

# The Dry Mouth Epidemic – It's More than Medications, Aging and Degenerative Diseases

***This course is no longer offered for Continuing Education credit.***



**Course Author(s):** Anne N. Guignon, RDH, MPH, CSP  
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**Disclaimer:** Participants must always be aware of the hazards of using limited knowledge in integrating new techniques or procedures into their practice. Only sound evidence-based dentistry should be used in patient therapy.

## **Conflict of Interest Disclosure Statement**

- The author reports no conflicts of interest associated with this course.

## **Introduction – Dry Mouth**

Saliva is a critical component of oral health and has both protective and digestive functions. While overt signs and symptoms of oral dryness are relatively straight forward, there are also many covert signs, symptoms and risk factors for dry mouth. Dry mouth is a side effect of numerous over-the-counter and prescription medications, can be a symptom or sign of a systemic disorder or disease, a response to the physical climate, a manifestation of an emotional response, the result of a lifestyle choice or behavior, an indication of an airway obstruction or breathing disorder, or the result of damage to the salivary glands during radiation treatment to the head and neck area. Dry mouth issues are a direct and indirect result of numerous other factors. While elderly patients are at greater risk for developing a dry mouth condition, the problem is not limited to any specific age group. When evaluating a patient's total oral health, it is important to consider the whole patient, their lifestyle and values.

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## Overview

Saliva is a complex fluid that helps support overall oral health. Dry mouth syndrome is a modern-day epidemic that affects people of all ages and significantly increases the risk for caries, erosion, dentinal hypersensitivity, and candidiasis. Insufficient or poor-quality saliva is a symptom of many conditions and illnesses, medications, and aging. Salivary issues are also modified by lifestyle choices, dietary intake, respiratory issues, and climate.

Dry mouth syndrome includes feeling dry (xerostomia), a condition that is not necessarily the same as being dry (hyposalivation). A strong scientific foundation in dry mouth syndrome prepares clinicians to take a more effective role in early diagnosis and preventing or minimizing the effects of this multifactorial condition.

## Learning Objectives

**Upon completion of this course, the dental professional should be able to:**

- Understand the difference between xerostomia and hyposalivation.
- Recognize clinical presentations and patient symptoms.

- Know the components and composition of healthy saliva.
- Adopt a plan to test salivary flow rates and oral pH levels.
- Learn the role dry mouth plays in caries, erosion, dentinal hypersensitivity, and candidiasis.
- Discover the risk factors for developing dry mouth syndrome.

## Introduction

In October 2016, the FDI World Dental Foundation, an umbrella organization of 200 dental associations from 130 countries, released a new definition of oral health. Traditional definitions defined oral health as the absence of disease. The new definition recognizes oral health as a significant part of overall health and well-being, that oral health is a dynamic process, does not occur in isolation and that an individual's values, perceptions and expectations impact oral health. The first part of the definition reads: *"Oral health is multifaceted and includes the ability to speak, smile, smell, taste, touch, chew, swallow and convey a range of emotions through facial expressions with confidence and without pain, discomfort and disease of the craniofacial complex."*<sup>1</sup>

Many aspects of this new definition are critical to the discussion of dry mouth syndrome. Today's dental professionals need a deep understanding of the multiple factors that cause dry mouth, the prevalence in various populations, salivary composition and flow rates and the impact of dry mouth on the quality of life.<sup>2</sup> Dry mouth plays a role in the development and progression of many debilitating oral health conditions including caries, erosion, periodontal disease, candidiasis, and dentinal hypersensitivity.<sup>2-5</sup> Clinicians should be well versed in methods to accurately diagnose dry mouth, ways to improve saliva quality, and strategies to increase flow rates.<sup>2,6-8</sup>

## Establishing Accurate Nomenclature

The terms dry mouth syndrome, hyposalivation, xerostomia and dry mouth are used interchangeably in the literature, a situation that creates confusion. Hyposalivation by definition is either decreased salivary flow or insufficient saliva. Hyposalivation can be observed and is measurable, but without a

baseline measurement for comparison, it is impossible to determine the magnitude of change over time. Xerostomia is a subjective perception of insufficient mouth moisture. Most who report having xerostomia have insufficient oral moisture, but changes in saliva composition can also lead to the feeling of a dry mouth even if salivary flow appears adequate. Dry mouth syndrome includes those with hyposalivation, as well as persons with adequate flow but dry mouth complaints.<sup>2,9</sup>

