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Review Article

Understanding halitosis: A comprehensive review of etiology, diagnosis, and management

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Abstract

Halitosis, or oral malodour, is a globally prevalent and socially distressing condition, ranking as the third most common reason for individuals to seek dental treatment. It is characterized by an unpleasant odour in the exhaled breath. Regardless of its origin, it poses a significant psychological burden due to the associated stigma and embarrassment. With increasing public awareness, improved literacy, and growing emphasis on oral hygiene, more individuals are actively seeking professional help to manage this issue. This review provides a comprehensive overview of the etiological factors and underlying conditions associated with halitosis, discusses diagnostic approaches, and outlines effective preventive and management strategies. Additionally, it emphasizes the importance of a multidisciplinary, interprofessional approach in delivering optimal care to individuals affected by this condition.

Keywords: Halitosis, Malodour, Oral hygiene, Volatile sulfur compounds, Psychogenic halitosis, Interdisciplinary approach

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1. Introduction

In modern society, personal presentation significantly influences social perception, extending beyond cultural background, ethnicity, and behavioral attributes. One often-overlooked yet socially impactful factor is halitosis, or bad breath. Historical records indicate that concerns related to oral malodour date back to ancient Greek and Roman civilizations, including references in the writings of Hippocrates (460–377 BC), widely recognized as the father of medicine. Halitosis is a global health concern and a widely acknowledged social stigma. Despite cultural variability in its perceived causes and treatments, the condition is consistently associated with negative psychosocial outcomes and reduced quality of life. Clinically, halitosis is defined as an unpleasant or offensive odour emanating from the oral cavity, regardless of its underlying etiology. The broader term "*oral malodor"* encompasses various descriptors such as ozostomia, stomatodysodia, fetor oris, and fetor ex ore.[1] The term '*halitosis*' is etymologically derived from the Latin word *halitus* (meaning "breath") and the Greek suffix *osis*, indicating a pathological condition.[2] It is estimated that halitosis affects approximately 50–65% of the general population. Nevertheless, it remains a frequently under-reported and socially sensitive issue, often ignored or considered taboo. Approximately 90% of halitosis cases originate from intraoral sources, most commonly due to gingivitis, periodontitis, microbial degradation of proteins, and the presence of a biofilm coating on the dorsum of the tongue. These conditions promote the production of Volatile Sulfur Compounds (VSCs), primarily hydrogen sulfide, methyl mercaptan, and dimethyl sulfide, which are largely responsible for the characteristic malodor.[3-5] An estimated 8% of cases are associated with ear, nose, and throat (ENT) pathologies,[6] while a smaller fraction can be attributed to systemic conditions, including metabolic disorders and gastrointestinal dysfunction. Given the high prevalence and social implications of halitosis, a deeper understanding of its etiology, diagnosis, and management is essential for improving patient outcomes and quality of life.

