Abstract
As evidenced by the billion-dollar oral health and breath product market, the interest on the part of consumers for accurate information in the treatment of bad breath continues to grow. A recent survey determined that consumers expect the dental professional to assess for oral malodor management both clinically and on a daily basis.

Dental professionals who have embraced oral malodor treatment and discussion into their treatment regimens have gained patient appreciation and a new way to motivate patients to optimal oral health.

Malodor Origins
The term halitosis has been used to describe bad breath when in fact it actually refers to odor generated from the gastric track or gut. Malodor can be segmented into 7 main categories:
1. mouth and tongue
2. nasal, nasopharyngeal, sinus, and oropharyngeal
3. xerostomia induced
4. primary lower respiratory tract and lung
5. systemic disease
6. gastrointestinal diseases and disorders
7. odiferous ingested foods, fluids, and medications

Dental professionals who havelist the compounds associated with oral malodor and their relationship to periodontal disease.

Learning Objectives
After reading this article, the reader should be able to:
• identify the 7 main categories of malodor and differentiate between oral and systemically based malodor.
• list the compounds associated with oral malodor and their relationship to periodontal disease.
• discuss clinical intervention, including mechanistic debridement and chemotherapeutic usage.
• identify those chemotherapeutic agents effective in oral malodor treatment and their mechanism of action.
which permits more bacteria and endotoxin invasion and may lead to the progression of periodontal infections. These compounds have been shown to interfere with collagen and protein synthesis as well as to suppress DNA synthesis, thereby impeding wound healing.\(^6\)\(^-\)\(^9\) Research also has suggested that the presence of these compounds may accelerate the infection process.\(^10\) As a result, neutralizing volatile sulfur compounds to eliminate odor may have even more importance in periodontal health.\(^11\) Therefore, oral malodor management should take into account methods to eliminate or neutralize volatile sulfur compounds.

The bacterial activity combined with existing oral conditions all lead to the presence of oral malodor. The following conditions are prime examples: periodontitis, aphthous ulcers, abscesses, candidiasis, xerostomia, gingivitis, traumatic ulcers, herpetic infection, oral cancer, and poor oral hygiene. As the shift from individual bacteria to that of biofilms begins to evolve, consideration of the conditions and niches in which biofilms thrive will arm clinicians with more information to effectively combat oral malodor as well as other oral-related diseases and conditions. With respect to oral malodor, it is important to correlate the presence of biofilms/bacteria on the posterior dorsum of the tongue, in the gingival sulcus/periodontal pockets, and in the tonsillar tissue.\(^2\)\(^-\)\(^5\)

**Assessment and Intervention**

The science of oral malodor has been elusive because of many factors, including diagnosis, variations throughout the day, gender, and subjectivity. As a result, the exact science relating to oral malodor assessment and diagnosis has not been qualified, so dental professionals should consider the easiest route when dealing with oral malodor discussion. Understanding that oral malodor can present itself at any time, the most reliable means for patient diagnosis is through a trusted counterpart, such as a family member or spouse. Aside from this, clinicians can be confident that every patient will have interest in methods to maintain fresh breath, and an approach that includes this fact will assist clinicians in providing oral malodor management strategies to all.

The primary factors associated with oral malodor production include salivary flow, presence of biofilms/gram-negative anaerobic bacteria, the oral pH, and the presence of cellular protein and/or food debris. These factors are indicative of the manifestation of oral infections, particularly periodontal diseases. Patient assessment should include consideration of these factors.

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<table>
<thead>
<tr>
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because oral malodor management will include addressing each of them. The goals of oral malodor management (Table 1) include increasing salivary flow, eliminating gram-negative bacteria/biofilms from key intraoral niches (posterior dorsum of the tongue, sulcus/periodontal pockets, tonsillar region), and neutralizing volatile sulfur compounds.

### Increasing Salivary Flow

Decreased salivary flow has many causes and results in xerostomia. Medications, medical conditions, and various oral habits can lead to dry mouth or reduced salivary flow. Not only will oral malodor be more prevalent in this population but also other oral health concerns arise, including the potential for increased decay. As a result, methods to increase salivary flow warrant careful consideration and include the use of saliva substitutes (oralbalance Mouth Moisturizing Gel, Laclede, Inc, Rancho Dominguez, Calif, www.laclede.com; Salivart® , Gebauer Company, Cleveland, Ohio, www.gebauer-co.com), increasing water intake, and chewing sugar-free gum or mints. If possible, recommend chewing gum or mints that contain xylitol (Biotène® Dry Mouth Gum, Laclede, Inc; TheraGum ™ , OmnII Pharmaceuticals™ , West Palm Beach, Fla, www.omnipharma.com), which is known to prevent caries. In addition, products that contain zinc will be beneficial in neutralizing volatile sulfur compounds (Halispheres™ BreathRx™ Sugar-Free Chewing Gum, Discus Dental, Inc Culver City, Calif, www.discusdental.com).

