Episode 67 – Halitosis August 26, 2022

Overview

- Halitosis, also know as bad breath, oral malodour, or fetor oris, originates from the Latin word “halitus” (breath) and the Greek suffix “osis” (diseased state).
- Refers to an unpleasant or foul odour emitted from exhaled air that is unpleasant or offensive to others.
- Estimated to affect 22-50% of the global population. [1]
- Third most common reason individuals seek oral healthcare, after dental caries and periodontal disease.
- Can cause severe social and psychological problems.
- Halitosis, by itself, is not a disease, but may be a sign or symptom of pathology.
- Individuals with halitosis may attempt to mask it through compulsive brushing or over-the-counter methods (e.g., gum, mints, scented liquid drops, mouthrinses). Most of these products simply provide a competing and temporary smell that masks the malodour. [2] [3] [4] [5] [6]

Pathophysiology

- Halitosis results from the production of volatile compounds, such as:
    - Volatile sulfur compounds
    - Aromatic compounds
    - Nitrogen-containing compounds
    - Alcohols
    - Ketones
    - Amines
    - Short-chain fatty acids
    - Aliphatic compounds
    - Aldehydes
- These compounds are released due to pathological or nonpathological processes, originating from an oral or extraoral source.
- Intraoral halitosis is initiated by the breakdown of epithelial cells, salivary proteins, serum proteins, and food debris present on the tongue dorsum, in saliva, or in periodontal pockets by anerobic bacteria, which degrade organic substances and produce odorous compounds.
- Approximately 80-90% of intraoral halitosis can be attributed to volatile sulfur compounds (VSCs), where bacteria degrade sulfur containing amino acids (e.g., methionine, cysteine) resulting in volatile sulfur gases, mainly hydrogen sulfide and methyl mercaptan, and to a lesser extent, dimethyl sulfide. [7]
- Together, hydrogen sulfide and methyl mercaptan account for 90% of all VSC content. [7]
- Hundreds of bacteria have been identified in the oral cavity that can produce VSCs, including gram-negative, proteolytic, and gram-positive bacteria. [5] [7] [8]

- VSCs are mainly produced by anaerobic bacteria belonging to the genera:
    - *Actinomyces*
    - *Bacteroides*
    - *Dialister*
    - *Eubacterium*
    - *Fusobacterium*
    - *Leptotrichia*
    - *Peptostreptococcus*
    - *Porphyromonas*
    - *Prevotella*
    - *Selenomonas*
    - *Solobacterium*
    - *Tannerella*
    - *Veillonella* [9] [10]

Odour characteristics of VSCs [11]

Volatile sulfur compound	Odour characteristic
Hydrogen sulfide	Rotten eggs
Methyl mercaptan	Pungent, rotten cabbage
Dimethyl sulfide	Unpleasantly sweet
Allyl mercaptan	Garlic like
Allyl methyl sulfide	Garlic like
Carbon disulfide	Slightly pungent
Ammonia	Pleasantly sweet
Dimethylamine	Fishy, ammonical
Trimethylamine	Fishy, ammonical

Etiology

- There may be single or multiple etiologies from intraoral or extraoral sources.
- Approximately 80-90% of halitosis cases originate in the oral cavity (i.e., intraoral halitosis). Sources of intraoral halitosis include tongue coating, periodontal diseases, poor oral hygiene, oral ulceration, oral malignancy, dry socket, chronic mouth breathing, food impaction, and dental caries. [12] [13]
- Approximately 10-20% of halitosis is caused by extraoral factors (i.e., extraoral halitosis) and may sometimes be a manifestation of serious disease. Sources of extraoral halitosis include upper and lower respiratory tract diseases, metabolic diseases of the liver or kidneys, diabetes, gastrointestinal tract disorders, medication use, intake of certain foods, alcohol consumption, and tobacco use. [12] [13]
- Classes of medications that may cause extraoral halitosis include acid reducers, aminothiols, anticholinergics, antidepressants, antifungals, antihistamines, steroids, antispasmodics, chemotherapeutic agents, dietary supplements, and organosulfur substances. [2] [7] [9] [14] [15] [16] [17]

Intraoral halitosis

Main causes for intraoral halitosis are tongue coating, periodontal disease, or a combination.