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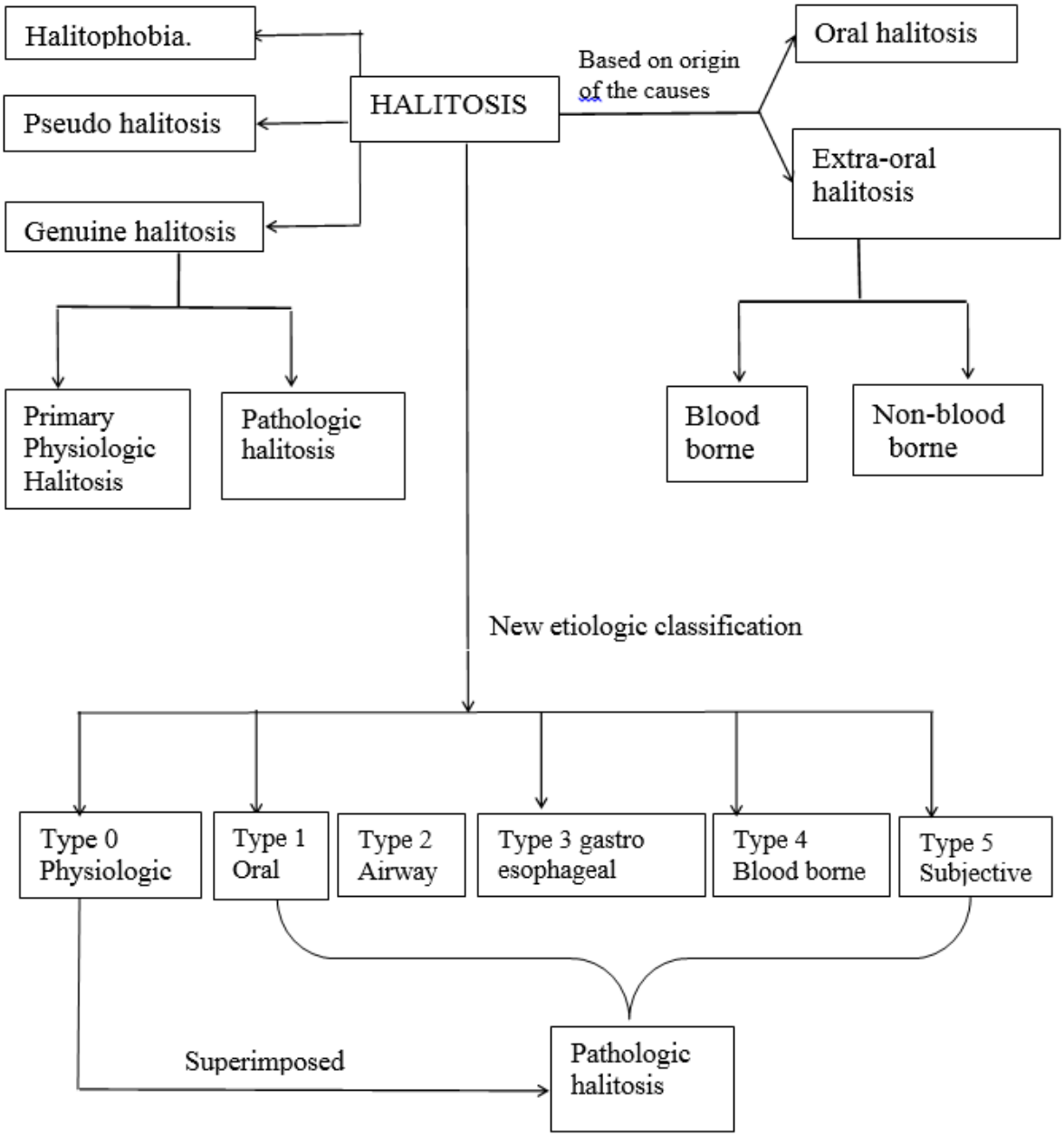

Figure 1: A simple classification of halitosis

2. Discussion

2.1. Classification of halitosis

A straightforward classification of halitosis was proposed by Miyazaki et al. in 1999[7] as genuine halitosis, pseudo-halitosis and halitophobia and by Aydin et al in 2014[8] a newer classification was proposed stating Types 1 to 5 representing distinct odour mechanisms that could occur individually or in combination at any given time as pathological halitosis. Each type of pathological halitosis (type1-5) may overlap with the presence of physiological odor (Type 0). Therefore, at any point, the overall halitosis is the result of the cumulative effect of these types, along with their underlying physiological contributions (**Figure 1**). Primary physiological halitosis is commonly observed in the morning and is attributed to reduced salivary flow during sleep, which leads to drying of the oral mucosa.[9] In such cases, individuals are typically unaware of the malodour emanating from their oral cavity. This unawareness can be explained by the limited capacity to perceive one's own breath due to anatomical airflow dynamics, while inhaled air travels vertically through the nasal cavity, exhaled air flows horizontally resulting in a discrepancy between inhaled and exhaled air. Additionally, olfactory adaptation to one's own scent may further impair recognition of oral malodour. Primary pathological halitosis, on the other hand, refers to an objectively offensive oral odour arising from various underlying causes.

