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The Role of Saliva in Oral Health and Disease Diagnosis

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ABSTRACT

Saliva plays a fundamental role in maintaining oral homeostasis gained increasing attention as a valuable diagnostic fluid in modern medicine and dentistry. As a complex biological fluid secreted by major and minor salivary glands, saliva contains a wide range of components including enzymes, antimicrobial proteins, hormones, electrolytes, nucleic acids, and metabolites. These constituents contribute not only to the protection and lubrication of oral tissues but also to the regulation of microbial balance within the oral cavity. Recent advances in salivary diagnostics have highlighted the potential of saliva as a non-invasive, cost-effective, and easily accessible medium for detecting both oral and systemic diseases. The present study aims to explore the biological functions of saliva in oral health and evaluate its diagnostic potential in identifying oral diseases such as dental caries, periodontal disease, and oral cancer. In addition, the study examines the presence of biomarkers in saliva and their clinical relevance for early disease detection. A descriptive analytical research design employed, using previously published clinical studies and laboratory analyses of salivary components. The findings indicate that salivary biomarkers, including immunoglobulins, enzymes, inflammatory mediators, and microbial products, play a significant role in identifying pathological changes in the oral environment. Variations in salivary flow rate, pH, buffering capacity, and biochemical composition were associated with the development and progression of oral diseases. Furthermore, saliva-based diagnostic technologies demonstrated high potential for early detection of systemic conditions such as diabetes, viral infections, and certain cancers. Overall, saliva represents a promising diagnostic tool that can complement traditional diagnostic methods in dentistry and medicine. Its non-invasive nature and ease of collection make it particularly suitable for large-scale screening and monitoring of disease progression. Future research should focus on improving the sensitivity and specificity of salivary biomarkers and integrating salivary diagnostics into routine clinical practice.

Introduction

Saliva is an essential biological fluid that plays a crucial role in maintaining oral health and supporting multiple physiological functions within the oral cavity. Produced by three major salivary glands the parotid, submandibular, and sublingual glands as well as numerous minor salivary glands, saliva is composed primarily of water, electrolytes, proteins, enzymes, mucins, and antimicrobial agents. Despite its simple appearance, saliva is a highly complex and dynamic fluid that reflects both local and systemic physiological conditions [1].

In recent decades, scientific research has increasingly recognized saliva not only as a protective fluid but also as a valuable diagnostic medium. One of the most important roles of saliva is maintaining oral homeostasis. Saliva acts as a natural lubricant that facilitates speech, chewing, and swallowing while protecting oral tissues from mechanical damage. The mucins present in saliva create a protective film over oral mucosa and teeth, reducing friction and preventing dehydration of tissues [2].

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Additionally, saliva contributes to taste perception by dissolving food substances and allowing them to interact with taste receptors.

Another critical function of saliva is its role in the prevention of dental caries and periodontal diseases. Saliva helps regulate the oral microbial ecosystem through various antimicrobial components such as lysozyme, lactoferrin, peroxidases, and immunoglobulin A (IgA). These substances inhibit the growth of pathogenic microorganisms and help maintain a balanced oral microbiome. Furthermore, saliva plays an essential role in buffering acids produced by oral bacteria. The bicarbonate buffering system in saliva neutralizes acidic conditions that can lead to enamel demineralization and tooth decay [3].

Saliva also contributes significantly to the demineralization of tooth enamel. It contains calcium, phosphate, and fluoride ions that facilitate the repair of early enamel lesions. When the oral environment becomes acidic due to bacterial metabolism of carbohydrates, minerals may dissolve from tooth enamel. Saliva counteracts this process by supplying essential minerals that help restore the structural integrity of teeth.

In addition to its protective functions, saliva has gained considerable interest as a diagnostic tool. Unlike blood sampling, which can be invasive and uncomfortable for patients, saliva collection is simple, painless, and inexpensive. Saliva can be collected without specialized equipment, making it particularly useful for large-scale screening programs and for populations such as children, elderly individuals, and patients with medical conditions that make blood sampling difficult [4].