<u>Tongue coating</u>

- The tongue is typically pink in colour with the presence of a thin white coating, which does not in itself imply presence of intraoral halitosis. The amount of tongue coating has been reported as increasing in individuals with halitosis. The greater the amount of tongue coating, the higher the production of volatile sulfur gas.

- Research has shown a direct correlation between amount of tongue coating and total number of anaerobic bacteria present in the coating. A coating 0.1-0.2 mm thick can deplete the environment of oxygen allowing anaerobic bacteria that cause halitosis to flourish. An improvement in odour emanating from the oral cavity is usually seen as anaerobic bacterial count on the tongue is reduced. [18]
- Formation of tongue coating is multifactorial, but the degree of oral hygiene is the strongest influencing factor.
- Tongue anatomy, with a surface area of ~25 cm^2, promotes growth and colonization of odour-causing bacteria because of its numerous fissures, crypts, and papillae. Individuals with deeply grooved or furrowed tongues have more potential to accumulate tongue coating than those with smoother tongue surfaces. [7]
- The tongue dorsum, posterior to the circumvallate papillae, has been shown to carry higher bacterial loads compared to other areas of the tongue.
- Tongue anatomy is also a barrier to saliva's cleansing action contributing to tongue coating. [7] [18]

<u>Periodontal disease</u>
- Several studies have shown a direct correlation between periodontal disease and halitosis. Individuals with periodontitis were three times more prone to halitosis. Individuals with chronic periodontitis and deep periodontal pockets experienced halitosis due to higher amounts of gram-negative anaerobic bacteria, accumulation of debris, and increased putrefaction. [19]
- Various studies have correlated VSC concentration to the number and depth of periodontal pockets. VSC concentration increased with the severity of periodontal disease. Also, VSC concentration increased proportionally with the gingival bleeding index, indicating blood components may accelerate VSC production. [7]

<u>Tongue coating and periodontal disease</u>
- Tongue coating plays a key role in VSC production in both periodontally healthy and periodontally compromised individuals.
- Research has shown individuals with history of periodontitis had tongue coating six times greater than those without a history of periodontitis and produced four times more VSC. A significant amount of tongue coating was also reported in individuals with halitosis and a healthy periodontium compared to those without halitosis and with a healthy periodontium. [7]

Extraoral halitosis

Extraoral halitosis can be subdivided into bloodborne and non-bloodborne.
- Bloodborne halitosis occurs when volatile chemicals in systemic circulation transfer to exhaled breath during alveolar gas exchange causing oral malodour.
- Non-bloodborne halitosis may be caused by the direct passage of volatile chemicals from the respiratory or gastrointestinal tracts into the oral cavity. [20] [21]

Etiology [3] [8] [15] [19] [22]

Etiology*	Possible findings
Oral conditions	
Poor oral hygiene	Allows food debris & bacterial plaque accumulation on teeth, tongue, & dental restorations, leading to caries, periodontal & peri-implant diseases.
Tongue coating	White or yellow deposit on dorsal surface of tongue. Greater the amount of tongue coating, the higher amount of anaerobic bacteria & VSCs.
Periodontal & peri-implant diseases	Gingivitis, periodontitis, necrotizing periodontal diseases, pericoronitis, peri-implant mucositis, peri-implantitis.[1]
Drug-influenced gingival enlargement[2]	Gingival enlargement may impede biofilm removal increasing halitosis risk. Drugs associated with gingival enlargement include anticonvulsants (e.g., phenytoin, sodium valproate), calcium channel blockers (e.g., nifedipine, verapamil, diltiazem, amlodipine, felodipine), immunosuppressants (e.g., cyclosporine), high-dose oral contraceptives. [23]
Deep carious lesions	Create retention areas for food debris & bacterial plaque; odour associated with necrotic pulp tissue, draining fistulas.
Unclean dentures	Failure to remove dentures at night & clean dentures, edentulous areas, & teeth supporting partial dentures; build-up of biofilm & food substrates under dentures (e.g., fixed implant dentures).
Unclean removable appliances	Build-up of bacteria & food substrates can occur on nightguards & removable orthodontic retainers.
Xerostomia[3]	Saliva has a protective function due to cleansing action causing constant removal of bacteria & food debris. Saliva has an anti-bacterial property, which helps to suppress growth & proliferation of gram-negative & anaerobic bacteria. Absence or reduced salivary flow causing dry mouth results in increased bacteria accumulation & microbial putrefaction increasing VSCs. Causes of xerostomia include dehydration, salivary gland diseases, Sjögren's syndrome,[4] certain drugs (e.g., antidepressants, antipsychotics, diuretic, antihypertensive),[5] mouth breathing, cancer therapy. [24]
Mucosal lesions	Lesions & ulcers (e.g., oral cancer, lesions from tuberculosis, syphilis)[6] allow colonization of bacteria that release large amounts of malodorous compounds
Food or plaque retention areas	Prosthetics (e.g., fixed bridges), orthodontic fixed appliances, faulty or broken restorations, poorly adapted restorative crowns,