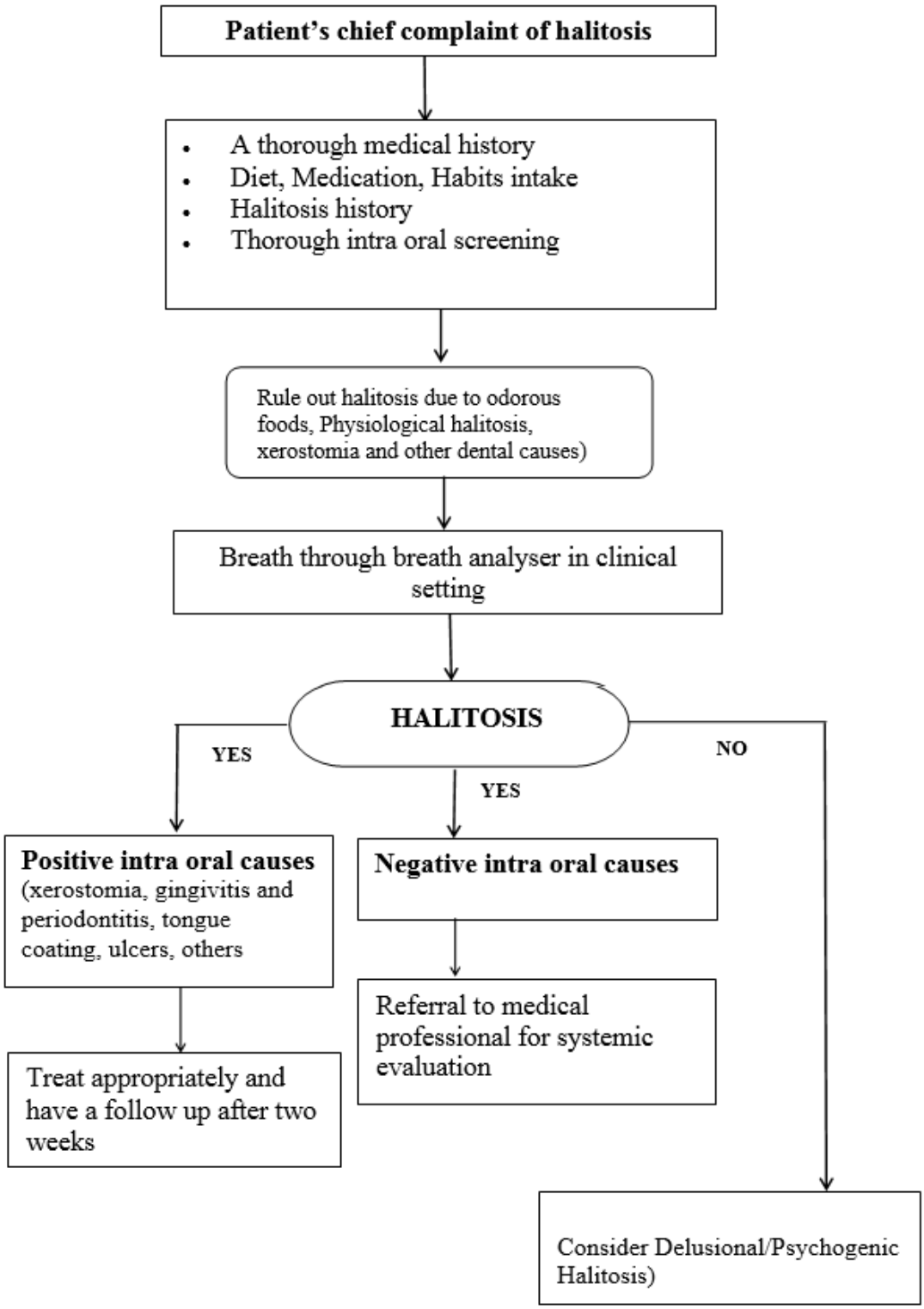

Figure 2: A diagnostic protocol workup in a clinical setting for a patient who presents to an Oral health professional**.**

Based on its origin, halitosis can be broadly classified into (a) Oral and (b) Extra-oral. Oral causes include poor oral hygiene, dental caries, gingival and periodontal diseases, as well as premalignant or malignant oral lesions. Extra-oral halitosis may stem from ear, nose, and throat infections, respiratory conditions, systemic illnesses, dietary factors, certain medications, alcohol consumption, and tobacco use. Pseudo-halitosis is characterized by the absence of clinically detectable malodour, although the individual firmly believes they have bad breath. Halitophobia refers to a persistent belief in having halitosis, even after successful treatment of genuine or pseudo-halitosis, despite the lack of objective

clinical or social evidence supporting the presence of malodour.[2]

2.2. Prevalence of halitosis

The accurate assessment of halitosis prevalence remains challenging due to the personal and subjective nature of the condition, variations in diagnostic methodologies, and inconsistencies in data collection across studies.[10] A study conducted among Polish university students reported a self-perceived halitosis prevalence of 24%.[11] In the Netherlands, halitosis was identified as one of the 100 most common causes of human distress.[12] Surveys conducted in Korea, Brazil, and Sweden have similarly indicated a prevalence of approximately 25%.[13-15] Villa et al.[16] reported a 37.6% prevalence among pediatric subjects, with a mean age of 12 years. Broadly speaking, it is estimated that at least one in every four individuals suffers from halitosis.[17,18] Miyazaki et al. observed that halitosis tends to be more prevalent and severe in older populations.[6] Additionally, a self-administered questionnaire-based study in India revealed that female students reported a lower incidence of self-perceived halitosis.[19]

2.3. Etiology of halitosis

The etiology of halitosis is multifactorial, involving local, systemic, psychological, dietary, and pharmacological contributors, individually or in combination. Halitosis results primarily from the production of volatile organic compounds, chiefly Volatile Sulfur Compounds (VSCs), Volatile Aromatic Compounds (VACs), organic acids, and amines. The key contributors to intraoral halitosis are methyl mercaptan and hydrogen sulfide, whereas dimethyl sulfoxide is mainly associated with extraoral sources.[20] VSC levels are known to rise significantly in cases of extreme xerostomia.[21] Poor oral health awareness, low socioeconomic status, and misinformation about dental issues often prevent individuals from seeking treatment, thereby contributing to the condition.