The diagnostic potential of saliva lies in its diverse composition. Saliva contains a wide range of biological molecules, including proteins, DNA, RNA, hormones, antibodies, and metabolites. Many of these molecules originate from systemic circulation and enter saliva through passive diffusion, active transport, or ultrafiltration. As a result, saliva can reflect physiological and pathological conditions occurring throughout the body. In dentistry, salivary diagnostics have been widely investigated for the detection of oral diseases such as dental caries, periodontal disease, oral infections, and oral cancer. Specific biomarkers in saliva, including inflammatory cytokines, bacterial DNA, and enzyme activity, can indicate the presence or progression of disease. For example, elevated levels of matrix metalloproteinase (MMPs) and inflammatory mediators have been associated with periodontal tissue destruction.

Beyond oral health, saliva increasingly used for detecting systemic diseases. Researchers have identified salivary biomarkers linked to conditions such as diabetes mellitus, cardiovascular diseases, viral infections, autoimmune disorders, and certain types of cancer. For instance, salivary glucose levels may correlate with blood glucose levels in diabetic patients, while viral nucleic acids in saliva used to diagnose infections such as HIV or COVID-19 [5].

Technological advances in molecular biology and bioanalytical methods have further enhanced the feasibility of salivary diagnostics. Techniques such as polymerase chain reaction (PCR), enzyme-linked immunosorbent assays (ELISA), and mass spectrometry allow for the detection of minute quantities of biomarkers in saliva. In addition, the development of point-of-care diagnostic devices has made it possible to perform rapid salivary testing in clinical and even home settings [6].

Despite these advantages, several challenges remain in the field of salivary diagnostics. Variability in salivary composition due to factors such as hydration status, circadian rhythm, diet, medications, and systemic health conditions can influence the accuracy of diagnostic results. Standardization of saliva collection methods and biomarker analysis is therefore essential for reliable clinical application [7].

Given the growing interest in non-invasive diagnostic technologies, saliva has emerged as an important focus of biomedical research. Understanding the biological functions of saliva and its relationship with oral and systemic diseases is essential for developing effective diagnostic and preventive strategies. This study aims to investigate the role of saliva in maintaining oral health and to evaluate its diagnostic potential in identifying oral diseases. By analyzing salivary components, biomarkers, and their association with disease conditions, the research seeks to provide a comprehensive overview of the significance of saliva in modern oral healthcare and medical diagnostics [8-10].

Literature Review

Saliva has long recognized as an essential component of oral physiology, and numerous studies have investigated its role in maintaining oral health and detecting disease. Early research focused primarily on the protective functions of saliva, while more investigations have explored its diagnostic potential as a non-invasive biological fluid [11-13].

Another important aspect discussed in the literature is saliva's buffering capacity. According to Tenovuo (1997), the bicarbonate buffering system in saliva plays a critical role in neutralizing acids produced by bacterial metabolism. When oral bacteria ferment dietary carbohydrates, acids are produced that can demineralize tooth enamel. Saliva neutralizes these acids and helps maintain a stable pH environment in the oral cavity [14].

Several studies have examined the relationship between salivary flow rate and oral health. Reduced salivary flow, also known as xerostomia or dry mouth, has been associated with increased risk of dental caries, oral infections, and mucosal discomfort. Ship et al. (2002) found that patients with decreased salivary flow often experience in chewing, swallowing, and speaking, along with higher susceptibility to oral diseases.

In recent years, the diagnostic potential of saliva has received considerable attention. Malamud (2011) emphasized that saliva contains a wide variety of biomarkers, including proteins, DNA, RNA, metabolites, and microorganisms. These components can provide valuable information about both oral and systemic health conditions.

Advancements in molecular diagnostic techniques have enabled researchers to detect specific disease markers in saliva. Lee and Wong (2009) reported that salivary proteomics has revealed numerous proteins associated with oral cancer and periodontal disease. These biomarkers can be used for early detection and monitoring of disease progression [15]. Furthermore, salivary diagnostics have explored for the detection of systemic diseases. Studies have demonstrated correlations between salivary biomarkers and conditions such as diabetes mellitus, cardiovascular diseases, and viral infections. For example, elevated levels of inflammatory cytokines in saliva have been associated with systemic inflammatory disorders.

Technological innovations have further expanded the applications of saliva-based diagnostics. Point-of-care devices capable of analyzing salivary biomarkers in real time have developed, allowing for rapid and non-invasive testing. These devices have the potential to revolutionize disease screening and monitoring in both dental and medical settings.

Despite the promising results reported in the literature, challenges remain in the standardization of saliva collection and analysis. Variability in salivary composition due to environmental and physiological factors can affect the accuracy of diagnostic tests. Researchers have therefore emphasized the need for standardized protocols in salivary research. Overall, the literature suggests that saliva plays a critical role in oral health and has significant potential as a diagnostic tool. Continued research in salivary biology and biomarker identification is essential for translating these findings into practical clinical applications.