### Multiple Benefits from a Complex Fluid

Dry mouth issues impact daily life.<sup>10,11</sup> Healthy saliva, in sufficient quantities, contributes to mastication, verbal communication, digestion, comfortable respiration, and sexual activities. Activities such as speaking, singing and whistling are compromised when the mouth is dry. Adequate saliva helps people chew food, is necessary to taste food, combines with food particles to form a bolus that can be swallowed, keeps food from sticking to the teeth, and dilutes hot, cold and spicy foods. Salivary enzymes begin the initial phase of digestion by breaking down starch molecules into less complex fermentable carbohydrates.<sup>2,11</sup>

Saliva lubricates and supports mucosal integrity, has antimicrobial properties, aids in healing and cleansing, supports remineralization, buffers acids and helps stabilize oral pH levels, improves comfort levels of a partial or full denture, and helps to form a protective pellicle on tooth surfaces. Saliva contains digestive enzymes, acid-buffering compounds, proteins, mucins, and is a rich source of calcium and phosphate, minerals necessary for maintaining the ionic balance of the oral environment. A homeostatic environment is critical to maintain healthy dentition.<sup>2,12</sup>

### Who Suffers from Dry Mouth?

Dry mouth can be episodic, chronic or a permanent condition. It can be a symptom of performance anxiety, a side effect of a short dose of antihistamines, or a response to a long-term treatment like hemodialysis. While transient episodes are uncomfortable, most cases of dry mouth are chronic, characterized by complex, multifactorial etiologies. Long-standing dry mouth conditions increase the risk for oral

disease significantly by tipping the balance away from homeostasis.<sup>2</sup> While some health care professionals do not consider dry mouth to be a major problem, numerous studies report significant quality of life issues.<sup>3,10,13-23</sup> Both dentate nursing home residents and those with dentures experience high levels of low quality of life directly related to dry mouth issues, especially those with cognitive disorders.<sup>17,22,25,26</sup>

Due to complex etiologies, dry mouth can affect any age.<sup>14,20</sup> While only a small percentage of patients initially self-report symptoms of dry mouth, studies have shown that dry mouth affects roughly 30% of the population,<sup>16-19</sup> with the number nearly doubling for those over the age of 65. One study found 10% of subjects in their early thirties were affected by xerostomia.<sup>20</sup> Numerous studies demonstrated that women have higher rates of dry mouth than men<sup>14,16,19-22</sup> and those over the age of 50 years are more likely to experience xerostomia.<sup>2,4,14,16-19,21-23</sup>

Most people who suffer from dry mouth don't report oral dryness until there is a perceptible reduction in salivary flow, despite having a clinical diagnosis of hyposalivation.<sup>13,18,21,23</sup> Additionally, early stages of dry mouth syndrome may not be recognized during a visual inspection or identified when asking a patient if they have dry mouth issues.<sup>2,17,18,21,23,26</sup>

### Clinical Presentation and Reported Symptoms

Clinical inspection of the oral cavity can include one or more of these signs: red, glossy, parched mucosal tissue, cracking in the corners of the mouth, a reddish tongue with a fissured or pebbly surface, chapped or cracked lips, or thick, foamy, ropy saliva (Figures 1A and 1B). These are objective, i.e., measurable and quantifiable observations. The palate is the driest area in the oral cavity, followed by the upper and lower lips.<sup>2</sup> All signs and symptoms should be documented in the patient records via a written narrative and supported by extra-oral and intra-oral photographs.

A variety of symptoms can indicate ongoing or progressing dry mouth issues. Symptoms are



**Figure 1A. Drug-induced Dry Mouth.**

Image courtesy of Dr. Géza T. Terézhalmy.



**Figure 1B. Drug-induced Dry Mouth.**

Image courtesy of Dr. Géza T. Terézhalmy.

subjective but can be important indications of a disorder or disease or a lifestyle issue. It is common for patients to report multiple symptoms. Descriptions can be vague and are typically reported using non-medical descriptors.<sup>2,3</sup>

Classic symptoms vary by patient but include sore mucosa, a burning sensation in the mouth, complaints of stickiness, sore or dry throat, perceived reduction in saliva, hoarseness and halitosis. Patients often have trouble talking, chewing or swallowing, frequent thirst, or have

an increased need to drink liquids while eating, as well as between meals. Other symptoms which point to dry mouth include feeling dry during the day, poor quality sleep, frequent urination at night, waking up with a dry mouth, difficulty in wearing dentures and performing oral hygiene activities, and a burning sensation in oral soft tissues.<sup>2,4,5,16,27,28</sup>