2.3.1. Oral causes

According to research conducted globally across several multidisciplinary breath clinic comprising experts from dentistry, ENT, internal medicine, and psychology, approximately 85–90% of breath odours are found to originate from within the oral cavity itself. The majority of halitosis cases originate within the oral cavity and are linked to factors such as: Tongue coating, Gingival and periodontal disease, Peri-implantitis, Deep carious lesions, Food impaction, Infected or necrotic pulp, Pericoronitis, Mucosal ulcerations, Overhanging restorations, Poorly maintained dentures, Reduced salivary flow and Inadequate oral hygiene. Bacterial degradation of organic substrates such as food debris, desquamated epithelial cells, and blood releases malodorous compounds. Numerous gram-negative and proteolytic obligate anaerobes contribute to this process, thriving in a favourable oral environment (temperature: 34–37°C; humidity: ~91–96%).[22,23] Anatomical niches like tongue fissures, gingival sulcus, and periodontal pockets include retention of odoriferous food debris leading to putrefaction of the debris resulting in fetid odor and VSC release. Poor oral hygiene is a major risk factor. **Table 1** outlines[24] bacterial species associated with VSC production. Research shows elevated counts of Gram-positive cocci in individuals with halitosis compared to those without.[25,26] There is a well-established correlation between the bacterial load on the tongue and the presence of oral malodor.[27] The primary source of malodour in individuals with healthy periodontal tissues and satisfactory oral hygiene is typically the posterior region of the dorsum of the tongue. Since the surface of the tongue has a highly irregular morphology and is characterized by papillae and fissures it creates a favorable anaerobic conditions for bacterial proliferation, limiting the cleansing effects of saliva in these areas.[27,28] This anatomical complexity creates bacterial colonization on the dorsum of the tongue dorsum which plays a key role in the production of volatile sulfur compounds (VSCs). Individuals with a history of Gastro-esophageal reflux disease and postnasal drip are predisposed to the accumulation of a coating on the dorsal surface of the tongue.[29] Regular self-cleaning of the tongue by mechanical debridement of the tongue and surface by tongue brushing or scraping have been shown to significantly reduce both oral malodor and tongue coating.[30]

Xerostomia exacerbates halitosis by reducing saliva's mechanical cleansing and antimicrobial effects leading to anaerobic bacterial putrefaction of food debris in the mouth which increases the cariogenic activity of the microorganisms resulting in increased production of VSCs contributing to malodour. High-protein diets and amino acid metabolism by oral microbiota further increase VSCs via raised pH and reduced oxygen tension. Several additional factors contribute to the development of halitosis, including exposed tooth pulps, non-vital teeth with pus draining into the oral cavity, oral pathologies, oral malignancies, ulcerative lesions, and healing or non-healing wounds following extractions, presence of fixed orthodontic appliances, improper hygiene maintenance of dentures, poorly adapted crowns and restorations and interdental food lodgement. All these factors promote the retention of food debris and dental plaque, which increases putrefaction and production of VSCs.

2.3.2. Non-oral causes

An estimated 10–20% of halitosis cases are attributed to non-oral causes.[26] Non-oral etiologies encompass: Behavioral factors such as tobacco use, alcohol consumption, and dietary choices; Systemic conditions such as respiratory, gastrointestinal, endocrine, hematological, and metabolic disorders; and certain medications which can directly or indirectly cause halitosis. The predominant VSCs associated with extraoral halitosis is dimethyl sulphoxide, while intraoral halitosis is mainly linked to methyl mercaptan and

hydrogen sulfide.[31,32] The following sections outline the most common sources of extraoral halitosis.

Tobacco smoking leads to mucosal dryness, reduced salivary output, and an increase in intraoral VSCs. Nitrogenous components of smoke also reduce lower esophageal sphincter (LES) tone, contributing to gastroesophageal reflux disease (GERD) and resultant oral malodour.[33] Inhaled sulfur compounds can enter systemic circulation and be exhaled over time. Alcohol contributes to halitosis through acetaldehyde exhalation and LES relaxation, facilitating gastric acid reflux. It also induces xerostomia and increases VSC production. Foods high in sulfur, such as onions and garlic, can enter the bloodstream via the gastrointestinal tract and cause exhaled malodour.[34] Similarly, certain vitamins (especially B-complex), oils, and trace elements like arsenic are excreted through sweat, urine, and breath, contributing to halitosis.