[1] Refer to Episodes 46, 49, & 50 for additional discussion on periodontal and peri-implant diseases.
[2] Refer to Episode 62 for discussion on drug-induced gingival enlargement (hyperplasia).
[3] Refer to Episode 55 for additional information on xerostomia.
[4] Refer to Episode 62 for additional information on Sjögren's syndrome.
[5] Refer to Episode 62 for discussion on drug-induced xerostomia.
[6] Refer to Episode 61 for additional oral manifestations of systemic diseases that may contribute to halitosis.

Etiology*	Possible findings
	misaligned teeth, open contacts can result in plaque accumulation & food impaction.
Tonsillar conditions	Tonsillitis, deep tonsillar crypts, tonsilloliths can house VSC-producing bacteria.
Extraoral disorders	
Nasal & sinus conditions	Nasal foreign body (usually in children, symptom: purulent or bloody nasal discharge), sinus infection (purulent nasal discharge; facial pain &/or headache) postnasal drip, etc.
Nasopharyngeal cancer	Bacterial activity associated with pathology leads to putrefaction of the tissues and production of malodorous gases. [8] Symptoms of nasopharyngeal cancer may include lymphadenopathy, hearing loss, tinnitus, ear pain, recurrent ear infections, nasal blockages (usually only one side), nose bleeds, headaches, blurred or double vision, facial pain or numbness, hoarse voice, swallowing difficulties, etc. [25] [26]
Lung pathology	E.g., bronchitis, lung abscess, lung cancer, bronchiectasis, foreign body. Bacterial activity associated with pathology leads to putrefaction of the tissues and production of malodorous gases. [8]
Gastrointestinal disorders	E.g., gastroesophageal reflux disease (GERD), Zenker's diverticulum, hiatus hernia. Causes food retention or undigested food regurgitated when lying down or bending over.
Diabetic ketoacidosis	Produces sweet or fruity odour of acetone.
Alcoholic ketoacidosis	Excessive alcohol intake & malnutrition, burns body fat content for energy producing excessive ketones. Causes fruity acetone odour.
Low carbohydrate diet	Excessive ketone production from low carbohydrate diet, burns body fat content for energy producing excessive ketones. Causes fruity acetone odour. [24]
Liver failure	Produces a unique mousy odour (musty, sweet, &/or sulfurous).
Renal failure	Produces an odour of urine or ammonia.
Bowel obstruction	Produces a fecal odour.
Stress	Predisposing factor for increase in VSCs. [27]
Drug-related halitosis	Certain medications are potential sources of bloodborne halitosis, e.g., dimethyl sulfoxide, cysteamine, nitrates & nitrites, disulfiram, penicillamine, chloral hydrate, phenothiazine, suplatast tosilat, paraldehyde, acetaminophen, chemotherapy drugs. [28] [29]
Ingested substances	
Certain foods & beverages (e.g., alcohol)	Odoriferous foods (e.g., garlic, onion, spices) absorbed into the bloodstream during digestion, transferred to the lungs & exhaled, exhaled air is characterized by the odour of food consumed. Acetaldehyde, the first metabolite of alcohol, contributes to halitosis when transferred to lungs from the bloodstream and exhaled. Alcohol contributes to hyposalivation. [24] [29] [30]
Tobacco	Tobacco smoke contains VSCs contributing to oral malodour.