Dry mouth can diminish or alter the sense of taste. Those with dry mouth can report sensitivity to salty, acidic, or spicy foods.<sup>27,28</sup> Dentinal hypersensitivity<sup>29,30</sup> or recurrent decay can also be a primary indicator, as well as the need to chew gum or suck on candy or lozenges throughout the day. Patients with dry eyes or ocular redness may also have dry mouth issues.<sup>19</sup>

### Saliva Basics – Source and Composition

Saliva's composition and fluid dynamics are complex. Healthy saliva is primarily water and accounts for 99% of overall salivary volume. The remaining 1% is a complex mix of proteins, enzymes, mucins and buffering compounds, making saliva one of Mother Nature's most sophisticated fluids.<sup>2,11</sup>

Ninety percent of whole saliva comes from three major glands. The parotid gland contributes 30% to the total volume, the submandibular glands account for 60%, and sublingual glands make up the remaining 5%. All three of these glands are located outside the mouth. Saliva is introduced into the oral cavity via a duct system specific to each gland. Minor salivary glands, responsible for the final 5% of salivary composition, are found throughout the mouth. Most of the minor salivary glands are located on the inside surface of the lower lip.<sup>2,11,31,32</sup>

Saliva has both serous and mucous components. Each gland supplies a different mix that contributes to overall oral wetness and comfort. The parotid gland is classified as serous, secreting mostly water and enzymes. The submandibular gland is considered seromucous. 90% of the flow is serous and 10% is mucous. The sublingual and minor salivary glands are mucous glands and deliver 80% of the daily mucins in the oral cavity.<sup>2,11,31,32</sup>



Salivary mucins add three critical properties: viscosity, elasticity and stickiness properties necessary to keep the saliva in continuous contact with oral structures. Mucins prevent the feeling of mouth dryness by lubricating and wetting all oral tissues.<sup>2,11,31,32</sup>

### Amino Acids and Proteins

Saliva contains hundreds of proteins and peptides (small chains of amino acids). Each of these amino acid aggregates create and support an ecological balance in healthy saliva. Many proteins have multiple activities and properties, and collectively their properties support important salivary functions. Proteins and amino acids contribute to the following salivary functions: antibacterial, antifungal, antiviral, tissue coating, wound healing, remineralization, digestion, lubrication, buffering and tasting. Mucins and lactoferrin are the only two proteins that are produced by all salivary glands. Mucins are a unique compound: 20% protein and 80% carbohydrate. Salivary protein composition does not remain static. It changes from infancy through adolescence and on into adulthood.<sup>2,31</sup>

Many salivary proteins contain a large amount of the amino acid proline, referred to as Proline Rich Proteins (PRP's). Proline rich proteins make up 70% of all salivary proteins and are responsible for the formation and function of the acquired enamel pellicle, the protein-rich barrier that functions as an initial enamel protector. A less abundant amino acid, arginine is found free in saliva and plays a significant role in modulating oral pH values.<sup>2,31</sup>

### Flow – Spontaneous, Resting, and Stimulated

There are three types of salivary flow rates: spontaneous, stimulated, and unstimulated, which is also referred to as the resting rate. All salivary glands contribute to the total volume of saliva. Each source plays a unique role in salivary production and composition. Minor salivary glands secrete a small volume of mucin-rich saliva continuously throughout the day and night. Unstimulated saliva is a mix of serous and mucous secretions coming primarily from the submandibular and minor salivary glands. The parotid gland produces the largest volume of stimulated saliva. Stimulated saliva accounts

for 80-90% of daily salivary production. The primary stimulants are chewing, anticipatory tongue and lip movements, smell and taste.<sup>2,31</sup>

### Testing Salivary Flow

Mounting evidence points to the importance of clinical assessment of oral dryness,<sup>33,34</sup> which is a significant predictor of salivary gland hypofunction.<sup>35</sup> While the total volume of saliva varies per individual, the average daily production ranges from 1 to 2 liters per day. The flow rate for normal, unstimulated saliva is 0.25 to 0.4 ml/minute. A resting flow rate between 0.1 and 0.25 ml/min is considered low and less than 0.1 is considered very low.<sup>31,32</sup>

A simple way to determine stimulated salivary flow rate, is to have a patient spit into a cup while chewing a piece of sterile wax for five minutes. Normal stimulated whole saliva flow is 1 to 3 ml per minute; 1 ml/min-0.7 ml/min is considered low. Rates below 0.7 ml/min are considered very low.<sup>31,32</sup>

Visual inspection of the mucosa inside the lips can also aid in detection of dry mouth. Retract the lower lip. Dry the surface with gauze. Within one minute there should be many tiny drops of saliva if there is enough flow from the minor salivary glands that are located just under the mucosal surface. Those with enough salivary flow will also have saliva pooling in the floor of the mouth.<sup>31,32</sup>

There is a saliva-testing examination tool that contains six different tests. Clinicians can evaluate salivary production, viscosity and pH of resting saliva, quantity and pH of stimulated saliva, and buffering capacity. This testing can provide initial baseline data and can be used to demonstrate salivary stability or quantify changes over time.