Systemic diseases that can cause halitosis include, Diabetes mellitus: Associated with ketonemia and elevated serum levels of malodorous compounds like mercaptans, phenols, and fatty acids. Gastrointestinal conditions such as GERD, vomiting, hyperacidity, gastric cancer, esophageal diverticula, Helicobacter pylori infection, Crohn's disease, and lower esophageal sphincter dysfunctions are associated with halitosis.[35] The characteristic odours in systemic diseases is shown in **Table 2**.[11]

Chronic kidney disease resulting in Uremic toxins accumulation, Disturbed urea cycle metabolism in Liver dysfunction, Trimethylaminuria: Also known as fish odour syndrome and Hypernatremia and cystinosis: Linked to metabolic halitosis.[36] Upper and lower respiratory tract infections also contribute to halitosis. In the nasal cavity and sinuses, retained secretions and infections such as: Chronic rhinitis, Sinusitis, Nasal polyps, Tumors, Foreign bodies, Adenoiditis, Tonsillitis, Pharyngitis, Middle ear infections can lead to inflammation and odor due to bacterial degradation of protein-rich secretions. Tonsillar crypts may retain necrotic debris, promoting tonsillolith formation and chronic follicular tonsillitis both of which are recognized causes of VSC elevation and halitosis.[37] Tonsillitis causes abnormal VSC levels and is one of the reasons of oral malodor in healthy individuals. Lower respiratory tract conditions such as bronchitis, pneumonia, bronchiectasis, lung abscesses, emphysema, tuberculosis, and lung malignancies may produce fetid breath due to microbial degradation of respiratory secretions.

Numerous medications contribute to halitosis either by inducing xerostomia or releasing malodorous compounds. These include: Anticholinergics, Antihistamines, Antipsychotics, Antidepressants, Anxiolytics, Diuretics, Antihypertensives, Chemotherapeutic agents, Bisphosphonates, Narcotics, Acetaminophen, Chloral hydrate, Dimethyl sulfoxide, Disulfiram, Nitrate/nitrite medications, Phenothiazines. A recent systematic review identified several drugs associated with extraoral halitosis: cysteamine (aminothiols), ranitidine (acid reducers), oxybutynin and glycopyrrolate (anticholinergics), imipramine and duloxetine (antidepressants), astemizole and beclomethasone dipropionate (steroids), Colpermin (antispasmodics), chemotherapeutics (PX-12, silybin-phytosome), dietary supplements (fish oil, selenium, vitamin E), diclofenac, and dimethyl sulfoxide.[38]

2.4. Assessment and diagnosis

Given that the oral cavity is the primary origin of breath odour, it is reasonable to expect that dentists are equipped to manage intra-oral halitosis within the scope of routine dental care. Nonetheless, dentists who aim to diagnose and treat halitosis must incorporate scientifically validated approaches into their clinical practice.

This includes

1. Clear protocols for evaluating and diagnosing patients with breath odor complaints, and
2. Standardized treatment strategies for halitosis management.[39]

It is important to acknowledge that patients with halitosis often experience the condition chronically causing significant psychological and social distress[40] and may have previously sought help from multiple healthcare professionals. Therefore, dentists should therefore consider the fact that halitosis is closely associated with patient's self-image and may be linked to underlying psychological conditions. Awareness of cultural and social attitudes toward halitosis is also essential for providing comprehensive care aimed at improving patient quality of life.[41] Accurate assessment methods are essential to differentiate between various forms of halitosis. The diagnosis of halitosis should focus on identifying the type and severity, whether it is true halitosis, pseudo-halitosis, or halitophobia. A thorough evaluation typically comprises of a detailed history, clinical examination, radiographic imaging, and instrumental analysis. If an underlying medical condition is identified as a contributing factor, appropriate referral for medical treatment should be initiated.

For centuries, the diagnosis of halitosis primarily relied on subjective evaluation, wherein the clinician assessed the odour of a patient's exhaled air. Despite its limitations in isolating specific malodours, this method was long regarded as the "gold standard" due to its simplicity and directness. However, its significant inter-examiner variability and lack of reproducibility have raised concerns regarding its reliability. In recent times, newly developed digital personal and clinical devices have significantly advanced halitosis diagnosis. Devices such as the Breathometer, a compact wireless tool that connects to smartphones to provide insights into oral health and portable bad breath testers are now commercially available. These innovations empower individuals to self-monitor their breath and determine

whether a dental consultation is necessary. Additionally, they streamline clinical visits by enabling quicker assessment and aiding clinicians in more efficient diagnosis.With the advent of advanced diagnostic technologies capable of producing consistent and objective results, subjective assessment is no longer considered the gold standard in halitosis diagnosis.[42] Several diagnostic methods for detecting halitosis have been employed over the years. However, many of these techniques have become obsolete due to technological advancements and owing to the potential risk of transmitting respiratory infections, an issue of heightened concern following outbreaks such as Severe Acute Respiratory Syndrome (SARS), various respiratory viral illnesses, and more recently, the COVID-19 pandemic.

