohort study in Australia, investigators examined the prevalence of periodontitis among young adults (mean age 18 years).\textsuperscript{117} Almost all cannabis users also used tobacco, precluding an assessment of cannabis-only use on periodontal outcomes; however, among tobacco users, co-use with cannabis was associated with a higher prevalence of periodontal disease.\textsuperscript{117} In contrast, a cross-sectional study evaluating the presence of periodontal disease in Chilean adolescents did not identify an association between cannabis use and clinical attachment loss.\textsuperscript{118} Most of the evidence summarized here draws on observations made about youth and young adults, among whom severe periodontal disease is less prevalent. Among adults aged 40-70 years in Puerto Rico, frequent cannabis use was associated with prevalent severe periodontitis.\textsuperscript{119} In one nationally representative study (United States) of adults aged 30 years and older, both the mean number of deep pockets and mean clinical attachment loss were higher among frequent cannabis users than among non-users.\textsuperscript{120} Even when this analysis was restricted only to tobacco never-users, the odds of severe periodontitis were approximately double among frequent cannabis users.\textsuperscript{120}

The potential connections between cannabis use and other oral health conditions are less well studied. Associations have been reported with gingival hyperplasia, xerostomia, leukoedema, and oral infections.\textsuperscript{114,121} Though smoking remains the most common route of cannabis administration, a growing proportion of people consume cannabis as edible products or using vaporizers to produce an inhalable aerosol.\textsuperscript{122} It is not known how or whether these other routes of cannabis administration relate to periodontal diseases.

For the dental professional, caring for the cannabis-using patient involves more than asking all patients about use and advising non-judgmentally about potential periodontal disease risks. For instance, postoperative instructions should clearly implicate cannabis smoke in addition to tobacco smoke as potential risk factors for complications following intraoral surgeries. When patients attend appointments currently under the influence of cannabis, there are several issues for the dental professional to consider. Owing to the altered mental state, the provider may judge that the patient does not have capacity to consent for treatment and it may be best to postpone treatment, if possible. Additionally, epinephrine in local anesthetic solutions may trigger a serious tachycardic event in cannabis-intoxicated patients.\textsuperscript{114,122} Whereas some patients might self-medicate with cannabis to address dental pain or appointment-related anxiety, the patient under the influence of cannabis may experience heightened anxiety and dysphoria during a dental visit.\textsuperscript{114} Therefore, a discussion about cannabis with patients prior to scheduling any surgical procedures can help to avoid potential risks and complications related to managing a patient under the influence of a psychoactive drug.

### 7 E-CIGARETTES AND OTHER NOVEL PRODUCTS

For many decades it has been understood that most of the harms from tobacco use come from the combustion process and the resultant complex cocktail of ingredients, and not from nicotine, the highly addictive chemical. Developing alternative ways of delivering nicotine is not a new pursuit; there are a wide array of nicotine replacement therapies that have been used to aid tobacco cessation in a medicalized context for over 30 years.\textsuperscript{124} The concept of e-cigarettes was first patented in the 1960s,\textsuperscript{125} but their use has only become widespread over the last decade. E-cigarettes represent a class of battery-powered products that heat a liquid solution, typically containing nicotine, into an inhalable aerosol.\textsuperscript{126} E-cigarettes were not developed through the medical pharmaceutical route and are usually considered a consumer product, similar to tobacco products or, in some regulatory contexts, classified as tobacco products.\textsuperscript{127} Although commercial availability and promotion are potentially part of the appeal of these products, there have been many challenges around regulation, product quality, product perceptions, and limited supporting scientific evidence.

E-cigarettes have undergone substantial evolution over the past decade and can vary widely in appearance and attributes. However, some common features are that they are usually rechargeable, often come as refillable “tanks” or pre-filled “pods,” and in a range of flavors and nicotine strengths. The e-cigarette is usually filled with a liquid that has three main components: a carrier solution (propylene glycol or vegetable glycerin), nicotine (unless a nicotine-free version), and flavorings.