Etiology*	Possible findings
	Some components of tobacco combustion absorbed into blood stream via oral & lung alveoli mucosae & exhaled via lungs due to blood-air exchange in lungs. Offensiveness of exhaled breath relates to odour intensity of tobacco used (e.g., cigar & pipe tobacco smokers may experience increased halitosis). Smoking decreases commensal bacteria leading to an increase in pathogenic microbes increasing probability of extensive disease development & increased biofilm formation on oral epithelial cells Smoking contributes to halitosis by causing hyposalivation & periodontal diseases. [31] [32]

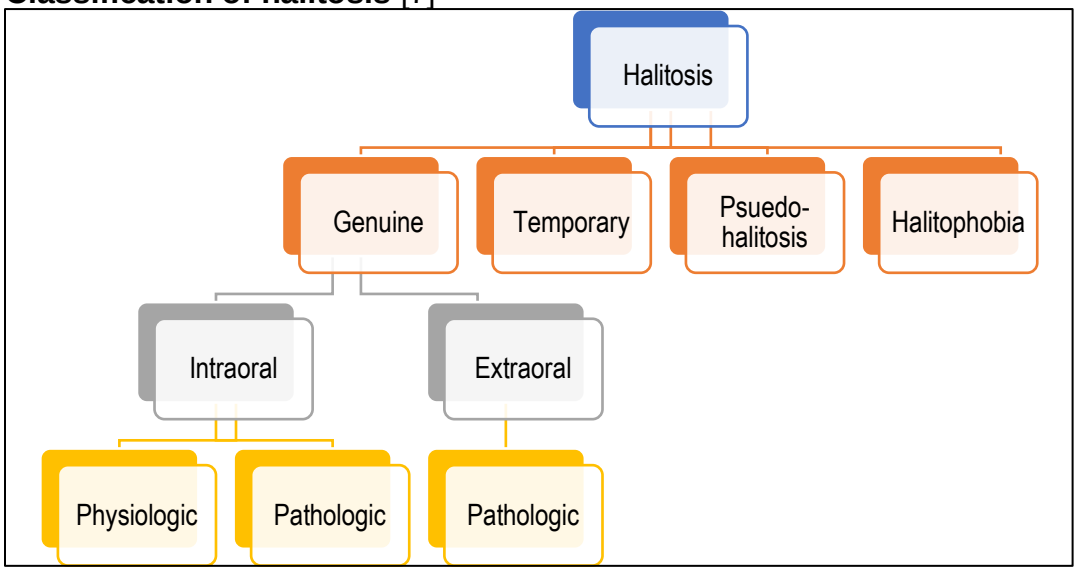
* This is not an exhaustive list.

Classification of halitosis

Several halitosis classification systems have been proposed in literature. One system classifies halitosis into genuine halitosis, temporary halitosis, pseudo-halitosis, and halitophobia.

- *Genuine halitosis* is described as obvious malodour, with intensity beyond socially acceptable levels.
    - Intraoral and extraoral halitosis are forms of genuine halitosis.
    - Intraoral halitosis is further categorized as either physiologic halitosis (i.e., no apparent disease or pathologic condition, such as tongue coating) or pathologic halitosis.
    - Extraoral halitosis often originates from pathologic processes.
- *Temporary halitosis* is caused by certain foods or beverages (e.g., onion, garlic, coffee). Morning breath is a form of temporary halitosis that disappears after activities such as eating and toothbrushing.
- *Pseudo-halitosis* is where oral malodour does not exist, but the individual adamantly believes they have it. The condition is improved by counselling (e.g., education and explanation of examination results) and simple oral hygiene measures.
- *Halitophobia* (affecting ~0.5-1% of adult population) is the fear of bad breath where the individual worries their breath will be regarded as bad smelling by others. There is no physical evidence halitosis is present. The individual persists in believing oral malodour continues despite treatment for genuine halitosis or pseudo-halitosis. [4]
    - Halitophobia is a psychiatric disorder referred to as one type of olfactory reference syndrome (olfactory reference disorder). Olfactory reference syndrome is an example of “other specified obsessive-compulsive and related disorders” in the *Diagnostic and Statistical Manual of Mental Disorders*, Fifth Edition (DSM-5). [33]
- Pseudo-halitosis may be treated by oral health professionals, whereas halitophobia must be referred to psychological specialists. [15] [34]