Oral malodour can be assessed using direct and indirect methods.

1. Direct method or Subjective Examination:
    a. Organoleptic Method

The organoleptic assessment involves the examiner sniffing the patient's breath and subjectively grading the intensity of halitosis by comparing the exhaled air from the patient's mouth with that from the nose while the mouth remains closed, helping to localize the source of the malodour. Despite its simplicity, it remains the most reliable and widely used method for evaluating oral malodour. To ensure diagnostic accuracy, the evaluation should be conducted on two or more separate occasions. For research purposes or when precise quantification is needed, particularly in clinical trials assessing the efficacy of anti-malodour agents, it is recommended that multiple trained examiners perform the organoleptic evaluation. Both nasal and oral breath should be assessed, nasal malodour (detected when the patient exhales through the nose with the mouth closed) may indicate an extra-oral origin such as nasal, sinus, respiratory, or gastrointestinal sources.

The intensity is typically graded using Rosenberg's six-point scale.[43] Prior to subjective examination, patients are instructed to: Refrain from oral hygiene practices and mouth rinses for 12 hours, Avoid food, beverages, smoking, and deodorants for a minimum of 12–24 hours, discontinue antibiotics for at least three weeks and avoid strongly odorous foods such as garlic and onions for at least two days.

During the test, a plastic tube is inserted into the patient's mouth, and the examiner smells the exhaled air from the opposite end. To ensure accuracy, examiners are advised to avoid strong-smelling foods and beverages (e.g., tea, coffee, juices) and refrain from smoking several hours prior to the test. Repetition over 2–3 consecutive days is recommended for increased diagnostic reliability, ideally alongside objective methods.[2] Various semi-quantitative scales have been developed, but the most commonly accepted is the 0–5 scale proposed at the International Workshop on Oral Halitosis (1999) (**Table 3**).[7]

Simple adjunct tests used in organoleptic evaluation include:[44]

1. Spoon Test: Used to assess odor originating from the posterior dorsum of the tongue. A sterile plastic spoon is used to scrape the tongue surface, and after 5 seconds, the odor is assessed by holding the spoon approximately 5 cm from the examiner's nose.
2. Dental Floss Odor Test: This evaluates malodour from interdental regions. Unwaxed dental floss is passed through the posterior interdental spaces, and the odor is assessed by holding the floss around 3 cm from the nose.
3. Saliva Odor Test: The patient expectorates 1–2 ml of saliva into a sterile glass tube, which is then sealed and incubated at 37°C for five minutes. The odor is evaluated by holding the tube approximately 4 cm from the nose.

2.5. Gas chromatography

Gas chromatography is widely regarded as the gold standard for identifying and quantifying VSCs and other odorous substances. When combined with a mass spectrometry detector, its diagnostic capability is significantly enhanced. However, conventional gas chromatography systems are complex, requiring inert carrier gases (e.g., nitrogen or helium), specialized equipment, and trained personnel, making them unsuitable for routine clinical use. A more practical alternative for use in dental settings is the recent development of portable gas chromatographs which utilizes ambient air instead of specialty gases and offer high sensitivity at a lower cost.[45]

2.6. Sulfide monitors

Sulfide monitors are portable, chairside diagnostic devices designed to assess oral malodor. These monitors are cost-effective and operate via an electrochemical sensor that detects VSCs. During the assessment, the patient exhales into a transparent tube connected to a suction pump, which directs the breath sample into the monitor. The device measures sulfur-containing gases in the exhaled breath, especially those with low boiling points, which are the primary contributors to oral malodour.[46] A reading is recorded once the peak concentration is reached. The measurements are expressed in parts per billion (ppb), with clinical interpretation as follows: <100 ppb: Normal, 100–180 ppb: Mild halitosis, 250 ppb: Chronic halitosis.

However, readings may be affected by other volatile substances such as acetone, ethanol, and methanol, leading to potential false positives.

2.7. Electronic nose

The electronic nose system that uses the response patterns of a gas-sensor array to identify odors. It represents an advanced diagnostic tool used for analyzing breath odour. The system includes a pre-concentrator with semiconductor sensors each with distinct sensitivities to odoriferous compounds, and a pattern recognition software. The analyzer can be set to

various operational modes for identifying substances with low boiling points. This technology enables comprehensive profiling of breath odor patterns, although it is more commonly used in research settings due to its complexity and cost.[46]

2.8. Dark field / Phase contrast microscopy

Dark field and phase contrast microscopy allow direct visualization of motile microorganisms, which are often abundant in patients with gingivitis and periodontitis. An increased presence of spirochetes and other motile bacteria has been associated with specific acidic oral malodour.[47] These microscopic techniques are valuable not only for monitoring treatment progress but also for enhancing patient awareness, as visualizing the microbial content in plaque, tongue coatings, and saliva can be impactful during patient education.