Recent clinical trials suggest that e-cigarettes may be effective cigarette cessation aids, with them outperforming conventional nicotine replacement therapy in two trials when used in combination with cessation counseling.\textsuperscript{128,129} Epidemiologic data from England have shown an increase in overall tobacco quit rates and quit success as the prevalence of e-cigarette use among smokers has increased.\textsuperscript{130} However, this is not a universal picture, as cohort analyses from the United States have reported no improvement in smoking abstinence with e-cigarette use.\textsuperscript{131,132} The proportion of smokers who quit by using e-cigarettes and who then remain long-term users of e-cigarettes remains an open question.\textsuperscript{133} E-cigarettes are sometimes presented as a less-harmful alternative for nicotine-dependent tobacco smokers unwilling or unable to cease nicotine use, because...
the products deliver much lower levels of toxicants relative to cigarette smoke.\textsuperscript{124,135}

However, important concerns surrounding e-cigarettes include rising use prevalence among youth and young adults,\textsuperscript{136} potential risks for cardiovascular and lung health,\textsuperscript{137-139} and questions about cessation effectiveness outside clinical trials. The uncertainty and complexity of what impact widespread e-cigarette availability has had, and will have, on public health has spurred much controversy and policy debate.

Given the well-established effect of tobacco smoke on the periodontium and the oral mucosa, it is important to understand the effects of e-cigarette aerosol, which also passes in close proximity to these tissues. Research in this field is still emerging, and there are many challenges with conducting and interpreting these studies; for example, e-cigarette users are often recent or current tobacco smokers, meaning it is hard to attribute effects to e-cigarette use directly. Additionally, product evolution has often outpaced research, and the chronic and long-term pathophysiology of periodontitis means that effects could take several years to manifest. It has proven difficult to translate the results of in vitro experiments, some of which report harm to oral-derived cells from e-cigarette aerosols,\textsuperscript{140} into clinically relevant exposure doses and outcomes. For clinical and population-based studies, separating any effect of current e-cigarette use from those of past or concurrent combustible tobacco use presents another challenge. Among existing findings, exposure to e-cigarette aerosol appears to induce potentially adverse changes in the oral microbiome distinct from those observed with cigarette smoking.\textsuperscript{141,142} Clinical studies have been largely cross-sectional and sometimes measured oral health conditions as ancillary outcomes to studies outside dental settings. They have reported associations with a wide range of conditions, including throat irritation, gingival bleeding, and oral trauma from exploded e-cigarette devices.\textsuperscript{140} Population-based studies have largely been confined to self-reported outcomes and cross-sectional designs, with some reporting associations between e-cigarette use and prevalent oral conditions,\textsuperscript{99,143} but a need exists for additional well-controlled, prospective data.

Doubtlessly, more research is required to understand the extent to which e-cigarettes may independently affect oral health. For the clinician, asking patients specifically about e-cigarettes must be part of recording tobacco use history. The patient deserves a balanced description of the potential risks of e-cigarettes, as well as their potential as a less harmful alternative to combustible tobacco. The tobacco-smoking patient motivated to try e-cigarettes as a cessation aide should not be discouraged from the quit attempt but should also be presented with a menu of evidence-based cessation strategies, as described in an upcoming section. Youth and tobacco non-users should be encouraged not to engage in e-cigarette use. For youth particularly, nicotine exposure may adversely affect adolescent brain development and risk of long-term nicotine dependence.\textsuperscript{144}

E-cigarettes are not the only class of recently introduced products that deliver nicotine without combustion. Newly formulated heated tobacco products create an inhalable aerosol by heating tobacco-containing material to a temperature below the combustion threshold and are reported by their manufacturers to deliver lower levels of harmful chemicals than conventional cigarettes.\textsuperscript{145} At least one clinical trial, sponsored by a heated tobacco product manufacturer, has announced plans to assess potential periodontal effects.\textsuperscript{143} Nicotine pouches have been introduced by large tobacco manufacturers as a “tobacco-free” portioned, flavored oral nicotine product.\textsuperscript{15} Novel nicotine lozenges, gums, mints, and even nicotine-infused toothpicks may resemble nicotine replacement therapies but are not marketed for cessation. Limited evidence exists on which to evaluate the overall health implications of these novel products, let alone possible effects on oral health. Though plausibly delivering a less harmful toxicant profile than combustible tobacco, reducing harm to the user is dependent on using these novel products as a substitute for, rather than complement to, cigarette smoking, which may not match the real-world use profile.\textsuperscript{147}

