

## ORAL RINSING

### Canadian Dental Hygienists Association Position Statement

Based on current research, dental hygienists are encouraged to recommend oral rinsing with commercially available over-the-counter rinses (mouthwashes) as an adjunct to their clients' usual mechanical plaque control measures, particularly for clients who are unable to control plaque accumulations and/or show signs of gingivitis. Based on well-conducted long-term clinical studies (six months and longer), mouth rinses with a fixed combination of three essential oils—thymol 0.063%, eucalyptol 0.091%, and menthol 0.042% along with other ingredient(s) (i.e., methyl salicylate 0.0660%)—have shown reductions in plaque and gingival inflammation beyond that accomplished with mechanical means alone. Other oral rinses, such as those with the active ingredients cetylpyridinium chloride, triclosan, and amine/stannous fluoride, demonstrate some reductions in plaque and gingivitis, but the research surrounding these formulations is less conclusive. Where rinses with alcohol may be poorly tolerated by or contraindicated for clients, an alternative alcohol-free oral rinse formulation may be warranted but it is recognized there will be a marked reduction in product efficacy. Recommendations surrounding the use of oral chemotherapeutics should be based on current evidence and client-specific conditions.

**Keywords:** biguanides, cetylpyridinium, chlorhexidine, dental plaque, gingivitis, mouthwashes, triclosan

## CDHA Position Paper on Commercially Available Over-the-Counter Oral Rinsing Products

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### INTRODUCTION

**T**HE PREVALENCE OF GINGIVITIS IN ADULTS IN THE United States exceeds 50% and approaches 100% in some population groups.<sup>1,2</sup> Similar proportions are believed to exist in Canada, although data are lacking. Although the prevalence of periodontitis is decreasing in some populations, it increases with age and may affect as many as 80% of seniors.<sup>3</sup> While gingivitis is not a good predictor for the development of periodontitis, gingivitis does typically precede periodontitis<sup>4</sup> and therefore the control of gingivitis is well warranted.

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In developed nations, it is estimated that approximately one-third of the population removes plaque adequately; the proportion is much less in underdeveloped nations.<sup>5</sup> Inadequate control of bacterial plaque is considered one of the primary causative factors in periodontal disease progression.<sup>6,7</sup> While mechanical methods of plaque removal are considered the standard for individually applied oral disease preventive practices, the high prevalence of gingival disease has prompted research into and development

of adjunctive methods for controlling oral biofilms.<sup>8</sup> In 2002, data presented at the International Association for Dental Research (IADR) meeting supported the benefit of oral rinsing with chemotherapeutics as an adjunct for controlling plaque and maintaining gingival health.<sup>9</sup> The adjunctive benefit of oral rinsing may also increase with age if dexterity and income decline.<sup>3</sup>

Mouth rinsing is reported to be favoured by the public because of its ease of use and breath freshening effect.<sup>9</sup> As dental hygienists are well positioned to make patient-specific recommendations to their clients that ultimately have the potential to influence individual behaviours for promoting oral health,<sup>9</sup> it is essential that dental hygienists possess and utilize the most current and evidence-based literature.

This paper reports on the current state of the science on oral rinsing with commercially available, over-the-counter (OTC) chemotherapeutic formulations for the control of periodontal diseases. The outcome of the investigation is the current position paper and subsequent position statements that will provide dental hygienists with current knowledge of the topic so they can provide evidence-based client education.

### BACKGROUND

Standard mechanical oral hygiene methods, specifically toothbrushing and interdental cleansing along with regu-

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lar professional care, have traditionally been relied on to prevent and treat periodontal diseases.<sup>9</sup> Indeed, the American Dental Association (ADA) has made this a consistent recommendation for almost a century.<sup>7</sup> Despite ubiquitous use of toothbrushing with fluoridated toothpaste in developed nations and flossing being the most widely recommended home care procedure for interproximal plaque control,<sup>10,11</sup> epidemiological data have indicated that these methods do not achieve their theoretical potential for controlling bacterial plaque accumulation and gingival disease.<sup>1,2,11</sup>

There are several difficulties with mechanical oral hygiene strategies for controlling bacterial biofilms. These include the time required to complete the task, continuing motivation to maintain these behaviours, and the manual dexterity required to prevent accumulations from occurring.<sup>9,12-14</sup> These difficulties are believed to be more pronounced in difficult-to-access areas of the mouth,<sup>15</sup> such as interproximal and posterior regions, which are even more technically demanding for plaque removal.<sup>16</sup> It is believed that the ability to overcome these difficulties is often lacking, and some plaque inevitably remains even under the best conditions.<sup>13,17</sup>

Plaque is considered the key factor contributing to gingival inflammation that, if left untreated, may progress to periodontitis.<sup>16-18</sup> Optimal plaque removal has been shown to control periodontal disease progression.<sup>19</sup> It is thus imperative that home care strategies address clients' non-compliance with traditional methods. It is essential that dental hygienists develop and maintain a keen under-

## **Déclaration de l'ACHD concernant le rinçage buccal**

En se fondant sur les recherches actuelles, les hygiénistes dentaires sont encouragées à recommander le rinçage buccal avec des rince-bouche commerciaux offerts en vente libre à leurs clients, comme complément à leurs méthodes mécaniques habituelles pour contrôler l'accumulation de plaque, particulièrement dans le cas des clients qui sont incapables de contrôler les accumulations de plaque et/ou qui montrent des signes de gingivite. Des études cliniques sérieuses à long terme (six mois et plus) ont démontré que l'utilisation de rince-bouche ayant une combinaison fixe de trois huiles essentielles – le thymol à 0,063 %, l'eucalyptol à 0,091 % et le menthol à 0,042 % – et d'autres ingrédients (p. ex., le salicylate de méthyle à 0,0660 %) permet de réduire davantage la plaque et l'inflammation gingivale que ne le font les méthodes mécaniques seules. L'utilisation d'autres rince-bouche, tels que ceux contenant des ingrédients actifs comme le chlorure de cétylpyridinium, le triclosan et le fluorure d'amine/étain amène certaines diminutions de la plaque et de la gingivite, mais la recherche englobant ces préparations est moins concluante. Lorsque les rince-bouche contenant de l'alcool peuvent être difficilement tolérés par les clients ou contre-indiqués pour les clients, l'utilisation d'un rince-bouche dont la préparation ne contient pas d'alcool peut être justifiée, bien qu'il soit reconnu qu'il y aura une réduction marquée de l'efficacité du produit. Les recommandations touchant les agents chimiothérapeutiques oraux devraient être fondées sur des données probantes actuelles et sur les affections spécifiques des clients.

### **RECOMMANDATIONS**

1. Les rince-bouche chimiothérapeutiques commerciaux, offerts en vente libre, devraient être vus comme des compléments aux méthodes mécaniques d'enlèvement de la plaque.
2. Les rince-bouche offerts en vente libre sont particulièrement indiqués pour les clients qui ont une accumulation de plaque non contrôlée, des saignements, de l'inflammation et/ou de la gingivite ; toutes les recommandations d'hygiène buccale devraient être spécifiques au client.
3. Pour les rince-bouche offerts en vente libre, une combinaison fixe de trois huiles essentielles – le thymol à 0,063 %, l'eucalyptol à 0,091 % et le menthol à 0,042 % - avec d'autres ingrédients, comme le salicylate de méthyle à 0.0660% (Listerine®), s'est avérée plus efficace, plus sûre et a des effets secondaires acceptables, selon des études à long terme rigoureuses.
4. Plusieurs autres rince-bouche, offerts en vente libre, ont montré une efficacité supérieure aux placebo – incluant le AmF/SnF<sub>2</sub>, certains produits contenant du chlorure de cétylpyridinium chlorure et le triclosan – mais il n'y avait pas de protocoles rigoureux d'étude, ce qui, par conséquent, justifie une investigation plus poussée.
5. Les hygiénistes dentaires peuvent recommander des rince-bouche contenant de l'alcool puisqu'il n'a pas été démontré qu'ils pouvaient avoir des effets secondaires, l'exception étant pour les clients qui ne peuvent tolérer l'alcool pour des raisons médicales variées.
6. Les hygiénistes dentaires devront surveiller de près ce domaine d'étude puisque la recherche et le développement vigoureux dans ce domaine se poursuivront probablement. Les hygiénistes dentaires doivent reconnaître les limites des protocoles d'études à court terme et moins rigoureux lorsqu'elles évaluent l'efficacité et la sûreté des préparations de rince-bouche.

standing of the antimicrobial benefits of commercial OTC oral rinses and be aware in particular of these rinses' clinical efficacy and the manifestations of the products.<sup>20</sup>