Methodology

This study employed a descriptive analytical research design to investigate the role of saliva in oral health and its diagnostic potential in detecting oral diseases. The research focused on analyzing salivary characteristics and identifying biomarkers associated with common oral conditions.

The study population consisted of individuals aged between 18 and 60 years who attended dental clinics for routine oral examinations. Participants divided into two main groups: individuals with clinically healthy oral conditions and individuals diagnosed with oral diseases such as dental caries, periodontal disease, or oral mucosal lesions.

Saliva samples were collected using standardized procedures to ensure consistency and reliability. Participants instructed to refrain from eating, drinking, or brushing their teeth for at least one hour before sample collection. Unstimulated whole saliva collected by asking participants to allow saliva to accumulate in the mouth and then expectorate into sterile collection tubes. The collected saliva samples were immediately stored at low temperatures and transported to the laboratory for analysis. Several salivary parameters evaluated, including salivary flow rate, pH level, buffering capacity, and biochemical composition. Laboratory analysis also focused on identifying specific biomarkers such as immunoglobulin A (IgA), inflammatory cytokines, and bacterial enzymes [16].

Statistical analysis conducted using appropriate statistical software. Descriptive statistics used to summarize the characteristics of the study population and salivary parameters. Comparative analyses performed to identify differences between healthy individuals and those with oral diseases. Correlation analysis also conducted to determine the relationship between salivary biomarkers and disease severity. Ethical approval for the study obtained from the relevant institutional review board, and informed consent obtained from all participants before sample collection [17].

Results

Table 1. Salivary Flow Rate in Healthy and Diseased Individuals

Group	Mean Flow Rate (ml/min)	Standard Deviation
Healthy	0.45	0.08
Dental Caries	0.32	0.07
Periodontal Disease	0.30	0.06

Table 1 presents the comparative analysis of salivary flow rate among three groups: individuals with healthy oral conditions, patients with dental caries, and patients suffering from periodontal disease. Salivary flow rate considered one of the most important physiological parameters influencing oral health, as it directly affects the cleansing ability of the oral cavity, the buffering of acids, and the distribution of antimicrobial components [18].

The results show that the mean salivary flow rate in healthy individuals was 0.45 ml/min with a standard deviation of 0.08. This value falls within the normal physiological range reported in the literature for unstimulated whole saliva, which typically ranges from 0.3 to 0.5 ml/min. Adequate salivary flow is essential for maintaining oral homeostasis because it helps remove food debris, neutralize acids, and inhibit microbial colonization. The relatively higher flow rate observed in the healthy group indicates a well-functioning salivary gland system and an optimal oral environment.

In contrast, individuals with dental caries demonstrated a reduced mean salivary flow rate of 0.32 ml/min. This decrease suggests a potential relationship between reduced saliva production and the development of carious lesions. Saliva plays a protective role in preventing dental caries by washing away fermentable carbohydrates and neutralizing acids produced by cariogenic bacteria such as Streptococcus mutans and Lactobacillus species. When salivary flow decreases, these protective mechanisms become less effective, allowing acids to accumulate on the tooth surface and promote enamel demineralization.

Similarly, patients with periodontal disease exhibited an even lower mean salivary flow rate of 0.30 ml/min. This finding suggests that reduced saliva production may also contribute to the development or progression of periodontal conditions. Periodontal disease is primarily caused by bacterial plaque accumulation and inflammatory responses in the supporting tissues of the teeth. Reduced salivary flow may facilitate the accumulation of microbial biofilm by decreasing the natural cleansing effect of saliva.

Another important aspect of these findings is the relatively small standard deviation within each group, indicating that the measured values were relatively consistent among participants. This consistency strengthens the reliability of the observed differences between groups and suggests that salivary flow rate may serve as a useful indicator of oral health status.

The results also highlight the importance of salivary gland function in disease prevention. Various factors can influence salivary flow rate, including dehydration, medications, systemic diseases such as diabetes, aging, and stress. Individuals experiencing chronic dry mouth, also known as xerostomia, are particularly vulnerable to oral health problems because reduced saliva compromises multiple protective mechanisms.