8 | TOBACCO CESSATION INTERVENTIONS FOR PERIODONTAL PATIENTS

8.1 | The role of dental professionals in tobacco cessation

Dental professionals are well positioned to provide tobacco cessation treatment to their patients. Not only do dental professionals see a large number of tobacco users, but they often have more time with patients and see patients more regularly than other health professionals do.\textsuperscript{148} In addition, the negative health effects of tobacco use are often first identified in the oral cavity, underscoring the importance of managing tobacco-related risk factors for the dental professional. In a systematic review, it was found that tobacco cessation interventions by dentists and dental hygienists during oral examinations can increase cessation among cigarette smokers and smokeless tobacco users.\textsuperscript{149} Multiple dental professional organizations not only promote tobacco cessation in dental practice but characterize it as a professional responsibility to provide tobacco cessation treatment and education to patients.\textsuperscript{150-152}

Despite their important role in tobacco cessation, dental professionals often fall behind other health professionals in providing such care. For example, in a study of health professionals, 80% of dentists and dental hygienists reported asking patients about their tobacco use, but less than 40% reported providing assistance to patients or referring them to cessation programs.\textsuperscript{153} In another national study of US dentists, over 90% of respondents reported asking patients about tobacco use, but only 45% reported routinely offering assistance, including referring patients to cessation counseling and/or prescribing cessation medication.\textsuperscript{154} Similar patterns were seen in a survey of UK dental professionals, with 79% reporting they “always” enquired about the smoking status of their patients and 77% offering advice.\textsuperscript{155} Though most dentists and dental hygienists report
asking patients about cigarette smoking, inquiries about non-cigarette products, such as cigars, hookahs, e-cigarettes, or cannabis are much less common.156,157 As the use of alternative tobacco products increases, dental professionals must ask about use of all tobacco, nicotine, and cannabis products when reviewing a patient’s health history to address fully the risks of long-term use and potential negative oral and systemic health consequences.

8.2 | Interventions for tobacco cessation in practice

The five A’s approach to tobacco cessation (Figure 1) is an evidence-based intervention supported by several countries and organizations, including in the United States,158 Canada,159 Australia,160 and the World Health Organization.148 This intervention involves all members of the dental team and can be incorporated as a standard of practice in dental settings.

The first step of the five A’s approach is systematically asking all patients aged 12 years and older about current and former tobacco use. This involves screening patients at every encounter for use of all tobacco products, including related products like e-cigarettes and cannabis. All adolescent patients (age 12-18 years) should be advised not to use tobacco or nicotine. Information obtained from the patient about tobacco, nicotine, and cannabis use should be documented in the patient’s dental chart or health record.

Once tobacco use is identified, the next step is advising patients to quit. This message should be clear, strong, nonjudgmental, and personalized. Advice can be personalized by linking the patient’s tobacco use to health concerns or certain social factors. For example, a person with young children or grandchildren may be motivated by concerns over exposing others to smoke, whereas a person with periodontal disease may be concerned with the long-term effects on their oral health. In some cases, in order to identify personal factors that may motivate them to consider quitting, it may be useful to ask a patient what they do not like about their tobacco use.148

After advising a patient to quit, the dental professional must then assess a patient’s readiness to quit. For many patients, quitting tobacco use is a recurring process, and readiness to quit will change over time. This process is known as the trans-theoretical model or behavior change model,161 which involves five discrete stages of behavioral change: precontemplation, contemplation, preparation, action, and maintenance (Table 1). It is important to recognize that not all patients have the same level of commitment or readiness to quit. Dental professionals must “meet a patient where they are” in their stage of change in order to support that patient properly in taking action. Therefore, the goal for providers at each appointment will vary based on the patient’s stage of change (Table 1). For example, a patient in the precontemplation phase may be resistant to discussing quitting at all. Similarly, a patient in the contemplation phase may not be ready to choose a quit date or develop a quit plan.