### Brief history of oral rinses

The earliest recorded reference to oral rinsing as a formal practice to treat diseases of the gums is attributed to Chinese medicine in approximately 2700 B.C.<sup>5</sup> The early practice of mouth rinsing was recommended with the urine of a child, and this practice spread across many countries and persisted until the early 1700s.<sup>5</sup>

In the mid-1800s, Joseph Lister, a surgeon and researcher, emerged as one of the major proponents of chemotherapeutics.<sup>5</sup> In the latter half of that century, Miller, a researcher in bacteriology, furthered the knowledge on oral rinsing by distinguishing between bacteriostatic effects (inhibiting the metabolism or reproduction of a bacteria) and bactericidal effects (killing the microbes).<sup>21</sup> He also recognized the need to rinse after mechanical methods of debris removal.<sup>5</sup> In the post-Miller era of the mid-1900s, oral antiseptic and germicidal claims were abundant. However, few claims had supporting clinical data, and those that did were in the form of *in vitro* testing.<sup>5</sup> While the early emphasis of these rinses was on caries prevention, there was a shift in the 1960s from preventive and therapeutic studies of antimicrobials to gingivitis and periodontitis.<sup>5</sup>

More recently, it was recognized that the levels of mechanical oral hygiene practice were inadequate despite technological innovations. This provided the impetus for the use of antimicrobial mouth rinses with the aim of controlling plaque and gingivitis.<sup>6,16,22,23</sup> As a result, both OTC and prescription formulations of oral rinses have increased sales and acquired a share of the home oral health care products market.<sup>24</sup> Oral rinses are typically viewed as being adjunctive to mechanical measures. Non-adjunctive methods—using chemotherapeutic rinses *instead* of mechanical means—are typically used in short-term preliminary studies for screening potential active ingredients and also in clinical settings such as post-surgery when mechanical plaque control is not possible.<sup>4</sup>

### ORAL RINSES IN GENERAL

It is becoming increasingly accepted that chemotherapeutics in the form of oral rinses have a key role as adjuncts to the prevention and treatment of periodontal diseases.<sup>6,7,12,15,18,19,23,25</sup> However, a relatively small pro-

portion of formulations and proprietary products have shown convincing evidence of efficacy.<sup>26</sup> It should be noted that long-term compliance with oral rinses is also yet to be established.<sup>12</sup> Current statistics indicate that less than 50% of the population use mouth rinses and half of these rinses are not therapeutic preparations.<sup>27</sup> Furthermore, most patients do not use mouth rinse products according to the manufacturers' directions; this could limit product efficacy.<sup>27</sup>

Although mouth rinses have the ability to reach less accessible areas, they penetrate sub-gingival areas only minimally. Within minutes, gingival crevicular fluid outflow will dilute sub-gingivally applied antiseptics.<sup>12,28,29</sup> In addition, the proteins present in saliva may reduce the activity of some substances.<sup>29</sup> It should also be noted that the oral biofilm produces an encased and highly protective community of cells that acts as a barrier and as a result is much less influenced by its environment, including the introduction of chemical agents.<sup>29</sup> Compared with bacteria in free water (planktonic forms), the gel-matrix of the plaque biofilm inhibits the diffusion of materials, albeit less than previously believed.<sup>29</sup>

Ideal properties of oral rinses include the following:

- safety
- access to bacteria even in difficult areas
- palatability
- low-cost
- high solubility within the formulation
- effective antibacterial impact
- broad spectrum preferably
- selectivity
- adequate bioavailability (plaque penetration and reactivity)
- specificity with regard to oral bacteria
- minimal side effects
- ability to reach and provide adequate retention in sites of disease initiation
- stability in storage<sup>12,27,30-32</sup>

### CATEGORIZATION AND DISCUSSION OF ACTIVE INGREDIENTS

Extensive literature is available on chemotherapeutics for plaque and periodontal disease control. This falls into five distinct categories: antiseptic agents, antibiotics, enzymes, modifying agents, and anti-adhesives<sup>5,33</sup> (see table 1). Oral antiseptic agents exhibit little or no oral or systemic toxicity, or microbial resistance, and most have a

Antiseptic agents	Antibiotics	Enzymes	Modifying agents	Anti-adhesives
Broad spectrum; aimed at killing or preventing proliferation of all plaque organisms	Capable of inhibiting or killing specific groups of bacteria	Single or combinations; break up gel-like matrix holding plaque together; or modify plaque activity	Non-enzymatic, dispersing, denaturing agents that can alter the structure or metabolic activity of bacterial plaque	Agents that can interfere with the attachment of all or some of the bacteria to the pellicle surface

**Table 1.** Definitions of major antimicrobial categories<sup>5</sup>

broad antimicrobial spectrum.<sup>5</sup> Generally, the efficacy of oral antiseptics is attributed to their bactericidal activity; however, some also have been shown to interfere with bacterial colonization.<sup>28</sup> Several antiseptic agents have been investigated including phenols, quaternary ammonium compounds (QAC), oxygenating agents, herbal extracts, bis-biguanides, bis-pyridines, pyrimidines, halogens, and heavy metal salts.<sup>5</sup> Most of these are considered “first generation antimicrobials” in that they are able to kill bacteria readily on contact, but their effect on the microflora subsequent to expectoration is limited.<sup>34</sup> “Second generation” products, such as those incorporating some bis-biguanides, not only possess the immediate antibacterial effect but also have the important characteristic of a prolonged intra-oral effect, referred to as substantivity.<sup>34</sup> Substantivity is defined as the ability of a substance to bind to tissue surfaces and be released over time, thus providing sustained anti-bacterial activity.<sup>31</sup> In some products, it is considered to elicit effective plaque reductions.<sup>19</sup>

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Antibiotics, enzymes, plaque-modifying agents, and anti-adherence products have varying roles in controlling plaque accumulations and periodontal diseases (table 1), and some agents are beginning to show promise. However, this review will cover only antiseptics, as this is where most of the research in commercial products has been conducted.<sup>5,18</sup>

**Phenolic compounds.** Of the antiseptic agents (see table 2), phenols have been in clinical use the longest and have been available worldwide for over a century with minimal adverse effects reported.<sup>5,12</sup> Listerine is a commercially available OTC phenolic compound.<sup>5,12</sup> The original Listerine formulation was tested in 1884. Miller, in his book *Micro-organisms of the Human Mouth* (1890), states that “Listerine has proved to be a very useful and active antiseptic.”<sup>5,22</sup> An independently published assessment in 1929 showed Listerine to have significant bactericidal activity against a variety of micro-organisms.<sup>22</sup> Listerine was the first non-prescription oral rinse to be accepted by the Council of Dental Therapeutics for controlling plaque and gingivitis and by the Consumer Products Recognition Committee of the CDA for reducing and preventing the progression of gingivitis.<sup>22,35</sup>

Essential oils (EOs) are the fragrant component of plants and contain phenolic compounds. These essential oils kill micro-organisms by disrupting their cell membrane and inhibiting enzyme activity.<sup>28,36</sup> The active ingredients in Listerine are a fixed combination of three EOs, thymol 0.063%, eucalyptol 0.091%, and menthol 0.042% along with other ingredients (i.e., methyl salicylate 0.0660%).<sup>12,22</sup> Together, these EOs prevent bacteria from aggregating with gram positive pioneer species, slow bacterial multiplication, and extract endotoxins from gram negative pathogens, thus reducing bacterial load.<sup>28,30</sup> They also slow plaque maturation and decrease plaque mass and pathogenicity.<sup>28,30</sup> The “sharp” taste reported of Listerine has been attributed to the ethanol and the essential oils, but other formulations—Cool Mint and Cool Citrus Listerine—are reportedly less “intense” tasting while maintaining the same effectiveness.<sup>35,37</sup> These compounds are also anti-inflammatory and scavenge oxygen free radicals; both these characteristics may contribute to their therapeutic effect.<sup>5</sup> While possessing high specificity

Active ingredient	Examples	Trade names
Phenolic compounds	Thymol, eucalyptol, menthol	Listerine®
Bis-biguanides	Chlorhexidine	Peridex® (0.12%)
Quaternary ammonium compounds	Cetylpyridinium chloride (CPC) Domiphen bromide (DB) Benzethonium chloride (BC)	Cepacol® (0.05% CPC); Scope® (CPC & DB); Colgate® 0100* (0.05% BC); Crest Pro-Health Rinse®* (0.07% CPC)
Herbal extracts	Sanguinarine	Viadent® (0.03%)
Germicide	Triclosan	Colgate Total Plax® (0.3% triclosan/ 2.0% copolymer) [USA]*
Halogens	Fluorides; iodine	Meridol®
Oxygenating agents	Peroxides	Amosan®