### pH and Buffering

Salivary pH is important, but highly variable due to several factors. A healthy resting saliva pH falls between 6.8 to 7.2. Saliva in this range favors homeostasis, creating an environment that supports remineralization, the suppression of pathogenic microbes, and favors the growth of non-pathogenic commensal oral microflora. Healthy saliva also contains sufficient levels

of bicarbonate ions, other proteins that can buffer acids, and sufficient levels of calcium and phosphorus.<sup>2,31,32,36</sup> Patients with low salivary flow rates typically exhibit a more acidic salivary pH.<sup>37</sup>

When salivary glands are stimulated, the quality of saliva improves, due to an increased concentration of protein, sodium, chloride, and bicarbonate. Bicarbonate concentration, also known as buffering capacity, can immediately neutralize oral acids.<sup>2,30,31,38,39</sup> Salivary proteins provide a secondary pathway for neutralizing plaque acids.<sup>2,31</sup> A number of microbes metabolize the amino acid arginine via the three-enzyme pathway known as the arginine deaminase system (ADS). The metabolic biproduct of the ADS is alkaline, which functions to neutralize oral acids, as well as create an environment that supports a healthy commensal microbial community.<sup>40</sup>

### Understanding Critical pH

Deminceralization does not occur or progress when the oral pH is maintained at or above what is known as the critical pH. The oral environment remains stable when the salivary pH remains above 6.5. Critical pH is a dynamic number dependent on salivary calcium and phosphate levels. When the pH drops below 5.5, and there are insufficient salivary concentrations of calcium and phosphorus to counteract the process, enamel begins losing valuable calcium and phosphorus ions on a microscopic level. As hard tooth structures are repeatedly exposed to lowered pH levels for protracted periods of time the risk for both caries and erosion increase.<sup>36</sup>

Enamel is the hardest substance in the body. Ninety-six percent of enamel is hydroxyapatite, an inorganic crystalline form of calcium phosphate. Water and organic material comprise the remaining 4%. When enamel is fortified with fluoride, hydroxyapatite becomes fluorapatite, which can withstand pH values as low as 4.5.<sup>36</sup>

Dentin is different than enamel and is 70% hydroxyapatite. The remaining 30% is organic material and water, with 90% as the protein, collagen. Dentin hydroxyapatite crystals are 30

times smaller than the enamel crystals, making dentin softer. The root surface is composed of dentin covered with a thin layer of cementum. The critical pH for root surfaces is higher than pH 6. This creates a significant challenge as more people keep their teeth throughout life. Over time, root exposure can occur as a direct result of periodontal disease, tooth misalignment, parafunctional habits, bruxism, or vigorous oral hygiene habits.<sup>36</sup>

### Increased Risk for Caries, Erosion, Hypersensitivity, and Candidiasis

Insufficient salivary flow decreases buffering capacity, leading to and sustaining an acidic environment.<sup>36</sup> A dry oral environment favors the proliferation of acidogenic cariogenic pathogens, such as *Streptococcus mutans* and *Lactobacillus spp.* Acidogenic microbes are responsible for the initial pH drop. In response to the acidic environment, aciduric microbes initially change their gene expression to tolerate lower pH levels. Once acclimated to the lower pH levels, aciduric microbes begin acid production that further supports continued low pH levels.<sup>41-46</sup>

*S. mutans* and *Lactobacillus spp.*, have long been associated with the caries process<sup>43,44</sup> and are relatively easy to identify and culture, but research has shown 10% of subjects with rampant caries do not have detectable levels of *S. mutans*.<sup>42,45,46</sup> *Candida albicans* is often present in plaque biofilms of children with early childhood caries.<sup>47,48</sup>

Root caries in elderly patients is associated with complex, polymicrobial communities that vary from subject to subject; however, *S. mutans*, *lactobacilli* and *Actinomyces* are typically present.<sup>49</sup> Dozens of acidogenic and aciduric microbes are now implicated in the caries process, with some organisms favoring specific tooth surfaces or primary or secondary dentition.<sup>45</sup>