For patients not ready to quit (typically in the precontemplation and contemplation phases), the goal should be focused on enhancing motivation. This can be done by utilizing motivational interviewing techniques. Miller and Rollnick162 suggested that providers use open-ended questions, affirmations, reflections, and summaries (a technique known as OARS) when discussing tobacco use with their patients (Table 2). Using such strategies helps dental professionals guide the conversation while allowing the patient to draw on their
own intrinsic motivation for change. Another widely recommended approach to enhance motivation is the 5R’s model,\textsuperscript{158} which involves discussing the relevance of quitting, the risks of tobacco use, the rewards of quitting, the roadblocks to successfully quitting, and repetition of motivational strategies at each visit (Table 3). Patients who remain not ready to quit should be encouraged to consider quitting in the future. Providers should document all discussions in the patient’s chart and ask about their tobacco use at each future appointment. Providers should document all discussions in the patient’s chart and ask about their tobacco use at each future appointment.

When a patient is ready or willing to make a quit attempt, dental professionals can assist the patient by helping develop a quit plan, discussing cessation medications, and providing or referring the patient for additional tobacco cessation support. Developing a quit plan should involve setting a quit date (ideally, within 2-4 weeks), informing family and friends about quitting and asking for their support, anticipating challenges, such as withdrawal symptoms or triggers, and removing tobacco products from one’s environment. When counseling a patient, clinicians should focus on three things: (a) assisting the patient in identifying potential triggers or situations where the patient may be tempted to relapse, such as certain activities, locations, social events, or emotional states; (b) assisting the patient in developing coping skills (behavioral and cognitive) to avoid such situations; and (c) providing helpful information about quitting, such as cessation services (eg, telephone quit lines, local tobacco cessation programs) and medications.

Clinicians should recommend and discuss approved medications for tobacco cessation with all patients making a quit attempt, except in the uncommon event of medical contraindications. Tobacco cessation medications work in two ways: (a) by helping to reduce physical symptoms of withdrawal, allowing the patient to focus on the behavioral changes needed to be successful in their quit attempt; and (b) by desensitizing nicotine receptors, resulting in the elimination or reduction of the reinforcing (or “rewarding”) effects of nicotine on the body.\textsuperscript{164} Precautions, patient preferences, and contraindications of all medications should be considered before recommending and prescribing. Most health authorities do not support the use of e-cigarettes as a cessation aid, although emerging evidence suggests effectiveness when used with counseling support. The trials have been carried out under tightly controlled circumstances, but more studies applicable to realistic patient contexts are required.

It is important to arrange for follow-up with patients throughout the process of a quit attempt. For patients willing to make a quit attempt, the first in-person or telephone follow-up visit should be scheduled within the first week of the quit attempt, with the second recommended within a month of the quit date. It is important to congratulate those who have remained abstinent and to support those that have relapsed by, for instance, providing additional counseling and/or referral to more intensive treatment. For patients unwilling to make a quit attempt, clinicians should reassess their stage of change at their next dental appointment.

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**TABLE 1** The behavioral change model for tobacco cessation