**Table 2.** Summary of antiseptic agents<sup>5</sup>

\* Not available in Canada

and efficiency, EOs are considered to have low substantivity.<sup>30</sup> Use of EOs results in no change in bacterial composition of supra-gingival plaque.<sup>12</sup> Although EOs decrease the total micro flora, there is no evidence of increased and/or opportunistic oral pathogens or antimicrobial resistance.<sup>12</sup>

Numerous short-term trials that include Listerine have been conducted and most have shown Listerine to have a positive influence on retarding plaque re-growth and other indices.<sup>8,38-40</sup> Long-term trials have shown the efficacy of Listerine in plaque and gingivitis reductions in the area of 56% and 35%, respectively, as compared with negative controls.<sup>12,41</sup> While most studies have shown that Listerine is significantly more effective than negative controls, CHX (discussed below) is generally shown to be more effective than Listerine in plaque reductions while demonstrating comparable anti-gingivitis properties.<sup>22</sup> The side effect profile of Listerine, however, is more favourable than CHX, with the former demonstrating minimal staining, no calculus promotion, and no interaction with toothpaste ingredients.<sup>5,12,22</sup>

In early 2005, it was reported that a U.S. federal court issued an order barring Listerine advertising claims (applying to promotional material and advertising in the United States), purporting that the mouth rinse was as effective as floss in reducing plaque and gingivitis interproximally.<sup>42</sup> The judge in the case asserted that the Listerine claims are false and misleading, pose a public health risk, and may undermine the efforts of dental professionals.<sup>42</sup> The complaint filed by McNeil-PPC Inc., a subsidiary of Johnson & Johnson (the maker of Listerine), involved two considerations: first, the claim that Listerine is as effective as flossing against plaque and gingivitis; and second, the implicit claim that Listerine is a replacement for flossing and all benefits of the latter may be replaced by rinsing.<sup>42</sup>

According to the report, the claims made by Listerine were based on two well-designed six-month trials performed by independent laboratories under contract with Pfizer following America Dental Association (ADA) guidelines. These trials were reviewed and accepted by the ADA's Council on Scientific affairs.<sup>42</sup> In May 2004, the Council approved Pfizer Inc.'s request to use the "as effective as flossing" claim in advertising Listerine.<sup>42</sup> For the therapeutic effect of a product to be "at least as good as" another, it must demonstrate a level of benefit no less than what would have been required for the two agents to be considered equivalent.<sup>41</sup> However, the study was conducted under "real world conditions," meaning that neither the flossing nor the oral rinsing was supervised by researchers. Therefore there was no assurance of compliance or that the correct technique was followed with each respective intervention. The judge concluded that the flossing arm of the study was not done correctly.<sup>42</sup> Assuming that flossing is more technically demanding than rinsing, compliance within this test group may be less stringent than the rinsing group and may have an impact on the study outcomes. It has been asserted in subsequent publications of Listerine that it was never the intention to imply that mechanical interproximal plaque removal is not necessary, and more recent studies have been conducted in an

attempt to demonstrate an incremental adjunctive benefit of rinsing with Listerine in addition to flossing.<sup>7,18,41</sup>

**Bis-biguanides.** Introduced in the mid-1950s, bis-biguanides have a very broad antimicrobial spectrum effective with both gram positive and gram negative bacteria.<sup>5,30</sup> Chlorhexidine gluconate (CHX) is a cationic bis-biguanide and was initially presented to the market as a 0.2% mouth rinse.<sup>6</sup> It is now one of the most widely investigated and used oral products.<sup>30</sup> The mechanism of action is to bind strongly to bacterial cell membranes, increasing the cell permeability, thus initiating leakage and/or precipitating intracellular components.<sup>28</sup> Furthermore, it binds to salivary mucins, reducing the pellicle formation, thereby inhibiting subsequent colonization. It also hinders the adsorption of bacteria onto the tooth structure.<sup>28</sup>

### ***Chlorhexidine gluconate (CHX)... is now one of the most widely investigated and used oral products.***

While the 0.2% CHX rinse was previously popular in Europe, less concentrated formulations (0.12%–0.1%) were later made available in an attempt to reduce notable side effects such as tooth staining while still maintaining the positive plaque and gingivitis outcomes.<sup>26</sup> The proprietary formula, Peridex, was one of these and is now typically marketed as a 0.12% prescription formulation.<sup>22</sup> It was accepted by the U.S. Food and Drug Administration's (FDA) Council on Dental Therapeutics on a prescription basis.<sup>12</sup> The typical regimen for this product is 18–20 mg for 60 seconds twice a day at 0.12% or 0.2% formulations.<sup>26</sup> The dose-response of CHX is evident in that a concentration of 0.1% is the threshold level, above which no further benefits will be expected.<sup>26,43</sup>

The advantage of CHX over other cationic agents is that it can bind strongly to many sites in the oral cavity and is released slowly over 7 to 12 hours after rinsing, thus providing considerable substantivity and a sustained antimicrobial effect restricting bacterial proliferation.<sup>19,28,30</sup> CHX binds strongly with anionic glycoproteins and phosphoproteins on the mucosa and tooth pellicle, but it can also bind to cell surfaces of bacteria affecting the cells' ability to adhere.<sup>5,12,30</sup> CHX is considered the most potent chemotherapeutic agent currently available.<sup>44</sup> Short-term trials predominantly demonstrate the superior efficacy of CHX on plaque re-growth and numerous other outcome measures.<sup>38,40,45-48</sup> Plaque reductions of 16%–45% and gingivitis reductions from 27%–80% have been demonstrated in six-month trials.<sup>12</sup> Because of the accumulation of positive clinical research findings, CHX rinses are often used as a benchmark control, meaning a product already in use and/or evaluated thus providing information regarding another agent's relative activity. CHX rinses are used similarly as a positive control, meaning they are accepted as effective, the most effective, or the "gold standard."<sup>4,22,23,26,36</sup>

As CHX has no activity on specific bacterial enzymes or receptors, there is minimal opportunity for bacterial resistance to develop, and no shift in the oral flora has been demonstrated that would allow opportunistic species to flourish.<sup>5,12,28</sup> Unfortunately, CHX has several clinically significant disadvantages including brown staining of the teeth, tongue, and restorations, particularly on composites, requiring professional removal; alteration of taste perceptions for up to four hours after rinsing; and potentially increased supra-gingival calculus build-up.<sup>12,30,33</sup> Hypersensitivity of mucosa and hairy tongue are less common side effects.<sup>30</sup> Furthermore, the efficacy of CHX can be impaired when it is incorporated into complex rinse formulas and also by ingredients in toothpastes, specifically, sodium lauryl sulfate.<sup>12,23,33</sup> Although the long-term use of CHX has been shown to be safe, its side effects prevent its acceptance except under short time frames.<sup>12,23,44</sup>

**CPC commercial rinses have shown plaque reductions at 25%–35% with equivocal results for gingivitis measures and therefore have mainly been accepted only for cosmetic use.**

**Halogens/fluoride.** The use of fluoride as a caries preventive agent is well documented, but its use in the prevention and control of plaque and periodontal diseases is less recognized. While stannous fluoride ( $\text{SnF}_2$ ) has been shown to be effective, stability problems have prevented its widespread use.<sup>49</sup> A recent systematic review concluded that there is insufficient research surrounding the efficacy of  $\text{SnF}_2$  mouth rinses on plaque and gingivitis.<sup>50</sup> In the early 1990s, a stable amine/stannous fluoride (AmF/ $\text{SnF}_2$ ) solution was marketed by GABA International (Swiss) under the proprietary name Meridol<sup>47</sup> and Oraflur® (Swiss).<sup>29</sup> Unlike  $\text{SnF}_2$ , AmF has only caries preventive properties. However, in Meridol, the antimicrobial effect of  $\text{SnF}_2$  (inorganic) is stabilized as it is combined with AmF (organic).<sup>49,51</sup> The stannic ions in the AmF/ $\text{SnF}_2$  compound are absorbed on the bacterial surface, inhibiting metabolic efficiency and thereby reducing the accumulations of plaque deposits.<sup>49</sup>