Alcohol-based mouth rinses should be avoided because they may desiccate the oral mucosa and worsen xerostomia symptoms. Alcohol-free mouth rinses, such as Biotène® Gentle Mouthwash (Laclede, Inc), BreathRx Anti-bacterial Mouth Rinse (Discus Dental, Inc), and Rembrandt® Dazzling Fresh ® Mouthwash, Rembrandt ® Plus™ Peroxide Whitening Rinse, and Rembrandt® Age-Defying Mouthwash (Den-Mat Corporation, Santa Maria, Calif, www.rembandt.com) contain active ingredients to neutralize volatile sulfur compounds and combat bacteria growth. Biotène® Mouthwash also helps replace key salivary enzymes for patients with xerostomia.

### Eliminating Gram-Negative Bacteria and Biofilms and Neutralizing Volatile Sulfur Compounds

Methods to reduce bacteria and biofilms in patients with oral malodor are not unlike standard dental
The clinical phase should continue to focus on the removal of plaque and bacteria via instrumentation. Agents that will assist in neutralizing volatile sulfur compounds will assist in jump-starting the oral malodor management regimen. Rinsing with neutralizing agents before and after procedures will decrease oral malodor, and irrigating with these agents will neutralize subgingival volatile sulfur compounds. Irrigation is most effective through a powered scaling device and subgingival inserts. Tongue cleaning or deplaquing is the best way to control oral malodor on a daily basis and should be implemented at every preventive appointment. Many clinicians choose to deplaque the tongue at the conclusion of the appointment while having patients observe the procedure. This alone will significantly reduce oral malodor and provide another excellent opportunity to discuss fresh breath maintenance.

For patients with periodontal disease, clinicians should consider implementing full-mouth disinfection or accelerated instrumentation.

### Table 2—Oral Hygiene Recommendations for Fresh Breath

- Automated toothbrushes
- Automated interdental devices
- Active agent impregnated floss
- Tongue scrapers/deplaquing devices combined with antibacterial tongue gels or sprays
- Toothpastes, mouth rinses, mints, chewing gum, and other vehicle options that contain a neutralizing agent
- Chewing gum, mints, or lozenges that contain xylitol or other active ingredients such as zinc; avoid products with sugar

### Table 3—Active Agents for Neutralizing Volatile Sulfur Compounds and Impacting Gram-negative Oral Flora

<table>
<thead>
<tr>
<th>Agent</th>
<th>Description</th>
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<tbody>
<tr>
<td>Zinc</td>
<td>The most recognized and effective agent for neutralizing volatile sulfur compounds</td>
</tr>
<tr>
<td>Essential oils</td>
<td>Known antigingivitis properties</td>
</tr>
<tr>
<td>Chlorhexidine gluconate</td>
<td>Broad-spectrum antimicrobial agent that also neutralizes volatile sulfur compounds</td>
</tr>
<tr>
<td>Chlorine dioxide</td>
<td>Known agent for neutralizing volatile sulfur compounds as well as mild antimicrobial activity</td>
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<tr>
<td>Cetylpyridinium chloride</td>
<td>Known mild antimicrobial agent</td>
</tr>
<tr>
<td>Triclosan</td>
<td>Known mild antimicrobial agent</td>
</tr>
<tr>
<td>Combination of above agents</td>
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Clinical intervention begins with a careful review of oral tissues and a thorough periodontal examination and provides an excellent opportunity to begin oral malodor discussion. During the periodontal examination, inform patients that probing depths greater than 4 mm will produce bad breath—this will lead to an involved and even interested patient. Oral lesions, tonsilloliths, and restorations that trap food and bacteria also are a common source of oral malodor. The assessment should make note of the tongue coating, including the color, texture, and description of the coating. It can be 4 to 6 times greater in patients with periodontal disease than in those without. The tongue coating is an excellent example of a complex biofilm that has been proven to contribute not only to oral malodor, but to periodontal disease as well.
phased appointments vs standard quadrant scaling and root planning in 4 appointments over several weeks. This is a process of accelerated treatment, which includes full-mouth instrumentation within 24 hours, use of chlorhexidine, and tongue cleaning. This protocol will fast track esthetic treatment plans, periodontal healing, and/or referral for further periodontal treatment. Full-mouth disinfection research has shown this protocol to be more effective than traditional quadrant scaling and root planing over time (4 appointments with completion in 6 weeks), with a gain in clinical attachment, greater reduction in probing depths, eradication of Porphyromonas gingivalis, greater reduction in spirochetes and motile organisms subgingivally, and greater reduction in oral malodor with the results being maintained 8 months postinstrumentation.16,17