Table 1: Bacteria which are active producers of volatile sulfur compounds

Hydrogen sulfide from cysteine	Peptosteptococcus anaerobius
	Microsprevotii Eubacteriumlimosum
	Bacteroides spp
	Centipedia periodontii Selenomonas artermidis
Methyl mercaptan from methionine	Fusobacterium nucleatum
	Fusobacterium periodonticm
	Eubacterium species
	Bacteroides species
Hydrogen sulfide from serum	Prevotella intermedia
	Prevotella loescheii
	Porphyromonas gingivalis
	Treponema denticola
Methyl mercaptan from serum	Treponema denticola
	Prophyromonas gingivalis
	Porphyromonas endodontalis

Table 2: Characteristic oral odour in systemic diseases

	Systemic disease	**Characteristic odour**
1	Type-1-diabetes in children Type-2-diabetes in adults Alcoholic ketoacidosis	Fruity odour, Acetone breath,
2	Unbalanced insulin Dependent diabetes	Rotten apples
3	Hepatic insufficiency	fetor hepaticus (breath of death)
4	Trisonemy	Cabbage odor
5	Kidney insufficiency, trimethylaminuria	Fish odor
6	Uremia, kidney failure	Ammonia or urine like
7	Maple syrup urine disease	Burned sugar odor
8	Homocystinuria	Sweet musty odor
9	Isovaleriaan acidity	Sweating feet
10	Intestinal obstruction	Fecal odor
11	Nephropathic cystinosis	Rotten eggs
12	Lung abscess or bronchiectasis	Rotten meat smell, putrefactive
13	Blood dyscrasias	Resembling decomposed blood of a healing surgical wound
14	Hepatic cirrhosis	Resembling decayed wound
15	Weger’s granulomatosis	Necrotic putrefactive
16	Syphilis, exanthematous disease, granuloma venerum	Fetid
17	Azotemia	Ammonia-like

Table 3: Organoleptic scoring scale.[7]

	Category	Description
0	Absence of odour	Odour cannot be detected
1	Questionable odour	Odour is detectable, although the examiner could not recognize it as malodour
2	Slight malodour	Odour is deemed to exceed the threshold of malodour recognition
3	Moderate malodour	Malodour is definitely detected
4	Strong malodour	Strong malodour is detected, but can be tolerated by examiner
5	Severe malodour	Overwhelming malodour is detected and cannot be tolerated by examiner (examiner instinctively averts the nose)

Table 4: Halitosis classification system with corresponding Treatment Needs

	Classification	Treatment needs	Description
1.	Genuine halitosis		Obvious malodour, with intensity beyond socially acceptable level, is perceived.
	i. Physiologic halitosis	TN-1	1. Malodour arises through putrefactive process within the oral cavity. Neither specific disease nor pathologic condition that could cause halitosis is found.
			2. Origin is mainly the dorsoposterior region of the tongue.
			3. Temporary halitosis due to dietary factors (e.g., garlic) should be excluded.
	ii. Pathologic halitosis		
	(i) Oral	TN-1 and TN-2	Halitosis caused by disease, pathologic condition or malfunction of oral tissues.
	Extraoral	TN-1 and TN-3	1. Malodour originates from nasal, paranasal and/or laryngeal regions.
			2. Malodour originates from pulmonary tract or upper digestive tract.
			3. Malodour originates from disorders anywhere in the body whereby the odour is bloodborne and emitted via the lungs (e.g., diabetes mellitus, hepatic cirrhosis, uremia, internal bleeding).
2.	Pseudo-halitosis	TN-1 and TN-4 1.	Obvious malodour is not perceived by others, although the patient stubbornly
3.	Halitophobia	TN-1 and TN-5	1. After treatment for genuine halitosis or pseudo-halitosis, the patient persists in believing that he/she has halitosis.
			2. No physical or social evidence exists to suggest that halitosis is present.

3. Indirect Methods or Objective Examination

Objective methods for assessing halitosis focus on detecting VSCs in exhaled air, especially those originating from the dorsum of the tongue, where anaerobic gram-negative bacteria such as Treponema denticola, Porphyromonas gingivalis, and Tannerella forsythia reside. Indirect methods for halitosis evaluation include bacterial cultures, microbial smears, and enzyme-based assays. These techniques aid in identifying malodor-producing microorganisms.