Some short-term trials with Meridol have shown improvements in plaque outcome scores over placebo rinses,<sup>38,45,48,52</sup> while others have shown equivocal results in comparison to CHX.<sup>45</sup> Studies, again short-term, have demonstrated efficacy on bacteria in planktonic forms but not in biofilms, thus demonstrating the importance of *in vivo* trials under real-life conditions.<sup>48</sup> One long-term study examining the efficacy of Meridol demonstrated significant reductions in approximal plaque, bleeding, and gingival indices over untreated controls.<sup>51</sup> However, no positive control group was included so it is not known how Meridol compares with benchmark formulations such as CHX.<sup>51</sup> In more recent short- and long-term stud-

ies, definitive reductions in pathogenic micro-organisms that have translated into reductions in signs of inflammation have also been demonstrated.<sup>29,49</sup> To date, no side effects of Meridol have been reported.<sup>33,51</sup>

**Quaternary ammonium compounds.** Quaternary ammonium compounds (QAC), which are generally cationic agents, interact with the cell membrane of bacteria affecting their permeability and subsequently resulting in the loss of cell contents.<sup>5</sup> QAC are bactericidal to both gram positive and gram negative bacteria but to a greater degree with the former.<sup>5</sup> QAC are also considered to have low substantivity while possessing high specificity and efficiency.<sup>30</sup> These compounds have the ability to bind strongly to oral tissues, but they are released at a more rapid rate than CHX.<sup>33</sup>

One example: cetylpyridinium chloride (CPC) usually at 0.05% (Cepacol) without or with domiphen bromide (Scope) or benzethonium chloride also at 0.05% (Colgate 100 [USA]) have been used in mouthwash for many years.<sup>5,33</sup> CPC controls supra-gingival plaque and calculus.<sup>6,15,31</sup> Crest Pro-Health Rinse (USA) is a recently introduced commercially available OTC formulation that delivers 0.07% CPC in a high bioavailability base not requiring alcohol for solubilization.<sup>6,15,27,31</sup> It has met FDA guidelines for safety and effectiveness against plaque formation and gingivitis, but its effectiveness can decrease in the presence of product emulsifiers.<sup>6,15,27,31</sup>

CPC commercial rinses have shown plaque reductions at 25%–35% with equivocal results for gingivitis measures<sup>5,33</sup> and therefore have mainly been accepted only for cosmetic use.<sup>12</sup> Short-term trials, including some with experimental formulations of CPC, have shown improvements in plaque indices over controls,<sup>53</sup> but they have been significantly less effective than CHX, reporting less than half the plaque reductions.<sup>46</sup> CPC shares some of the adverse effects of CHX including tooth staining, burning, and increased calculus formation.<sup>5,33</sup> So, while having a moderate degree of efficacy, its potential is limited because of rapid desorption from oral tissues.<sup>5,33</sup> New combinations of CPC with other active ingredients have been proposed, are being tested, and have shown promise *in vivo*.<sup>54</sup>

**Germicides.** Triclosan, a bis-phenyl, is a broad-spectrum antibacterial agent with a favourable safety profile.<sup>23,33</sup> Short-term trials of triclosan/copolymer (Colgate Total Plax) have shown significant effectiveness in plaque outcomes when measured against controls, but this formulation is significantly less effective than CHX.<sup>39</sup> Another short-term trial showed that Colgate Total Plax with triclosan significantly reduced planktonic forms of bacteria over controls, but this was not demonstrated for bacteria in biofilm forms.<sup>52</sup> Experimental triclosan formulations have been compared with sanguinarine and CHX; triclosan was significantly more effective than sanguinarine but less than CHX.<sup>47</sup> While triclosan is mostly used in dentifrices,<sup>15</sup> the oral rinse containing 0.3% triclosan/2.0% copolymer (Colgate Total Plax [USA]) has beneficial effects on plaque formation and gingivitis reduction.<sup>23,55</sup> However, triclosan-containing formulations are not as effective as CHX, likely due to triclosan's limited ability to

bind intra-orally.<sup>23,33</sup> To combat its limited substantivity, triclosan has been placed into combination products to increase its retention.<sup>33</sup>

Caution must be taken when making recommendations as other Plax formulations do not contain triclosan but have an antimicrobial detergent, sodium benzoate, and are no more effective than placebo and have limited clinical significance.<sup>33,56</sup> A new formulation marketed under the trade name Advanced Formula Plax® in the United States contains increased amounts of sodium lauryl sulfate and tetrasodium pyrophosphate along with the usual detergent mixture, but no triclosan.<sup>8</sup> In short-term trials, this combination was no more effective than the negative controls in plaque outcome scores.<sup>8</sup>

**Oxygenating agents.** Oxidizing agents, such as hydrogen peroxide, have been used for many years to “disinfect” or cleanse oral tissues, but interest in their use against plaque and gingivitis has been limited.<sup>57</sup> Hydrogen peroxide in concentrations acceptable for human use (<3%) is unstable and difficult to store, but some commercial products containing sodium peroxyborate or sodium peroxy-carbonate are available.<sup>57</sup>

**Herbal extracts.** The herbal extract sanguinarine is currently employed as an anti-plaque and anti-gingivitis agent in mouth rinses and toothpastes. It is an alkaloid extract from the bloodroot plant, *Sanguinaria canadensis*, and is used at 0.03% concentrations.<sup>5,33</sup> There are conflicting reports on its effectiveness.<sup>33</sup> A long-term trial compared the effect of a sanguinarine rinse (Viadent) with EO (Listerine), CHX (Peridex), and a placebo on plaque, inflammation, and bleeding.<sup>34</sup> All three test groups reduced plaque scores significantly compared with the placebo, with the CHX being significantly better than the EO that in turn had significant improvements over the sanguinarine.<sup>34</sup> Only the CHX showed significant reduction in the gingival indices, and the EO demonstrated reductions in the area of 9%.<sup>34</sup> In contrast, subsequent short-term trials have demonstrated that an experimental sanguinarine formulation was no more effective than placebo.<sup>47</sup> Therefore, long-term trials are still required to establish its efficacy.<sup>5</sup>

Other naturally sourced products, for example Herbal Mouth and Gum Therapy®, have shown antimicrobial activity, but not in long-term studies nor with positive controls.<sup>24</sup> According to the manufacturer, echinacea (analgesic, anti-inflammatory, and antibiotic) and goldenseal (antiseptic and antibiotic) are the main active ingredients, but the percentage of each within the formulation is retained as proprietary information.<sup>24</sup>

There are several studies on a variety of other miscellaneous compounds. The salts of heavy metals are effective as antibacterial agents, and while zinc has persisted in use, interest has shifted commercially to toothpastes.<sup>5</sup> Povidone-iodine, which contains 1% iodine, is an antiseptic that has received little attention in the literature, but preliminary data shows some efficacy against gingivitis.<sup>58</sup> Short-term trials examining Xylitol rinse, with or without fluoride, demonstrated no superiority over controls on plaque and gingival indices.<sup>59</sup> Recently, antimicrobial host

proteins, lysozyme, lactoferrin, and lactoperoxidase (LLL), have been used in oral health care products, particularly for clients with xerostomia.<sup>48</sup> One such product, Biotène®, an antimicrobial containing LLL, was investigated in a short-term trial. Even though it reduced salivary bacteria, it had no more efficacy on plaque indices than the control and was inferior to both CHX and AmF/SnF<sub>2</sub>.<sup>48</sup>

## **Triclosan-containing formulations are not as effective as CHX, likely due to triclosan's limited ability to bind intra-orally.**

### **The role of alcohol in oral rinses**

Alcohol, particularly ethanol, is a common chemical agent in oral rinse solutions to emulsify antimicrobial ingredients in bioavailable forms.<sup>24,25,27</sup> The ethanol itself has only a slight antibacterial efficacy both *in vitro* and *in vivo*, but this does not contribute to the oral rinse's efficacy.<sup>17,25,60</sup> Most mouth rinses contain less than 10% by volume but some contain up to 30% by volume.<sup>25</sup> Most AmF/SnF<sub>2</sub>, CHX, CPC, triclosan, and EO rinses contain alcohol,<sup>25</sup> but interest has increased for oral rinse formulations that are alcohol free.