Suggested modifications to the protocol include use of powered instrumentation and simultaneous administration of neutralizing agents, tongue scraping vs brushing, and treatment phases completed at least within 1 week vs 24 hours.18 Regardless of the health of the patient, oral malodor education and intervention is warranted and should be an integral part of every preventive appointment.

It is not surprising that the full-mouth disinfection studies using chlorhexidine resulted in a decrease in oral malodor because this agent has been proven to be effective in neutralizing volatile sulfur compounds.9 While pure mechanics are important in oral malodor treatment, just as in periodontal instrumentation, consideration to neutralizing volatile sulfur compounds is important because of the adverse effects these gases have on oral tissues and their implication in impeding wound healing. Also, patients will be motivated if their focus includes oral malodor reduction.

In addition to chlorhexidine, agents that neutralize volatile sulfur compounds include zinc-containing products (BreathRx®) and chlorine dioxide products (ClosysII®, Rowpar Pharmaceuticals, Inc, Scottsdale, Ariz, www.rowpar.com). Instrumentation alone will not neutralize volatile sulfur compounds, thus incorporation of neutralizing agents in automated scaling devices or irrigated postinstrumentation will be advantageous and complete oral malodor treatment.

Recommendations for Everyday Fresh Breath

While clinical intervention is an important step in fresh breath, maintenance must take place every day (Table 2). Effective oral malodor is accomplished through mechanics, including daily tongue deplaquing, and chemotherapeutics to neutralize the volatile sulfur compounds. This protocol fits in perfectly with that of general oral health maintenance but provides infinitely more motivation and implies in impeding fresh breath.19-20 When combined with neutralizing agents, this process alone will result in longer-lasting fresh breath.

Tongue cleaning should take place at least daily and even more frequently for those with a heavier tongue coating. Morning deplaquing may be easier for patients prone to gagging and some even complete the tongue cleaning in the shower. This simple procedure will dramatically improve bad breath and is the one single new oral hygiene procedure that will generate interest and motivation for patients.

Mouth Rinses

Most patients are interested in mouth rinses, but there is very little published data to demonstrate the effectiveness of one product over the other with the exception of a study published in June 2002 that compared BreathRx Anti-Bacterial Mouthrinse (CPC [Discus Dental, Inc]) with Oxyfresh® Zinc Mouthrinse (CD/Zn [Oxyfresh Inc, Coeur d’Alene, Idaho, www.oxyfresh.com]), Listerine® (EO [Pfizer, Inc, Morris Plains, NJ, www.listerine.com]), and a control.21 This nearly 100-participant study evaluated the effectiveness of these products on oral malodor. BreathRx® was more effective in reducing oral malodor, in addition to having a cumulative effect. In other words, the breath ratings for the BreathRx® group never went back to baseline. Researchers concluded the following:

• The 4 mouth rinses tested are all capable of reducing oral malodor within 4 hours after a single product use, with the mouth rinse containing CPC the most effective and the placebo rinse the least effective.
• The daily use of the 2 commercial mouth rinses (EO or CD/Zn as active ingredient) and the placebo rinse for up to 4 weeks did not reduce oral malodor from week 0 baseline scores.
• The CPC product was the only mouth rinse that reduced oral malodor from week 0 baseline scores after 2 and 4 weeks of daily use.

Daily removal of the tongue coating not only reduces oral malodor but may reduce periodontal-related bacteria.5

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- The CPC product was more effective than the other 3 mouth rinses in reducing oral malodor.

Until more comparative data is available, clinicians should select products containing active ingredients that neutralize volatile sulfur compounds and impact oral flora (Table 3). It will also be important for clinicians to introduce a variety of “vehicle” options that contain these agents. Today, active ingredients can be found in mouth rinses, toothpastes, tongue gels and spray, and chewing gums and mints. Avoiding sugar-containing products is important for obvious reasons and avoiding habits that dry the oral cavity also will assist in maintaining fresh breath.