One commonly used test is the Benzoyl-DL-arginine-naphthylamide (BANA) test,[48] which detects proteolytic enzyme activity of anaerobic bacteria such as Porphyromonas gingivalis, Tannerella forsythia, and Treponema denticola. This rapid, chairside test evaluates non-sulfurous malodorous compounds. The procedure involves wiping the tongue or interdental areas with a cotton swab, applying the sample to a BANA test strip, and placing it into a compact incubator. The sample is heated to 55°C for 5 minutes. A positive result is indicated by a blue color change on the strip, with the intensity of the color corresponding to the bacterial load. A reference color chart is included on the kit container to assist in result interpretation.[49] The BANA test may also be useful in assessing prognosis and monitoring treatment response.

The Ninhydrin method, an inexpensive chemical assay, identifies low molecular weight amines and polyamines. Samples are mixed with isopropanol, centrifuged, and analyzed using spectrophotometry based on light permeability.[50]

Polymerase Chain Reaction (PCR) offers high specificity and sensitivity by quantifying VSC-producing microorganisms in samples such as saliva, tongue coating, and subgingival plaque.

Pseudohalitosis is characterized by the belief of having halitosis despite the absence of clinical evidence. Therefore, If no detectable odour is identified after multiple clinical

assessments conducted on different days, the patient may be classified as having pseudohalitosis. Structured diagnostic questionnaires can support this diagnosis. In such cases, a psychological component is often present, and patients may benefit from pyschiatric health care professional referral and counseling.[51]

3.1. Treatment of halitosis

All individuals presenting with halitosis irrespective of etiology should undergo evaluation by an oral health professional. Miyazaki et al.[7] proposed a classification system with corresponding treatment needs (**Table 4**), which has since been expanded to include five treatment need (TN) categories for clinical guidance.

TN-1 and TN-2: Physiologic and oral pathologic halitosis, managed by dental professionals
TN-3: Extra-oral halitosis, requires referral to physicians or ENT specialists
TN-4: Pseudo-halitosis, requires dental evaluation and counselling
TN-5: Halitophobia, requires management by psychologists or psychiatrists

Initial assessment should include a comprehensive examination of teeth, periodontal tissues, tongue, mucosa, and salivary function. Conditions such as active caries, periodontal disease, pulp infections, ulcerative lesions, fungal/viral infections, xerostomia, and malignancies must be identified and treated appropiately since these pathologies are a major contributor to the accumulation and putrefaction of bacteria and increased levels of oral VSC.

3.2. Phases of intraoral halitosis management

1. Mechanical Reduction – Includes scaling, root planing, and debridement of tongue dorsum using scrapers
2. iChemical Reduction – Use of antimicrobial mouthwashes such as 0.2% chlorhexidine, 0.025% cetylpyridinium chloride, or triclosan
3. Neutralization of VSCs – Chemical inactivation of malodorous gases
4. Masking the Malodour – Use of sprays, flavoured lozenges, or chewing gum to increase salivary flow and provide temporary relief.

Studies have shown that oral probiotics, especially lactobacilli, can be effective in managing physiological halitosis by modulating the oral microbiome.[20] Moreover, Clear oral hygiene instructions and ways to do daily tongue cleaning should be provided to all patients. Van der Sleen et al. reported that tongue scrapers remove up to 75% of VSCs, compared to 45% with toothbrushes.[52]

3.3. Management of extra-oral and psychogenic halitosis

Treatment of extra-oral halitosis (TN-3) involves addressing systemic conditions such as GERD, sinusitis, hepatic or renal dysfunction, diabetes, and respiratory tract infections. A multidisciplinary referral system may include gastroenterologists, ENT specialists, nutritionists and endocrinologists.

For halitophobia (TN-5), psychological counselling, behavioural therapy, and sometimes pharmacologic intervention are necessary. A strong therapeutic alliance and continuous reassurance are crucial to prevent social withdrawal and anxiety. The management strategy for a patient presenting with halitosis, intended for use by oral health professionals, is illustrated in **Figure 2**.

4. Conclusion

Halitosis is a widespread condition with complex, multifactorial etiology. Dental professionals play a central role in the diagnosis and management, especially for intraoral causes. However, due to its diverse origins ranging from local oral factors to systemic and psychogenic conditions a multidisciplinary approach involving dentists, ENT specialists, gastroenterologists, physicians, psychologists, and nutritionists is often essential for effective and individualized patient care. Rather than dismissing bad breath as a trivial or socially awkward issue, clinicians must recognize it as a multifaceted condition that reflects the interplay between oral, systemic, and psychosocial health.

5. Source of Funding

None.

6. Conflict of Interest

None.

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