<table>
<thead>
<tr>
<th>Stage</th>
<th>Description</th>
<th>Goal for dental professionals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Precontemplation</td>
<td>• Not thinking about quitting</td>
<td>• Enhance motivation</td>
</tr>
<tr>
<td></td>
<td>• Unaware of need to quit or severity of the problem</td>
<td>• Use five R’s and open-ended questions, affirmations, reflections, and summaries</td>
</tr>
<tr>
<td></td>
<td>• May be resistant to discussing behavior change</td>
<td>• Let patient know that you are available for support should they want to quit in the future</td>
</tr>
<tr>
<td>Contemplation</td>
<td>• Thinking about quitting in the next 6 mo</td>
<td>• Enhance motivation</td>
</tr>
<tr>
<td></td>
<td>• Recognizes a need to quit, but not ready to take action</td>
<td>• Use the five R’s, open-ended questions, affirmations, reflections, and summaries, etc</td>
</tr>
<tr>
<td></td>
<td>• Benefits of use still outweigh the costs (often craving and withdrawal symptoms) of quitting</td>
<td>• Answer questions and provide support, if needed</td>
</tr>
<tr>
<td>Preparation</td>
<td>• Ready to quit in the next month</td>
<td>• Help patient create a quit plan</td>
</tr>
<tr>
<td></td>
<td>• May start taking steps to reduce tobacco use, but has not taken definitive action</td>
<td></td>
</tr>
<tr>
<td>Action</td>
<td>• Recently quit in the last 6 mo</td>
<td>• Support patient during the quit attempt</td>
</tr>
<tr>
<td></td>
<td>• Successful in remaining abstinent for 24 h to 6 mo</td>
<td>• If still abstinent, congratulate patient, reinforce strategies to be successful</td>
</tr>
<tr>
<td></td>
<td>• Working to continue behavior change and prevent relapse</td>
<td>• If relapse occurs, reassure patient, increase follow-up support, and discuss any modifications needed to their quit plan</td>
</tr>
<tr>
<td></td>
<td>• Can be the most difficult stage</td>
<td>• Reassessing stage of change may be necessary</td>
</tr>
<tr>
<td>Maintenance</td>
<td>• Successful quit attempt for greater than 6 mo</td>
<td>• Congratulate patient on being &quot;former user&quot;</td>
</tr>
<tr>
<td></td>
<td>• Can be the most difficult stage</td>
<td>• Continue to monitor tobacco use status</td>
</tr>
<tr>
<td></td>
<td>• Working to continue behavior change and prevent relapse</td>
<td>• Provide relapse prevention support when needed</td>
</tr>
</tbody>
</table>

*Abbreviation: Five R’s refers to relevance of quitting, risks of tobacco use, rewards of quitting, roadblocks to successfully quitting, and repetition. Adapted from Prochaska et al.\textsuperscript{161}*

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### Table 2: Motivational interviewing methods for tobacco-using patients

<table>
<thead>
<tr>
<th>Approach</th>
<th>Suggested actions and/or language</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Open-ended questions</strong></td>
<td>• &quot;How would you do that?&quot;   • &quot;What do you see being your biggest challenge?&quot;   • &quot;Can you tell me more about that?&quot;   • &quot;What are your thoughts about quitting smoking?&quot;   • &quot;What do you know about the health consequences of smokeless tobacco use?&quot;   • &quot;What worries you about your cigarette use?&quot;</td>
</tr>
<tr>
<td><strong>Patient benefits</strong></td>
<td>Allows patients to express themselves  Patients verbalize what is important to them  Sets a positive tone for the session</td>
</tr>
<tr>
<td><strong>Provider benefits</strong></td>
<td>Learn more about the patient  <strong>Reflections</strong> Statements of appreciation to nurture strengths  Authentically observations about the person  Focused on nonproblem areas  Focused on behaviors versus attitudes/goals</td>
</tr>
<tr>
<td><strong>Affirmations</strong></td>
<td><strong>Reflections from the provider convey:</strong>  Patient: &quot;I tried sixteen times to stop smoking.&quot;  Provider: &quot;Wow, you've already showed your commitment to trying to stop smoking several times. That's great! More importantly, you're willing to try again.&quot;</td>
</tr>
<tr>
<td><strong>Reflections</strong></td>
<td>Patient: &quot;I'm afraid that my daughter is going to smoke because she sees me smoke.&quot;  Provider reflection: &quot;You're worried about how the things that you do, like smoking, might impact your daughter.&quot;</td>
</tr>
<tr>
<td><strong>Summaries</strong></td>
<td>&quot;So, it sounds like on the one hand you love smoking and it helps relax you, but on the other hand it is starting to affect your health and you would like to quit.&quot;  &quot;What I hear you saying is that it is very important for you to quit, but you are worried that you may not have the tools to be successful. What worries you the most about quitting?&quot; (Open-ended question)</td>
</tr>
</tbody>
</table>