Classification of halitosis [7]



Halitosis terms [7] [9] [35]

Diagnosis	Description
Temporary halitosis	Malodour caused by dietary factors (e.g., garlic, onions). Morning breath generally transient upon waking, arises from decreased salivary flow during sleep, & generally disappears after eating & morning oral hygiene regimens.
Intraoral halitosis	Obvious malodour with intensity beyond socially acceptable level &/or affecting personal relationships. Origin from tongue dorsum &/or a pathologic condition of oral tissues (e.g., periodontal disease). Influenced by cofactors influencing saliva quality & quantity (e.g., medication, smoking, Sjögren syndrome, etc.).
Extraoral halitosis	Malodour originates from pathologic conditions outside oral cavity, such as nasal, paranasal, laryngeal regions, pulmonary or upper digestive tract (i.e., non-bloodborne extraoral halitosis). For bloodborne extraoral halitosis, malodour is emitted via the lungs & originates from systemic disorders (e.g., hepatic cirrhosis).
Pseudo-halitosis	Obvious malodour is not perceived by others but individual stubbornly states its existence. Condition is improved by counselling & simple oral hygiene measures.
Halitophobia	Individual persists in believing they have halitosis even after therapy for genuine halitosis or pseudo-halitosis. No physical or social evidence exists for presence of halitosis.

Halitosis assessment

- Identifying halitosis can be problematic due to client and clinician subjectivity. Individuals are often unaware of their own halitosis. Inability to smell their own oral malodour has been attributed to adaptation or dulling of senses from continual exposure.
- Lack of objectivity poses a hurdle not only during diagnosis but also on end results of therapy, especially when psychological etiopathogenesis is identified (i.e., pseudo-halitosis, halitophobia). [11]

- Estimating prevalence of halitosis is also hindered by lack of standard methodology.
- Normal breath of a healthy individual with healthy oral tissues is nonodorous or mildly sweet smelling.
- Main approaches for assessing halitosis include client history review, intraoral and extraoral examination, and halitosis measurement.

Review medical, oral health, and personal history for predisposing and etiologic factors such as:

- Systemic conditions that may influence halitosis, (e.g., sinus infections, snoring, sleep apnea, throat infections).
- Medications (e.g., causing xerostomia).[7]
- Oral selfcare routine and frequency of oral healthcare appointments (e.g., regular scaling appointments, etc.).
- Tobacco and alcohol use.
- Diet and eating habits.

Review halitosis history covering items such as frequency, duration, time of appearance within a day, and whether others have identified halitosis.[8]

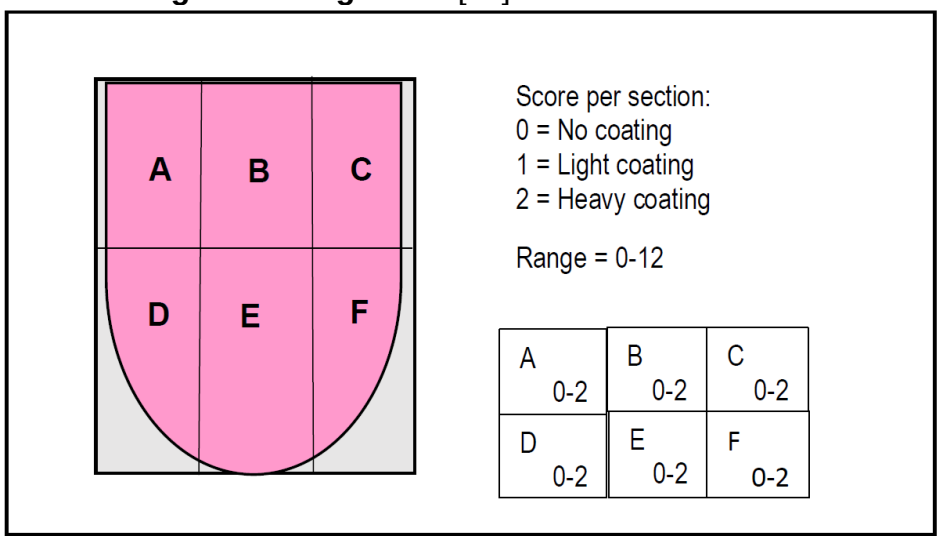
Extraoral examination assessing for pathologies that may contribute to halitosis.