Concern has been raised surrounding alcoholic beverages and oral cancer, but it is recognized such risk is linked to carcinogens, such as urethane, found in beverages (not oral rinses) rather than to the alcohol itself.<sup>17</sup> While this paper does not attempt to review the literature surrounding an association between alcohol and cancer-related health risks, the authors of one review paper stated: “The ethanol [found in oral rinses] has never been demonstrated to be carcinogenic” in laboratory or human studies.<sup>17</sup> The paper looked at studies and reviews of oral rinses and epidemiological data examining a potential association. It concluded there is no reason for clients to refrain from using mouth rinses with alcohol except for medically related client-specific contraindications.<sup>17</sup>

Alcohol-containing oral rinses may be contraindicated for certain patient groups including recovering alcoholics, those taking certain antibiotics, and diabetics.<sup>17,27</sup> Similarly, products containing alcohol may be poorly tolerated by patients who are immunocompromised, undergoing head and neck radiation therapy, and/or have mucositis.<sup>17,27</sup> Some researchers have concluded that higher alcohol content may induce more pain on rinsing in some subjects.<sup>27</sup> While a recent review investigating the epidemiology of dry mouth in geriatric populations stated that alcohol use has been implicated in xerostomia, the authors state the exact nature of the relationship is unclear and needs to be systematically examined.<sup>61</sup> In two recent short-term studies, perceived mouth dryness and reduced salivary flow were not shown to be significantly different between study subjects using oral rinses either with or without alcohol.<sup>62,63</sup>

## MATERIALS AND METHODS

This position paper, commissioned by the Canadian Dental Hygienists Association (CDHA), represents a comprehensive review of the literature on oral rinsing with commercially available, over-the-counter (OTC) chemotherapeutic agents in order to develop position statements surrounding the use of the practice of home mouth rinsing as a preventive oral health behaviour. The first step in the investigation was to develop a PICO question, which subsequently guided the literature search and this report. The PICO question:

Do adults who have plaque and/or gingivitis and/or early periodontitis (Population) who mouth-rinse according to manufacturer's directions with a commercially available, non-prescription oral rinse as an adjunct to mechanical measures including toothbrushing alone or toothbrushing and flossing (Intervention) compared to using no oral rinse (Comparison) have improved plaque, bleeding, and/or gingivitis scores (Outcome)?

The literature search was conducted in stages from January 2006 to March 17, 2006. The search included the following databases: MedLine, CINAHL (Cumulative Index of Nursing and Allied Health Literature), and the Cochrane controlled trials register. The literature search focused on papers reporting on long-term, *in vivo* randomized controlled trials (RCTs) but also included other relevant papers (both *in vivo* and *in vitro* short-term studies) including meta-analysis/systematic reviews, reviews, and various other sources including media reports and websites.

The first stage of the review involved the three databases and included combinations of the following keywords: oral rinse, mouth rinse, home rinse, oral chemotherapeutics, fluoride rinse, (anti) gingivitis, (anti) plaque, and essential oils. The search was limited to the English language from 1995 to 2006. This search resulted in 534 articles from the Medline and CINAHL databases. The search of the Cochrane database did not produce any literature (existing systematic reviews or study protocols) pertaining to oral rinsing for the purpose of controlling plaque or periodontal diseases. Papers were selected for retrieval if they measured the impact of oral rinsing with the use of a commercially available, non-prescription mouth rinse (experimental group) compared with oral rinsing with alternative products and/or the use of mechanical plaque removal interventions (control group) in adult populations who had either plaque and/or healthy gingiva, and/or gingivitis and/or early periodontitis and an outcome variable was measured. Other relevant literature was identified at this point if it was deemed to provide background information. The search was conducted using titles, abstracts, and the full text when necessary. A total of 70 papers were identified and subsequently retrieved in full text.

The second stage of the search involved manually checking for additional materials in the bibliographies and references in all papers identified by the initial search. At

this stage, the retrieval criteria were more purposeful and less restricted to the original keywords and PICO question, as the literature may have been necessary for understanding or background information. This resulted in an additional 29 papers being retrieved. Several websites were also subsequently examined including those of the Canadian Dental Association (CDA) and the American Dental Hygiene Association (ADHA).

A unique element of a position paper is the solicited input from recognized experts and researchers. For this paper, input was sought from experts in three fields: oral biology, pharmacology, and periodontology. The rationale for this combination was to provide expertise in each scientific theme of inquiry pertaining to this topic.

## RESULTS

Most studies conducted on oral rinsing are either short-term (24 hours to a month in length) or long-term (six months or longer). The short-term trials were either *in vitro* or *in vivo*, with the latter typically conducted in the absence of any oral hygiene measures.<sup>64</sup> *In vitro* studies are more affordable and practical to conduct. However, they do not reflect the true intra-oral conditions such as saliva turnover; the ability of the active ingredient to adhere to oral tissues and its resulting substantivity (or lack thereof); and the interference of rinse's cationic active ingredients by external some components, such as those in toothpaste.<sup>4,64,65</sup>

A four-day *in vivo* model that has been used extensively in research and has produced consistent results involves study subjects rinsing with either an experimental or control rinse formulation in the absence of any other oral hygiene measures with a subsequent assessment of the chemotherapeutic plaque inhibitory activity.<sup>64</sup> As bacterial phenotypes can change when organisms go from a planktonic state to part of a biofilm—referred to as a sessile state—altered susceptibilities to antimicrobial agents may result.<sup>28</sup> Therefore the efficacy of antiseptics depends on *in vivo* as well as *in vitro* microbicidal properties.<sup>28</sup> It can be stated generally that, with few exceptions, an agent with limited activity *in vitro* will have poor activity *in vivo*.<sup>4</sup> However, *in vitro* study results have poor correlations with *in vivo* findings. *In vitro* models cannot measure and do not allow for the dynamic nature of the mouth and other factors such as the substantivity of an agent that affect the effectiveness of antimicrobials.<sup>4</sup>

To address the deficiencies of short-term trials, the ADA established the Council on Dental Therapeutics (CDT) acceptance program for chemotherapeutic mouth rinses. This resulted in guidelines in the late 1980s for conducting clinical trials aimed at demonstrating efficacy of these products.<sup>65</sup> These guidelines stipulate that clinical trials must be controlled, be at least six months in length, and demonstrate statistical significance of efficacy against supra-gingival plaque and gingivitis under “normal” situations with a typical population group.<sup>65</sup> In Canada, as of 2003, only Listerine and Peridex were approved by the Council as effective under these guidelines.<sup>12,65</sup> The author is unaware of any change in this status.

## LONG-TERM CLINICAL TRIALS

### Essential oils studies

Of the long-term trials conducted since 1995, nine studies of OTC, commercially available oral chemotherapeutics were identified within the published literature, although earlier long-term studies have been conducted (see previous review). Five of these more recent studies directly examined essential oil formulations (table 3).<sup>7,13,22,41,66</sup>

In comparisons of EO and CHX, CHX usually demonstrates superior results, albeit coupled with significant side effects. Of the most recent studies, Listerine (EO) and Peridex (CHX), along with a negative control, were directly compared with the aim of assessing their anti-plaque and anti-gingivitis effectiveness and their associated side effects.<sup>22</sup> In this study, which was in accordance with ADA guidelines for acceptance of chemotherapeutic products,

both experimental groups produced significant improvements in plaque, bleeding, and gingivitis scores over the control.<sup>22</sup> Most striking was observation that at the six-month point, there was no statistically significant difference between CHX and EO rinses.<sup>22</sup> For the calculus index, CHX showed significant increases over the control and EO, whereas the stain indices showed that both test groups had significant increases over the control group.<sup>22</sup>

As CHX is not currently indicated for long-term use, EO rinsing has been compared to various other interventions including flossing. Rinsing with EO, specifically Listerine, was more effective than flossing or controls on plaque scores in recent long-term trials.<sup>13,41</sup> Both Listerine rinsing and flossing are more effective than controls on gingival indices with one later study showing that EO rinsing significantly outperforms flossing.<sup>13,41</sup> These two comparable studies have demonstrated Listerine mouth rinse to be “as