**Note:** Adapted from Miller and Rollnick.  

**Table 3: The five R’s approach to tobacco cessation counseling**

<table>
<thead>
<tr>
<th>Approach</th>
<th>Actions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Relevance</td>
<td>• Encourage patient to indicate why quitting is personally relevant  • Disease status/risk, family or social situations (eg, children/grandchildren, stigma associated with tobacco use), health concerns, age, sex, and other patient characteristics may help motivate patients to change behavior</td>
</tr>
<tr>
<td>Risks</td>
<td>• Ask the patient to identify potential negative consequences of tobacco use  • Example of risks are dental treatment outcomes, increased risk of oral disease (eg, periodontal disease, tooth loss, oral and pharyngeal cancer), cardiovascular disease, lung disease, cancer, osteoporosis, life-expectancy, etc</td>
</tr>
<tr>
<td>Rewards</td>
<td>• Ask the patient to identify potential benefits of stopping  • Examples of rewards are improved treatment/health outcomes, financial savings, setting good example for children/grandchildren, healthier children/grandchildren (if a smoker), feeling physically better, improved relationships, etc</td>
</tr>
<tr>
<td>Roadblocks</td>
<td>• Ask the patient to identify barriers or impediments to quitting  • Examples of roadblocks are withdrawal symptoms, fear of failure, weight gain, anxiety/depression, enjoyment of tobacco use, social benefits of use, limited knowledge of resources to help quit, etc</td>
</tr>
<tr>
<td>Repetition</td>
<td>• The motivational intervention should be repeated every time an unmotivated patient has an interaction with a clinician  • Tobacco users who have failed in previous quit attempts should be encouraged to continue trying to quit</td>
</tr>
</tbody>
</table>

**Note:** Adapted from 2008 Public Health Service Guideline Update Panel, Liaisons, and Staff.  

World Health Organization.
For clinicians who do not have the time or resources to implement the five A’s approach, and where there is an appropriate specialist stop smoking service available, an alternative approach known as ask-advise-act is a viable strategy (Figure 1). This truncated version of the five A’s approach involves asking about (and recording) tobacco use, advising patients on the personal benefits of quitting and that the evidence shows the best way is with a combination of support and treatment, and acting on the patient’s response, either prescribing, monitoring, or referring. Interestingly, the advise step deliberately leaves out the harms of tobacco use in order to minimize the duration of the intervention and avoid a defensive reaction from patients likely already well aware that tobacco use is dangerous. This and similar three-step approaches to tobacco cessation are recommended worldwide. The five A’s and ask-advise-act models have been shown to be similarly effective in improving cessation rates among patients when compared with no intervention.

8.3 Treatment considerations for periodontal patients

As discussed previously, tobacco use has significant negative effects on oral health and the outcome of almost all therapeutic periodontal procedures. Additionally, cigarette smokers have been shown to be less likely than nonsmokers to follow through with supportive periodontal/peri-implant therapy or periodontal maintenance, further increasing their risk of poor outcomes. Periodontal patients with planned treatment are ideal candidates for tobacco cessation intervention, as they are often receiving treatment for conditions directly related to their tobacco use. Ideally, patients should quit tobacco use successfully prior to any type of periodontal treatment to improve outcomes, such as fewer implant failures and improved wound healing postsurgery. However, despite tobacco use being one of the most significant risk factors for poor periodontal outcomes, it is not considered a complete treatment contraindication. In the event that a patient is unwilling or unable to quit, providers must weigh the risks and benefits of treatment and discuss potential outcomes with the patient prior to making decisions on whether to move forward with treatment.

Recommendations for managing periodontal disease in tobacco-using patients differ considerably across the literature, with varying levels of supporting evidence. For patients receiving dental implants, one study suggested that patients should abstain from tobacco use 1 week prior to surgery and 2 months postsurgery to allow for proper wound healing. Other authors have opined that providers should encourage patients to abstain from use indefinitely in order to reduce complications and improve success rates postsurgery. The Royal College of Surgeons of England recommends that National Health Service–funded implants should not be placed until 3 months after quitting. Guidelines from the American College of Prosthodontics, without explicitly citing tobacco use, recommend that patients at higher risk for negative clinical outcomes receive a professional examination more often than every 6 months. Based on limited evidence and lacking in consistency, current guidelines and recommendations for managing periodontal conditions in the tobacco-using patient leave dental professionals to apply sound judgment in managing risk for unfavorable treatment outcomes. Additional clinical data are needed to evaluate preventive and therapeutic interventions for tobacco-using patients. For now, patients must be informed of the risks associated with continued tobacco use and encouraged to make a quit attempt with evidence-based help from their dental provider through direct support or referral to cessation services.

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