From a clinical perspective, measuring salivary flow rate could be an effective screening tool for identifying individuals at increased risk of oral diseases. Dental practitioners may use salivary flow tests to evaluate salivary gland function and implement preventive strategies such as saliva-stimulating agents, dietary modifications, or improved oral hygiene practices [19].

Overall, the findings presented in Table 1 reinforce the concept that adequate saliva production is essential for maintaining oral health. Reduced salivary flow is strongly associated with both dental caries and periodontal disease, highlighting the importance of saliva in regulating the oral environment and preventing microbial overgrowth.

Table 2. Salivary pH Levels among Study Groups

Group	Mean pH
Healthy	7.2
Dental Caries	6.5
Periodontal Disease	6.7

Table 2 presents the mean salivary pH levels observed among healthy individuals, patients with dental caries, and individuals diagnosed with periodontal disease. Salivary pH is an important indicator of the chemical environment within the oral cavity and plays a critical role in the processes of enamel demineralization and demineralization.

The results indicate that healthy individuals had an average salivary pH of 7.2, which is slightly alkaline and considered optimal for maintaining oral health. A near-neutral or slightly alkaline pH environment helps prevent the dissolution of tooth enamel and supports the natural demineralization process. Saliva contains buffering systems, primarily bicarbonate ions, that help maintain this stable pH balance by neutralizing acids produced by oral bacteria.

In contrast, individuals with dental caries exhibited a significantly lower mean salivary pH of 6.5. This more acidic environment is highly conducive to the development of carious lesions. When salivary pH drops below the critical threshold of approximately 5.5, enamel begins to lose minerals such as calcium and phosphate, leading to demineralization. Although the pH observed in this group was not extremely low, persistent mildly acidic conditions can still contribute to the gradual breakdown of enamel over time.

The reduced pH levels observed in individuals with dental caries attributed to increased bacterial metabolism within dental plaque. Cariogenic bacteria metabolize dietary carbohydrates and produce organic acids such as lactic acid. These acids accumulate on tooth surfaces and lower the pH of the surrounding environment. If saliva is unable to neutralize these acids effectively, prolonged acidic conditions can lead to the formation of cavities.

Patients with periodontal disease showed a mean salivary pH of 6.7, which is slightly higher than that observed in the caries group but still lower than the healthy group. Periodontal disease is associated with chronic inflammation and bacterial infection in the supporting tissues of the teeth. The inflammatory processes and metabolic activities of periodontal pathogens can alter the chemical composition of saliva, leading to moderate changes in pH levels.

Another factor influencing salivary pH is salivary flow rate. As shown in Table 1, both the caries and periodontal disease groups exhibited reduced salivary flow. Lower saliva production can reduce the buffering capacity of saliva, allowing acids to accumulate more easily. This interaction between salivary flow rate and pH highlights the complex relationship between different salivary parameters in maintaining oral health [20].

The data also emphasize the protective role of saliva in regulating oral acidity. In healthy individuals, the salivary buffering system rapidly neutralizes acids produced during food consumption. This buffering action helps restore normal pH levels within minutes after eating. However, when saliva production or buffering capacity is impaired, the oral environment may remain acidic for longer periods, increasing the risk of tooth damage.

Clinically, monitoring salivary pH may provide valuable information for assessing an individual's risk for dental diseases. Patients with consistently low salivary pH levels may benefit from preventive measures such as dietary counseling, fluoride therapy, or the use of saliva-stimulating products.

In summary, the findings presented in Table 2 demonstrate a clear relationship between salivary pH levels and oral health status. Healthy individuals maintain a near-neutral salivary pH, whereas individuals with dental caries and periodontal disease exhibit more acidic oral environments. These results underscore the importance of saliva's buffering capacity in protecting teeth and maintaining oral homeostasis.

Table 3. Levels of Salivary Immunoglobulin A

Group	Mean IgA (mg/dL)
Healthy	12.5
Dental Caries	9.8
Periodontal Disease	15.2

Table 3 presents the levels of salivary Immunoglobulin A (IgA) observed among healthy individuals, patients with dental caries, and patients with periodontal disease. Immunoglobulin A is one of the most important components of the mucosal immune system and plays a critical role in protecting oral tissues against microbial invasion [21].

The results indicate that healthy individuals exhibited an average IgA level of 12.5 mg/dL. This level reflects a balanced immune response within the oral cavity. In healthy conditions, IgA functions as a first line of defense by preventing the attachment of bacteria to oral surfaces and neutralizing toxins produced by microorganisms.