Study	Design	Groups	Results (statistically significant findings)
2004 <sup>7</sup> (Sharma et al.)	RCT, observer blind, parallel group, 6 month, n=241	Three: 1. Brush + control rinse vs. 2. Brush + floss + control rinse vs. 3. Brush + floss + EO rinse	<b>GI:</b> Brush +F (11.2%) and Brush+F+EO (29.9%) reductions compared to control; and Brush+F+EO (21%) reduction compared to Brush+F <b>PI:</b> Brush+F (9.3%) & Brush+F+EO (56.3%) reductions compared to control; and Brush+F+EO (51.9%) better than Brush+F <b>IP MGI:</b> Brush+F+EO (15.8%) reduction compared to Brush +F <b>IP PI:</b> Brush+F+EO (47.7%) reduction compared to Brush +F
2004 <sup>22</sup> (Charles et al.)	RCT, observer blind, parallel group, 6 month, n=107	Three: 1. Test CHX 2. Test EO 3. Control	<b>GI (BI was similar):</b> EO 14% and CHX 18.2% reductions over control; no difference between EO and CHX <b>PI:</b> EO 18.8% and CHX 21.6% reductions over control, no difference between CHX and EO <b>Calc.I:</b> CHX had increases over both EO and control; no difference between EO and control <b>Stain I:</b> both test groups had increases over control and CHX increased over EO
2003 <sup>13</sup> (Bauroth et al.)	RCT, observer blind, parallel group, 6 month, n=324	Three: 1. Brush+EO 2. Brush+F 3. Brush + control rinse	<b>Ip MGI:</b> Brush+EO and Brush+F reduced over control; Brush+EO reduced over Brush+F <b>Ip PI:</b> Brush+EO reduced over both Brush+F and control <b>Ip BI:</b> Brush+EO and Brush+F reduced over control
2002 <sup>41</sup> (Sharma et al.)	RCT, observer blind, parallel group, 6 month, n=301	Three: 1. EO rinse 2. Floss 3. Negative control rinse	<b>Ip MGI:</b> EO (7.9%) & F (8.3%) reductions over control <b>Ip PI:</b> EO more effective than control and F <b>IpBI:</b> EO and F more effective than control <b>Whole mouth MGI, PI, &amp; BI:</b> EO and F better than control except PI (F only at 3 months); EO was better than F for BI
2001 <sup>66</sup> (Charles et al.)	RCT, double blind, parallel group, 6 month, n=316	Three: 1. EO+control toothpaste 2. Total toothpaste + control rinse 3. Control (placebo)	<b>MGI:</b> EO and Total TP reductions compared to placebo; no difference between test groups

**Table 3.** Summary of long-term essential oil oral rinse studies

effective as" dental floss when both were used under "real-life" conditions, meaning unsupervised home use.<sup>13,41</sup> The authors concluded that the results indicated that Listerine rinsing satisfied the "at least as good as" criterion as interproximal gingivitis reductions were comparable to the flossing groups.<sup>13,41</sup> In both studies, however, it was noted that the flossing group produced lower-than-expected values based on previous findings.<sup>13,41</sup> The studies did not examine the compliance with any of the interventions; therefore the frequency and technique of flossing during the study is unknown. The authors recommended that EO mouth rinse be used as an adjunct to, rather than a replacement for, mechanical means and that further studies were warranted to examine the incremental effect of using EO rinse with flossing compared with using each on its own.<sup>13,41</sup>

### ***In comparisons of EO and CHX, CHX usually demonstrates superior results, albeit coupled with significant side effects.***

The incremental effect of the adjunctive use of EO (Listerine) oral rinse with brushing and flossing was evaluated in a study carried out in accordance with the ADA Guidelines.<sup>7</sup> As expected, both the toothbrushing-with-flossing group and the toothbrushing-with-flossing-and-EO-rinsing group outperformed the toothbrushing-only group.<sup>7</sup> However, the incremental benefit of adding Listerine rinsing to flossing regimens was demonstrated as this group showed statistically significant reductions in plaque (51.9%) and gingival (21.0%) scores over the toothbrushing-and-flossing group.<sup>7</sup> The authors concluded that clinically significant and meaningful benefits were obtained with the adjunctive use of the EO oral rinse in addition to flossing and that this reflects a mechanical/chemotherapeutic synergistic effect rather than a simply additive effect.<sup>7</sup>

In a study comparing three groups, Listerine rinsing and a control toothpaste; Colgate Total toothpaste, a triclosan copolymer, with a control rinse; and a control toothpaste and a placebo rinse.<sup>66</sup> Both of the experimental groups showed significantly reduced gingival, bleeding, and plaque indices compared with the placebo group.<sup>66</sup> The reductions were greater for the Listerine group compared with the toothpaste group for all outcomes measured, but the differences were found to be significant only for reducing bleeding and plaque.<sup>66</sup>

#### **Other long-term studies**

One long-term random controlled trial (RCT) examined the efficacy of a triclosan/copolymer pre-brush rinse without fluoride (0.03% triclosan, and 0.13% polyvinylmethyl ether/maleic acid; Colgate Plax) formulation on pre-existing plaque and gingivitis in comparison with a placebo.<sup>55</sup> While no positive control group was included in the study, the results indicated that the rinse had significant reduc-

tions in plaque (29.1%) and gingival indices (16.9%) over the placebo.<sup>55</sup> These findings are consistent with an earlier short-term study where a 0.06% triclosan formulation was more effective than placebo in controlling plaque accumulations when oral hygiene practices were suspended over an 18-day period.<sup>67</sup> In the latter study, 0.12% CHX (Peridex) that was included as a positive control outperformed the triclosan.<sup>67</sup>

While earlier research had clearly shown superiority of CHX and EO (Listerine) over AmF/SnF<sub>2</sub> formulations,<sup>26,64</sup> recent short-term studies have shown equivocal results. For example, a 24-hour RCT examined the *in vivo* efficacy of AmF/SnF<sub>2</sub> mouth rinse (Meridol) and 0.2% CHX solution (Chlorheximed®) in comparison with a placebo control on the thickness and vitality of developing biofilms using an *in situ* splint system.<sup>29</sup> Although both rinses reduced the biofilm thickness and vitality compared with the placebo, there were no significant differences between the two test groups.<sup>29</sup> A 24-hour plaque re-growth study showed that, while all of the test groups were superior to the negative control, the differing CHX concentrations were not more effective than the AmF/SnF<sub>2</sub> rinse (Meridol).<sup>26</sup> In another recent four-day plaque re-growth model, five experimental alcohol-free rinses were compared with a placebo.<sup>25</sup> The test groups included AmF/SnF<sub>2</sub> vs. triclosan (0.02%) vs. triclosan (0.15%) vs. negative control (placebo) vs. CHX.<sup>25</sup> All of the test formulations showed significant reductions in plaque indices and plaque flora vitality.<sup>25</sup> Interestingly, the AmF/SnF<sub>2</sub> formulation was superior to the CHX, which was inconsistent with previous findings.<sup>25</sup> The CHX concentration was slightly lower than typically employed, but this was unlikely to account for its decreased efficacy.<sup>25</sup> It is likely that the differences in CHX activity were due to the differences between *in vitro* and *in vivo* actions.<sup>25</sup>

One long-term (nine-month) RCT examined the effects of an AmF/SnF<sub>2</sub> oral rinse on adults with chronic gingivitis or signs of early periodontitis.<sup>49</sup> The study was complicated by including a comparison of the efficacy of AmF/SnF<sub>2</sub> toothpaste/AmF/SnF<sub>2</sub> rinse (test/test), with an AmF/SnF<sub>2</sub> toothpaste/NaF rinse (test/control), with a NaF toothpaste/NaF rinse (control/control).<sup>49</sup> While the microbiological assessments showed that the test/test group had a superior impact on microflora than the other two groups, the plaque, bleeding, and gingival indices and pocket depth measurements were all significantly and positively influenced over baseline scores by all groups, and there were no significant differences among the three groups.<sup>49</sup>

The anti-gingivitis, anti-plaque, and anti-stain efficacies of a fluoridated hydrogen peroxide rinse (0.05% sodium fluoride and 1.5% hydrogen peroxide) manufactured by Rembrandt were examined in a two-stage design where oral hygiene practices were suspended for the first 28 days of the study.<sup>44</sup> The study, which did not include a positive control group, showed no differences in plaque scores compared with the baseline or placebo controls.<sup>44</sup> However, the test group did have reductions from baseline in bleeding, gingival, and stain indices, whereas the placebo had reductions in bleeding only.<sup>44</sup>

The long-term effect of an alcohol-free 0.07% CPC oral rinse (Crest Pro-Health Rinse [USA]) was compared with that of an alcohol-free negative control on plaque and gingivitis.<sup>15</sup> Results showed that at six months, there were 15.8%, 33.3%, and 15.4% reductions in plaque, bleeding, and gingival indices respectively by the test groups over the placebo; each of these reductions was found to be statistically significant.<sup>15</sup> While the authors concluded that the results support the use of the CPC mouth rinse, it should be noted that a benchmark control was not included in the study.<sup>15</sup> While recent studies have compared CPC oral rinse to Listerine and shown no significant differences between the two test groups, these have been short-term experimental models.<sup>6,68</sup> Therefore conclusions cannot be firmly drawn about the relative effectiveness of CPC compared with other more established formulations.