Intraoral examination assessing areas such as:

- Tongue coating. Various indexes are available to evaluate presence and quantity of coating (e.g., Winkel Tongue Coating Index [WTCI]). For WTCI, the tongue dorsum is divided into 6 sections. The amount of coating is subjectively graded from 0 to 2 for each section. Total score, ranging from 0 to 12, is calculated by adding the scores for each section.
- Hard tissues, including investigating for pathology, and food and plaque retentive areas (e.g., necrotic pulp tissue, dental abscesses, caries, defective restorations, fractured teeth, broken restorations, open contacts, etc.).
- Soft tissues, including tonsillar area (e.g., tonsillar crypts, tonsilloliths) and screening for oral cancer[9] (e.g., nonhealing lesions), mouth breathing, and xerostomia.
- Periodontal tissues, perform complete periodontal examination, including amount and location of deposits.

[7] Refer to Episode 62 for additional information on drug-induced xerostomia.
[8] Sample halitosis questionnaires: https://www.cda-adc.ca/jcda/vol-66/issue-5/259.pdf https://www.andreas-filippi.ch/pdfs/halitosis%20questionnaire%20english.pdf
[9] Refer to Episodes 53 for sign & symptoms of oropharyngeal cancer.

Winkel Tongue Coating Index [17]



Measurement of oral malodour

While there is currently no ideal standard test to measure the extent and cause of halitosis, there are several direct breath odour diagnostic methods available. Diagnostics methods for halitosis include organoleptic testing, sulfide monitoring, and gas chromatography.

Organoleptic testing

Organoleptic testing is a subjective method and is considered gold standard for assessing and measuring halitosis. An experienced clinician sniffs air exhaled from the client's nose and mouth to determine presence or absence of malodour. Comparison of nose and mouth breath helps to differentiate intraoral and extraoral halitosis. Ideally, for 48 hours before testing, the client avoids eating garlic, onions, and spicy food, and for two hours before, abstains from eating, drinking (besides water), oral hygiene, and smoking. Mouth-breath evaluation is done by instructing the client to close their mouth for one minute and asking them to exhale slowly about 10 cm from the clinician's nose. Similarly, nose breath is evaluated by asking the client to exhale slowly from their nose. Odour assessment is based on a scale from 0 to 5 (0 = no odour, 1 = barely noticeable, 2 = slight but clearly noticeable, 3 = moderate, 4 = strong, 5 = extremely strong). Odour from the mouth is likely from oral or pharyngeal origin. Odour from the nose alone is likely from nasal or sinus origin. Odour from both nose and mouth may suggest a systemic or pulmonary cause. Results are recorded to assess the degree of halitosis and to evaluate success of treatment.

Sulfide monitoring

Sulfide monitoring measures VSC content present in exhaled breath via portable halitometers. Other volatile compounds associated with halitosis are not detected by these devices.

Gas chromatography

Gas chromatography measures different volatile components in the breath. The equipment is expensive, bulky, and requires a skilled operator. Thus, this technology is usually used in research and not in clinical practice. [3] [7] [8] [11] [13] [15] [21] [22] [36]

Diagnostic methods for halitosis [15] [20] [22]

Method	Advantages	Disadvantages
Organoleptic testing	Simple method Closely mimics daily life (i.e., noticed by others) Inexpensive No equipment needed Wide range of odours detectable	Subjective May be unpleasant for clinician Client may feel embarrassed or dislike testing process Lack of quantification Clinicians with anosmia (partial or full loss of smell) cannot detect different odours especially at low concentrations Clinician may detect odours the client does not consider offensive (e.g., tobacco) Client must avoid eating odoriferous food for 48 hours before assessment & refrain from smoking, drinking (besides water), & using scented cosmetics prior to testing Clinician must refrain from smoking, drinking (besides water), & using scented cosmetics prior to testing During COVID-19 pandemic, clinicians cannot perform test due to mask wearing protocols
Sulfide monitoring	Monitors are relatively inexpensive Portable Easily operable	Unable to differentiate between various sulfides & other odorous gases associated with halitosis False positives common if client recently ate odorous food or used distinct smelling toothpastes or mouthwashes
Gas chromatography	Differentiates between intraoral & extraoral halitosis Readily detects hydrogen sulfide, methyl mercaptan, dimethyl sulfide Can detect odours in low concentrations	Gas chromatograph is expensive Need trained personnel for values to be properly detected & measured Equipment usually not portable