Additional recommendations should include the use of automated toothbrushes and even automatic flossers. Automated plaque control devices provide a safe and effective means for plaque removal that does not require much skill on the part of the user. And given that the average amount of time spent by patients on oral hygiene routines is 24 to 60 seconds, any method that can be more effective within this span of time is tantamount.24

Conclusion

Dental professionals are being sought out more than ever for their role in social enhancements. Oral malodor management and education represents an opportunity to effect patients’ lives while providing a motivation that they will respond to and appreciate. The dental professional is obligated to provide the utmost in care, including addressing those issues and concerns of greatest interest to their patients. By actively incorporating oral malodor management strategies into clinical practice, clinicians are much closer to helping patients achieve optimal oral health through social-based needs rather than relying on the disease-based motivation model. These approaches will not only address patients’ concerns but also represent a new and unique method for clinicians to affect oral health and potentially total health. 

References

### CE Quiz

**Instructions**—Contemporary Oral Hygiene offers 2 Continuing Education (CE) credit hours per issue. To receive credit, record your answers on the enclosed answer sheet or submit them on a separate piece of paper. You may also phone your answers in to (888) 596-4605, or fax them to (703) 404-1801. Be sure to include your name, address, phone number, Social Security number, and method of payment. The deadline for submission of quizzes is 12 months after the date of publication. Participants must attain a score of 70% on each quiz to receive credit. To register, call (888) 596-4605. Participants are urged to contact their state registry boards for special CE requirements.

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1. An estimated 80% or more of malodor is:
   - a. halitosis
   - b. oral
   - c. ozostoma
   - d. stomadysodia

2. What provides the ideal surface for bacteria and food retention and, without daily cleansing, will be a major source of oral malodor?
   - a. periodontal sulcus
   - b. geography of the tongue
   - c. dentigerous cyst
   - d. partially erupted tooth

3. Gram-negative anaerobic bacteria produce odor-related compounds called:
   - a. semi-calciﬁed exudate
   - b. phagocytic exudates
   - c. volatile sulfur compounds
   - d. metabolized protein

4. The primary cause of oral-related malodor is:
   - a. gram-negative anaerobic bacteria
   - b. oral pH
   - c. presence of oral infection
   - d. all of the above

5. Which of the following is associated with patients who have periodontal disease?
   - a. hydrogen sulfide
   - b. methyl mercaptan
   - c. dimethyl sulfide
   - d. dimethyl disulfide

6. Which of the following is associated with patients who are periodontally healthy?
   - a. hydrogen sulfide
   - b. methyl mercaptan
   - c. dimethyl sulfide
   - d. dimethyl disulfide

7. In addition to volatile sulfur compounds being the odor-related component of bad breath, they also have been associated with:
   - a. an increase in mucosa permeability, which permits more bacteria and endotoxin invasion.
   - b. an interference with collagen and protein synthesis.
   - c. a suppression of DNA synthesis.
   - d. all of the above.

8. Zinc is a:
   - a. gram-negative bactericidal agent
   - b. gram-positive bactericidal agent
   - c. volatile sulfur compound neutralizing agent
   - d. decreasing cell permeability agent

9. The most reliable means of patient diagnosis is:
   - a. self-assessment
   - b. a trusted counterpart
   - c. an organoleptic judge
   - d. a halimeter

10. Research has demonstrated that cleaning the surface of the tongue with a tongue scraper is:
    - a. more effective than using a traditional toothbrush.
    - b. less effective than using a traditional toothbrush.
    - c. less comfortable than a toothbrush.
    - d. less safe than a toothbrush.

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### CE Answer Form

**April 2004**

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<th>Circle Answers</th>
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**PROGRAM EVALUATION**

Please evaluate this issue’s programs by responding to the following statements, using the scale of:

- (3 = Excellent to 1 = Poor.)

- Clarity of objectives  
  • Usefulness of the content  
  • Benefit to your clinical practice  
  • Usefulness of the references  
  • Quality of the written presentation  
  • Quality of the illustrations  
  • Clarity of review questions  
  • Relevance of review questions  

- Did the lessons achieve their educational objectives? [ ] Yes [ ] No
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[ ] Full-time registered Hygienist [ ] Dental Asst. [ ] Part-time registered Hygienist

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