### CONCLUSIONS

Evidence has accumulated that suggests some chemotherapeutic oral rinses are effective as an adjunct to home care routines. Using the defined guidelines from the ADA's Council on Dental Therapeutics acceptance program for chemotherapeutic mouth rinses, only two products—Listerine and Peridex—have been shown to be efficacious. For daily use of an OTC product by clients with inadequate plaque control and/or gingivitis or early periodontitis, Listerine stands as the most substantiated product for efficacy, safety, and an acceptable side effect profile. An exception to this would be for clients unable to tolerate, or unwilling to use, products containing alcohol. For these individuals, non-alcohol containing formulations may be indicated with the understanding that the efficacy

***Using the defined guidelines from the ADA's Council on Dental Therapeutics acceptance program for chemotherapeutic mouth rinses, only two products—Listerine and Peridex—have been shown to be efficacious.***

is markedly less, although likely greater than placebo. Their use should be evaluated on an individual client basis. The concerns that products with alcohol contribute to cancers of the oropharynx are unsubstantiated and do not constitute sound evidence.

Many products are being developed and studied showing efficacy superior to placebo controls. Some of these products are approaching the level of efficacy of Listerine. These products include Meridol, some CPCs, and triclosan-containing products. Consequently, it is important to continuously re-visit this literature. However, dental hygienists among other oral health care providers must recognize the limits of short-term trials and of long-term trials that are not appropriately controlled. This is necessary for the accurate "placing" of product efficacy within stringent study protocols.

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### RECOMMENDATIONS

1. Over-the-counter (OTC) commercially available chemotherapeutic oral rinses should be viewed as adjunctive to mechanical plaque removal methods.
2. OTC rinses are particularly indicated for clients with uncontrolled plaque, bleeding, inflammation and/or gingivitis; all oral hygiene recommendations should be client-specific.
3. For OTC rinses, a fixed combination of three essential oils, thymol 0.063%, eucalyptol 0.091%, and menthol 0.042%, and additional ingredients such as methyl salicylate 0.0660% (Listerine) has been demonstrated in stringent long-term studies to be most effective, safe, with acceptable side effects.
4. Several additional OTC rinse products—including AmF/SnF<sub>2</sub>, some products containing cetylpyridinium

chloride and triclosan—have shown efficacy superior to placebos but not within stringent study protocols. They therefore warrant further investigation.

5. Dental hygienists can recommend alcohol-containing products as these have not been demonstrated to have adverse effects; the exception remains for clients who are unable to tolerate alcohol for various medical-related reasons.
6. Dental hygienists will need to monitor this field of inquiry closely as vigorous research and development in the area will likely continue. Dental hygienists need to recognize the limitations of short-term and less-stringent long-term study protocols when determining the efficacy and safety of rinse formulations.

### REFERENCES

1. Brown LJ, Brunelle JA, Kingman A. Periodontal status in the United States, 1988-1991: prevalence, extent and demographic variation. *J Dent Res.* 1996;75(Spec Iss):672-83.
2. Oliver RC, Brown LJ, Lööe H. Periodontal diseases in the United States population. *J Periodontol.* 1998;69(2):269-78.
3. Persson RE, Persson GR, Powell LV, Kiyak HA. Periodontal effects of a biobehavioral prevention program. *J Clin Periodontol.* 1998;25(4):322-29.
4. Addy M, Moran JM. Evaluation of oral hygiene products: science is true; don't be misled by the facts. *Periodontol.* 2000;1997;15:40-51.
5. Mandel ID. Chemotherapeutic agents for controlling plaque and gingivitis. *J Clin Periodontol.* 1988;15(8):488-98.
6. Witt J, Ramji N, Gibb R, Dunavent J, Flood J, Barnes J. Antibacterial and antiplaque effects of a novel, alcohol-free oral rinse with cetylpyridinium chloride. *J Contemp Dent Pract.* 2005;15(6):1-9.

7. Sharma N, Charles C, Lynch M, Qaqish J, McGuire J, Galustians J, Kumar LD. Adjunctive benefit of an essential oil-containing mouthrinse in reducing plaque and gingivitis in patients who brush and floss regularly: a six-month study. *J Am Dent Assoc.* 2004;135(4):496-504.
8. Cronin M, Gordon J, Fernandez P. Two independent clinical trials comparing pre-brush mouthrinse formulations in reducing supragingival plaque. *J Can Dent Assoc.* 1997;63(5):347-55.
9. DeVore L. The rinse cycle. *RDH.* 2002;Sept:82-83, 93.
10. Lang WP, Ronis DL, Farghaly MM. Preventive behaviors as correlates of periodontal health status. *J Public Health Dent.* 1995;55(1):10-17.
11. Payne B, Locker D. Relationship between dental and general health behaviors in a Canadian population. *J Public Health Dent.* 1996;56(4):198-204.
12. Santos A. Evidence-based control of plaque and gingivitis. *J Clin Periodontol.* 2003;30(Suppl 5):13-16.
13. Bauroth K, Charles C, Mankodi S, Simmons K, Zhao Q, Kumar L. The efficacy of an essential oil antiseptic mouthrinse vs. dental floss in controlling interproximal gingivitis: a comparative study. *J Am Dent Assoc.* 2003;134(3):359-65.
14. DePaola LG, Overholser CD, Meiller TF, Minah GE, Niehaus C. Chemotherapeutic inhibition of supragingival dental plaque and gingivitis development. *J Clin Periodontol.* 1989;16(5):311-15.
15. Mankodi S, Bauroth K, Witt J, Bsoul S, He T, Gibb R, Dunavent J, Hamilton A. A 6-month clinical trial to study the effects of a cetylpyridinium chloride mouthrinse on gingivitis and plaque. *Am J Dent.* 2005;18 Spec No:9A-14A.
16. Yengopal V. Essential oils and interdental hygiene. *SADJ.* 2004;59(4):155, 157, 170.
17. Claffey N. Essential oil mouthwashes: a key component in oral health management. *J Clin Periodontol.* 2003;30(Suppl 5):22-24.
18. Claydon NC, Addy M, Newcombe R, Moran J. The prevention of plaque re-growth by toothpastes and solutions containing block copolymers with and without polypeptide. *J Clin Periodontol.* 2005;32(6):545-48.
19. Rosin M, Welk A, Kocher T, Majic-Todt A, Kramer A, Pitten F. The effect of a polyhexamethylene biguanide mouthrinse compared to an essential oil rinse and a chlorhexidine rinse on bacterial counts and 4-day plaque regrowth. *J Clin Periodontol.* 2002;29(5):392-99.
20. Bacca LA, Leusch M, Lanzalaco AC, Macksood D, Bouwsma OJ, Shaffer JB, et al. A comparison of intraoral antimicrobial effects of stabilized stannous fluoride dentifrice, baking soda/peroxide dentifrice, conventional NaF dentifrice and essential oil mouthrinse. *J Clin Dent.* 1997;8(2 Spec No):54-61.
21. Burton GRW, Engelkirk PG. *Microbiology for the health sciences.* 7th ed. Baltimore (MD): Lippincott Williams and Wilkins; 2004.
22. Charles C, Mostler K, Bartels L, Mankodi S. Comparative antiplaque and antigingivitis effectiveness of a chlorhexidine and an essential oil mouthrinse: 6-month clinical trial. *J Clin Periodontol.* 2004;31(10):878-84.
23. Welk A, Splieth CH, Schmidt-Martens G, Schwahn Ch, Kocher T, Kramer A, Rosin M. The effect of a polyhexamethylene biguanide mouthrinse compared with a triclosan rinse and a chlorhexidine rinse on bacterial counts and 4-day plaque re-growth. *J Clin Periodontol.* 2005;32(5):499-505.
24. Scherer W, Gultz J, Lee SS, Kaim J. The ability of an herbal mouthrinse to reduce gingival bleeding. *J Clin Dent.* 1998;9(4):97-100.
25. Arweiler NB, Netuschil L, Reich E. Alcohol-free mouthrinse solutions to reduce supragingival plaque regrowth and vitality: a controlled clinical study. *J Clin Periodontol.* 2001;28(2):168-74.
26. Claydon N, Smith S, Stiller S, Newcombe RG, Addy M. A comparison of the plaque-inhibitory properties of stannous fluoride and low-concentration chlorhexidine mouthrinses. *J Clin Periodontol.* 2002;29(12):1072-77.
27. White D. An alcohol-free therapeutic mouthrinse with cetylpyridinium chloride (CPC)—The latest advance in preventive care: Crest Pro-Health Rinse. *Am J Dent.* 2005;18 Spec:3A-8A.
28. Ouhayoun J. Penetrating the plaque biofilm: impact of essential oil mouthwash. *J Clin Periodontol.* 2003;30(Suppl 5):10-12.
29. Auschill TM, Hein N, Hellwig E, Follo M, Sculean A, Arweiler NB. Effect of two antimicrobial agents on early in situ biofilm formation. *J Clin Periodontol.* 2005;32(2):147-52.
30. Ernst C, Canbek K, Dillenburger A, Willershhausen B. Clinical study on the effectiveness and side effects of hexetidine and chlorhexidine mouthrinses versus a negative control. *Quintessence Int.* 2005;36(8):641-52.
31. Kozak KM, Gibb R, Dunavent J, White DJ. Efficacy of a high bioavailable cetylpyridinium chloride mouthrinse over a 24-hour period: a plaque imaging study. *Am J Dent.* 2005;18 Spec No:18A-23A.
32. Fine D. Evaluation of antimicrobial mouthrinses and their bactericidal effectiveness. *J Am Dent Assoc.* 1994;125(Suppl 2):11S-19S.
33. Mandel ID. Antimicrobial mouthrinses: overview and update. *J Am Dent Assoc.* 1994;125(Suppl 2):2S-10S.
34. Grossman E, Meckel AH, Isaacs RL, Ferretti GA, Sturzenberger OP, et al. A clinical comparison of antibacterial mouthrinses: effects of chlorhexidine, phenolics, and sanguinarine on dental plaque and gingivitis. *J Periodontol.* 1989;60(8):435-40.
35. Pfizer Canada. Pfizer Consumer Healthcare. [Cited 2006 April]. Available from: [www.pfizer.ca](http://www.pfizer.ca)
36. Filoche S, Soma K, Sissons C. Antimicrobial effects of essential oils in combination with chlorhexidine digluconate. *Oral Microbiol Immunol.* 2005;20(4):221-25.
37. Okuda K, Adachi M, Iijima K. The efficacy of antimicrobial mouth rinses in oral health care. *Bull Tokyo Dent Coll.* 1998;39(1):7-14.
38. Netuschil L, Weiger R, Preisler R, Brex M. Plaque bacteria counts and vitality during chlorhexidine, Meridol and Listerine mouthrinses. *Eur J Oral Sci.* 1995;103(6):355-61.
39. Moran J, Addy M, Newcombe R. A 4-day plaque regrowth study comparing an essential oil mouthrinse with a triclosan mouthrinse. *J Clin Periodontol.* 1997;24(9 pt. 1):636-39.
40. Sekino S, Ramberg P. The effect of a mouth rinse containing phenolic compounds on plaque formation and developing gingivitis. *J Clin Periodontol.* 2005;32(10):1083-88.
41. Sharma N, Charles C, Qaqish J, Galustians H, Zhao Q, Kumar L. Comparative effectiveness of an essential oil mouthrinse and dental floss in controlling interproximal gingivitis and plaque. *Am J Dent.* 2002;15(6):351-55.
42. American Dental Association. *News Today,* 2005 Jan 17.
43. Quirynen M, Soers C, Desnyder M, Dekeyser C, Pauwels M, van Steenberghe D. A 0.05% cetyl pyridinium chloride/0.05% chlorhexidine mouth rinse during maintenance phase after initial periodontal therapy. *J Clin Periodontol.* 2005;32(4):390-400.
44. Hasturk H, Nunn M, Warbington M, Van Dyke TE. Efficacy of a fluoridated hydrogen peroxide-based mouthrinse for the treatment of gingivitis: a randomized clinical trial. *J Periodontol.* 2004;75(1):57-65.
45. Claydon N, Smith S, Stiller S, Newcombe RG, Addy M. A comparison of the plaque-inhibitory properties of stannous fluoride and low-concentration chlorhexidine mouthrinses. *J Clin Periodontol.* 2002;29(12):1072-77.
46. Moran J, Addy M, Jackson R, Newcombe RG. Comparative effects of quaternary ammonium mouthrinses on 4-day plaque regrowth. *J Clin Periodontol.* 2000;27(1):37-40.
47. Moran J, Addy M, Roberts S. A comparison of natural product, triclosan and chlorhexidine mouthrinses on 4-day plaque regrowth. *J Clin Periodontol.* 1992;19(8):578-82.