Individuals with dental caries showed a lower average IgA level of 9.8 mg/dL. This reduction may indicate a weakened mucosal immune defense against cariogenic bacteria. Lower IgA levels may reduce the ability of saliva to inhibit bacterial adhesion to tooth surfaces, thereby facilitating the colonization of harmful microorganisms such as Streptococcus mutans [22].

On the other hand, patients with periodontal disease demonstrated a significantly higher average IgA level of 15.2 mg/dL. This increase may reflect an intensified immune response to chronic bacterial infection in periodontal tissues. Periodontal pathogens stimulate the immune system, leading to increased production of antibodies including IgA.

While increased IgA levels may indicate an active immune response, they do not necessarily imply effective protection. In chronic inflammatory diseases such as periodontitis, persistent immune activation can contribute to tissue destruction. Therefore, elevated IgA levels may represent both a defensive reaction and an indicator of ongoing inflammation.

These findings suggest that salivary IgA levels can serve as a useful biomarker for assessing oral immune status. Changes in IgA concentration may reflect variations in microbial exposure, immune activity, and disease progression within the oral cavity.

Overall, the results highlight the complex relationship between immune defense mechanisms and oral diseases. Monitoring salivary IgA levels may help clinicians evaluate susceptibility to infections and assess the severity of periodontal inflammation [23-25].

Table 4. Presence of Inflammatory Biomarkers

Biomarker	Healthy	Disease
IL-6	Low	High
TNF-α	Low	Moderate

Table 4 presents the distribution of inflammatory biomarkers, specifically interleukin-6 (IL-6) and tumor necrosis factor-alpha (TNF-α), in healthy individuals and patients with oral diseases.

The results show that both IL-6 and TNF-α were present at low levels in healthy individuals but were significantly elevated in individuals with oral diseases. These cytokines are key mediators of inflammation and play an important role in the body's immune response to infection and tissue injury.

Elevated IL-6 levels are commonly associated with periodontal inflammation. This cytokine stimulates immune cell activity and contributes to the breakdown of connective tissue and bone surrounding the teeth. High IL-6 levels therefore indicate active inflammatory processes in periodontal tissues [26].

Similarly, TNF-α is a potent inflammatory mediator involved in immune regulation and tissue destruction. Increased TNF-α levels in saliva may reflect the presence of bacterial infection and inflammatory responses within the oral cavity.

The detection of these cytokines in saliva highlights the potential of saliva as a diagnostic medium for inflammatory conditions. Because saliva collection is non-invasive, monitoring inflammatory biomarkers could provide a convenient method for evaluating disease activity and treatment outcomes.

Overall, the results demonstrate that salivary cytokines can serve as valuable indicators of oral inflammatory diseases.

Table 5. Salivary Biomarkers Associated with Oral Cancer

Biomarker	Diagnostic Significance
IL-8	Early detection marker
MMP-9	Tissue destruction indicator
CD44	Tumor progression marker

Table 5 identifies several salivary biomarkers associated with oral cancer, including IL-8, MMP-9, and CD44. These molecules have been widely studied as potential indicators of tumor development and progression.

Interleukin-8 (IL-8) is a pro-inflammatory cytokine that plays a role in tumor growth, angiogenesis, and metastasis. Elevated levels of IL-8 in saliva have detected in patients with oral squamous cell carcinoma. This biomarker may therefore serve as an early indicator of malignant transformation in oral tissues [27-29].

Matrix metalloproteinase-9 (MMP-9) is an enzyme involved in the degradation of extracellular matrix components. Increased MMP-9 activity is associated with tumor invasion and tissue destruction. Detecting elevated levels of MMP-9 in saliva may help identify individuals at risk of developing aggressive oral cancers. CD44 is a cell surface glycoprotein involved in cell adhesion and migration. Overexpression of CD44 observed in several types of cancer, including oral cancer. Salivary detection of CD44 may therefore provide valuable information regarding tumor progression and metastatic potential. The presence of these biomarkers in saliva demonstrates the growing potential of salivary diagnostics in oncology. Early detection of oral cancer significantly improves treatment outcomes, and saliva-based screening could offer a practical approach for identifying high-risk individuals. Overall, the biomarkers presented in Table 5 highlight the promising role of saliva in non-invasive cancer diagnostics and reinforce the importance of continued research in this field [30].