Halitosis management

Temporary, intraoral, and pseudo halitosis can be managed by oral health professionals. However, both extraoral halitosis and halitophobia requires referral to medical practitioners (e.g., physicians, nurse practitioners, specialists), psychiatrists, and psychologists.

Since up to 90% of halitosis cases are of oral origin, halitosis management aims to reduce bacterial biofilms present in the oral cavity, through professionally delivered and self-performed biofilm control methods.

Professional treatment

- At present there are no standard protocols for oral malodour treatment because of its multiple etiology.
- Initial treatment approaches should include client education, control of oral pathologies, particularly periodontal diseases (e.g., restorations, root canal treatment, extractions, xerostomia management), and referrals as required.
- Client education should include halitosis etiologies and selfcare measures.
- Initial periodontal treatment includes scaling and root planning to reduce periodontal pockets depths, gingival inflammation, and VSC-producing bacteria. A systematic review found nonsurgical periodontal therapy in combination with oral hygiene instruction reduced VSC values in individuals with intraoral halitosis and/or periodontal diseases, independent of tongue cleaning and mouthrinse use. [8] [37]

Client education and selfcare

- Essential treatment for halitosis is good oral hygiene including:
    - Tongue cleaning (e.g., by tongue brushing or tongue scraping)
        - Regularly performed mechanical tongue cleaning can be regarded as basic therapeutic and preventive measure for all types of halitosis.
        - Clean tongue gently with low force avoiding tissue trauma focusing on the posterior part of tongue dorsum not lateral borders.
        - Mechanical tongue cleaning may also improve taste sensation. [38]
    - Brushing
    - Interproximal cleaning
    - Cleaning dentures daily and thoroughly.
- Management of dry mouth (e.g., sugar free gum/candy, such as xylitol-sweetened, to stimulate saliva flow; staying hydrated; saliva substitutes if necessary).[10]
- Lifestyle modifications including avoiding smoking, tobacco, and alcohol; reducing onions, garlic, and spices in diet.
- Mouthrinses provide only brief benefits. Different systematic reviews on mouthrinses and halitosis reported most evidence was provided for chlorhexidine mouthrinses, and those containing a combination of chlorhexidine and zinc; chlorhexidine, cetylpyridinium chloride, and zinc; or cetylpyridinium chloride and zinc. However, strength of evidence was graded as weak. Chlorohexidine also has some potential disadvantages when used long term, including teeth and tongue staining, metallic taste, and reduced taste sensation. More research is required on the use of mouthrinses for halitosis. [17] [39] [40]
- Frequent recare examinations and regular dental hygiene appointments. [3] [6] [9]

[10] Refer to Episode 55 for strategies to manage xerostomia.

Halitosis treatment [9] [36]

Treatment approach	Class of halitosis				
	Temporary	Intraoral	Extraoral	Pseudo-halitosis	Halitophobia
Explanation of halitosis, oral selfcare instruction, including tongue & interdental cleaning & use of additional measures	✓	✓	✓	✓	✓
Address contributory factors, including dietary and tobacco	✓	✓	✓	✓	✓
Nonsurgical periodontal therapy (e.g., scaling/root planing, air polishing[11]) & treatment of oral conditions contributing to malodour (e.g., gingivitis, periodontitis, peri-implantitis, caries, ulcers, etc.) as required. Referral to specialists (e.g., periodontist, oral pathologist, endodontist, etc.) as required		✓			
Referral to physician, nurse practitioner, medical specialist, or halitosis specialist			✓		
Explanation of examination findings; reinforcement of oral selfcare, causes of malodour, & reassurance				✓	
Referral to a clinical psychologist, psychiatrist, or other psychological specialist					✓