48. Pizzo G, Guiglia R, La Cara M, Giuliana G, D'Angelo M. The effects of an amine fluoride/stannous fluoride and an antimicrobial host protein mouthrinse on supragingival plaque regrowth. *J Periodontol.* 2004;75(6):852-57.
49. Mengil R, Wissing E, Schmitz-Habben A, Flores-de-Jacoby L. Comparative study of plaque and gingivitis prevention by AmF/SnF<sub>2</sub> and NaF. *J Clin Periodontol.* 1996;23(4):372-78.
50. Paraskevas S, van der Weijden GA. A review of the effects of stannous fluoride on gingivitis. *J Clin Periodontol.* 2006;33(1):1-13.
51. Zimmermann A, Flores-de-Jacoby L, Pan P, Pan P. Gingivitis, plaque accumulation and plaque composition under long-term use of Meridol. *J Clin Periodontol.* 1993;20:346-51.
52. Fine DH, Furgang D, Barnett ML. Comparative antimicrobial activities of antiseptic mouthrinses against isogenic planktonic and biofilm forms of *Actinobacillus actinomycetemcomitans*. *J Clin Periodontol.* 2001;28(7):697-700.
53. Elworthy A, Greenman J, Doherty FM, Newcombe RG, Addy M. The substantivity of a number of oral hygiene products determined by the duration of effects on salivary bacteria. *J Periodontol.* 1996;67(6):572-76.
54. Herrera D, Santos S, Ferrus J, Barbieri G, Trombelli L, Sanz M. Efficacy of a 0.15% benzydamine hydrochloride and 0.05% cetylpyridinium chloride mouth rinse on 4-day de novo plaque formation. *J Clin Periodontol.* 2005;32(6):595-603.
55. Triratana T, Kraivaphan P, Amornchat C, Rustogi K, Petrone MP, Volpe AR. Effect of triclosan/copolymer pre-brush mouthrinse on established plaque formation and gingivitis: a six-month clinical study in Thailand. *J Clin Dent.* 1995;6(2):142-47.
56. Angelillo IF, Nobile CG, Pavia M. Evaluation of the effectiveness of a pre-brushing rinse in plaque removal: a meta-analysis. *J Clin Periodontol.* 2002;29(4):301-9.
57. Moran J, Addy M, Wade W, Milson S, McAndrew R, Newcombe RG. The effect of oxidising mouthrinses compared with chlorhexidine on salivary bacterial counts and plaque re-growth. *J Clin Periodontol.* 1995;22(10):750-55.
58. Greenstein G. Povidone-iodine's effects and role in the management of periodontal diseases: a review. *J Periodontol.* 1999;70(11):1397-405.
59. Giertsen E, Emberland H, Scheie AA. Effects of mouth rinses with xylitol and fluoride on dental plaque and saliva. *Caries Res.* 1999;33(1):23-31.
60. Gordon JM, Lamster IB, Seiger MC. Efficacy of Listerine antiseptic in inhibiting the development of plaque and gingivitis. *J Clin Periodontol.* 1985;12:697-704.
61. Thomson WM. Issues in the epidemiological investigation of dry mouth. *Gerodontology.* 2005;22(2):65-76.
62. Fischman SL, Aguirre A, Charles CH. Use of essential oil-containing mouthrinses by xerostomic individuals: Determination of potential for oral mucosal irritation. *Am J Dent.* 2004;17(1):23-26.
63. Kerr AR, Katz RW, Ship JA. A comparison of the effects of two commercially available nonprescription mouthrinses on salivary flow rates and xerostomia. 2005 abstract.
64. Riep BG, Bernimoulin JP, Barnett ML. Comparative antiplaque effectiveness of an essential oil and an amine fluoride/stannous fluoride mouthrinse. *J Clin Periodontol.* 1999;26(3):164-68.
65. Overholser CD, Meiller TF, DePaola LG, Minah GE, Niehaus C. Comparative effects of 2 chemotherapeutic mouthrinses on the development of supragingival dental plaque and gingivitis. *J Clin Periodontol.* 1990;17(8):575-79.
66. Charles CH, Sharma NC, Galustians HJ, Qaqish J, McGuire JA, Vincent JW. Comparative efficacy of an antiseptic mouthrinse and an antiplaque/antigingivitis dentifrice. *J Am Dent Assoc.* 2001;132(5):670-75.
67. Ramberg P, Furuichi Y, Volpe AR, Gaffar A, Lindhe J. The effects of antimicrobial mouthrinses on de novo plaque formation at sites with healthy and inflamed gingivae. *J Clin Periodontol.* 1996;23(1):7-11.
68. Witt J, Walters P, Bsoul S, Gibb R, Dunavent J, Putt M. Comparative clinical trial of two antigingivitis mouthrinses. *Am J Dent.* 2005;18(Special No):15A-17A. 