Discussion

The findings of this study highlight the significant role of saliva in maintaining oral health and its growing importance as a diagnostic tool. The analysis of salivary flow rate, pH, and biomarker levels demonstrated clear differences between healthy individuals and those with oral diseases [31].

Reduced salivary flow rate observed in individuals with dental caries and periodontal disease supports previous research indicating that adequate saliva production is essential for oral protection. Saliva contributes to mechanical cleansing of the oral cavity, removal of food debris, and regulation of microbial growth. When salivary flow decreases, these protective mechanisms compromised, increasing the risk of disease development.

Similarly, variations in salivary pH observed in this study emphasize the importance of saliva's buffering capacity. Healthy individuals exhibited near-neutral pH levels, whereas individuals with dental caries showed more acidic conditions. Acidic environments promote enamel demineralization and facilitate the growth of acidogenic bacteria such as Streptococcus mutans.

The study also revealed differences in salivary immunoglobulin levels. Increased IgA levels in periodontal disease patients may reflect an immune response to bacterial infection. Immunoglobulin A plays a critical role in mucosal immunity by neutralizing pathogens and preventing bacterial adhesion to oral surfaces.

Inflammatory biomarkers such as interleukin-6 and tumor necrosis factor-alpha were elevated in individuals with oral diseases, indicating the presence of inflammatory processes within oral tissues. These biomarkers have been widely studied as indicators of periodontal disease activity and tissue destruction.

In addition, several salivary biomarkers identified as potential indicators of oral cancer. Molecules such as IL-8, MMP-9, and CD44 have been associated with tumor development and progression. The detection of these biomarkers in saliva suggests that salivary diagnostics used for early screening of oral malignancies [32].

The advantages of saliva-based diagnostics are numerous. Saliva collection is non-invasive, painless, and cost-effective, making it suitable for large-scale screening programs. Furthermore, salivary testing reduces the risk of infection transmission associated with blood sampling.

However, challenges remain in the clinical application of salivary diagnostics. Factors such as diet, circadian rhythm, medication use, and systemic health conditions can influence salivary composition. Therefore, standardized protocols for saliva collection and analysis are necessary to ensure reliable results.

Overall, the results of this study support the growing body of evidence that saliva is a valuable diagnostic fluid with significant potential in both dentistry and medicine [33].

Conclusion

Saliva is a vital biological fluid that plays a fundamental role in maintaining oral health and supporting numerous physiological processes within the oral cavity. Beyond its traditional functions in lubrication, digestion, and antimicrobial defense, saliva has emerged as a promising diagnostic medium for detecting both oral and systemic diseases.

The findings of this study demonstrate that variations in salivary characteristics such as flow rate, pH, and biochemical composition are closely associated with the development and progression of oral diseases. Reduced salivary flow and lower pH levels observed in individuals with dental caries and periodontal disease, highlighting the protective role of saliva in maintaining a balanced oral environment.

Furthermore, the presence of specific salivary biomarkers, including immunoglobulins and inflammatory mediators, provides valuable insights into the immune response and inflammatory processes occurring within the oral cavity. These biomarkers may serve as important indicators for the early detection and monitoring of oral diseases.

The identification of tumor-related biomarkers in saliva also suggests that salivary diagnostics may play a significant role in the early detection of oral cancer. Early diagnosis is critical for improving treatment outcomes and reducing mortality rates associated with oral malignancies.

One of the most significant advantages of salivary diagnostics is its non-invasive nature. Unlike blood tests, saliva collection does not require specialized equipment or trained medical personnel, making it accessible and convenient for both patients and healthcare providers. This feature makes saliva particularly suitable for large-scale public health screening programs.

Despite its many advantages, further research is required to improve the reliability and accuracy of salivary diagnostic techniques. Standardized methods for saliva collection, storage, and analysis are essential for ensuring consistent and reproducible results. Advances in molecular biology and bioanalytical technologies expected to enhance the sensitivity and specificity of salivary biomarker detection.

In conclusion, saliva represents a highly valuable biological fluid with significant potential in oral healthcare and disease diagnosis. Integrating salivary diagnostics into routine clinical practice could improve early detection, disease monitoring, and preventive strategies in dentistry and medicine.

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Conflicts of interest

The authors declare that they have no competing interests.

Disclosure Statement

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Authors' Contributions

All authors contributed to data analysis, drafting, and revising of the paper and agreed to be responsible for all the aspects of this work.

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