Probiotics and halitosis

- Probiotics[12] are nonpathogenic live microorganisms administered to improve microbial balance, especially in the gastrointestinal tract.
- Evidence from clinical studies suggests probiotic use may potentially be effective for preventing and treating intraoral halitosis. However, available evidence is quantitatively and qualitatively insufficient for recommendations in terms of administration strategies and pretreatment. Further research is required to verify probiotic efficacy in the management of intraoral halitosis. [17] [41] [42] [43] [44] [45]

COVID-19 and halitosis

- Numerous studies have reported oral manifestations in individuals with COVID-19, evaluating taste disorders or focusing on other oral conditions, such as halitosis, xerostomia, and mucosal lesions.[13]
- Halitosis was reported in a case series with 18 individuals and by 10% of 573 patients with COVID-19 from a cross-sectional study. [46] [47]
- Possible pathophysiology for the association between halitosis and COVID-19 include:
    - Respiratory tract infections may contribute to halitosis. [48]

[11] Refer to Episode 35 for discussion on air polishing.
[12] Refer to episode 63 for more information on probiotics and oral health.
[13] Refer to Episode 10, 27, & 61 for discussion on oral manifestations of COVID-19.

    - ACE2 receptors are more densely located on the tongue's dorsum, where the epithelium is significantly altered during COVID-19 and may predispose to overgrowth of anaerobic bacteria, leading to halitosis.
    - Medications used to treat COVID-19 (e.g., antivirals)[14] may cause xerostomia increasing risk of halitosis.
    - Antibiotics to treat bacterial coinfections arising from SARS-CoV-2 may modulate the oral environment to allow proliferation of halitosis-associated microbiota and periodontopathic gram-negative bacteria.
    - Mask wearing may make individuals more aware of their breath smell or encourage mouth breathing leading to dry mouth, which can contribute to halitosis.
    - Psychological impact of the COVID-19 pandemic could negatively change health-related behaviours, including oral selfcare and avoidance of oral healthcare leading to increased oral bioburden, oral diseases, and halitosis.
- Mask wearing during the COVID-19 pandemic may have impacted halitosis diagnosis so the burden of this condition may be under estimated. Clinician masking protocols during the pandemic results in the need for client's family and friends to help determine if halitosis is present and if treatment was successful. [49] [50] [51]

Take home messages

- Halitosis negatively impacts quality of life and interpersonal relationships.
- Considering the multifactorial complexity of halitosis, proper diagnosis, identification of the etiology, and timely referrals are important for effective treatment.
- Most cases of halitosis can be managed in the oral healthcare setting considering the main source of halitosis is intraoral.
- If the etiology is intraoral (e.g., tongue coating, periodontal and peri-implant diseases, caries, poor oral hygiene), elimination of halitosis can be attained by correcting these factors via professional treatment, client education and selfcare, and referrals to oral healthcare specialists as required.
- If systemic factors are contributing to halitosis or halitophobia, an interdisciplinary approach is required.

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[14] Refer to Episode 57 for discussion on COVID-19 treatment.

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https://odha.on.ca/wp-content/uploads/2016/08/Brushing-Flossing.14.1-copyright.pdf

Periodontal (Gum) Disease, ODHA Factsheet
https://odha.on.ca/wp-content/uploads/2016/08/Gum-Disease.14.1-copyright.pdf

Dry Mouth, ODHA Factsheet
https://odha.on.ca/wp-content/uploads/2016/08/Dry-Mouth-fact-sheet.v2.pdf

Tooth Decay (Caries), ODHA Factsheet
https://odha.on.ca/wp-content/uploads/2016/08/Tooth-Decay.14.1-copyright.pdf

Dentures and Oral Health, ODHA Factsheet
https://odha.on.ca/wp-content/uploads/2016/08/Dentures-15.1-copyright.pdf

Smoking and Smokeless Tobacco, ODHA Factsheet
https://odha.on.ca/wp-content/uploads/2016/08/ODHA-Facts-Smoking.VFS19.1-copyright.pdf

Additional Resources

University of British Columbia Breath Testing Clinic Clinical Record Questionnaire
https://www.cda-adc.ca/jcda/vol-66/issue-5/259.pdf

Halitosis Questionnaire, School of Dental Medicine, University of Basle, Switzerland
https://www.andreas-filippi.ch/pdfs/halitosis%20questionnaire%20english.pdf

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