*Candida albicans*, a common and aggressive fungal organism, favors a highly acidic environment.<sup>50</sup> Patients with dry mouth are at increased risk for oral candidiasis infections. *C. albicans* can be associated with periodontal disease.<sup>43,50</sup>

It is now possible to identify the presence of *Streptococcus mutans*, *Streptococcus sobrinus* and *Lactobacillus casei*, bacteria that are known to increase caries risk. The simple-to-administer test uses an oral rinse saliva sample that can be collected chairside. The same saliva sample can be used to determine the presence of a variety of *Candida* species.

Erosion is defined as the loss of hard tooth structure as a result of acid demineralization that does not involve bacterial activity. It is considered the leading cause of erosive tooth wear (ETW) and dentinal hypersensitivity (DH). Both ETW and DH are fueled by dietary factors and are exacerbated by dry mouth.<sup>30,36</sup>

Research has shown that patients with hypersensitivity have eight times more open dentinal tubules that are twice the mean diameter than those who do not have this problem.<sup>51</sup> The prevalence of dentinal hypersensitivity is rising in all age groups and is directly related to dry mouth syndrome and dietary behaviors. Decades ago, hypersensitivity was primarily a problem reported by adults, but young children are now showing signs of erosion.<sup>36,52</sup>

### Medical Conditions and Lifestyle

It often takes years to get an accurate diagnosis of hyposalivation or xerostomia.<sup>10</sup> Some health care providers consider dry mouth a vague symptom or a life inconvenience, but in direct contrast, those with dry mouth actually require more careful management by dental professionals, especially if the patient has cognitive issues.<sup>53</sup>

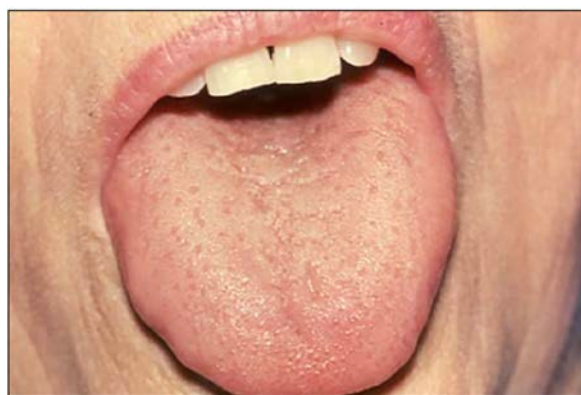
Dry mouth syndrome is now a well-recognized complication for a number of medical conditions including autoimmune disorders, radiation treatment to the head and neck area, salivary gland dysfunction, chronic renal failure, liver disorders, rheumatoid diseases, HIV/AIDS, Parkinson's disease, thyroid disease, and diabetes mellitus.<sup>2,5,8-10,12,31,36,54-60</sup> Hyposalivation is also an issue for those who experience hormonal imbalance, nasal blockage, sleep apnea, chronic obstructive pulmonary disease, gastric esophageal reflux disease and high fevers.<sup>2,31,62-64</sup>

Typically, there are natural decreases in salivary flow with age, especially in women.<sup>14,16,19-22</sup> Decreased estrogen levels, as a result of either natural or surgically induced menopause, can lead to decreased salivary flow. Dry mouth is common for those with late stage terminal illness and severe dry mouth often occurs within the last few weeks of life.<sup>65-68</sup>

Sjögren's Syndrome is the classic dry mouth disease, known as primary Sjögren's (Figure 2). Dry mouth is a frequent symptom for many autoimmune disorders often resulting in a diagnosis of secondary Sjögren's. Ninety percent of those diagnosed with Sjögren's are women. It is not uncommon for a patient to be diagnosed with multiple autoimmune disorders.<sup>2,5,10,19</sup> Autoimmune disorders tend to cluster in families; however, members of the same family may have different conditions.

Dry mouth is the most common side effect for both prescribed and over-the-counter medications, including herbal preparations and supplements.<sup>2,31,38</sup> A wide range of medications can mediate or potentiate dry mouth issues. Medications used to control or modulate hypertension, anxiety, depression, pain, seasonal allergies, asthma, appetite control, and nausea can each contribute to hyposalivation.<sup>69-75</sup> Medical marijuana also causes dry mouth.

Seniors are at the highest risk for dry mouth for two reasons. They are more likely to have one or more diseases that cause dry mouth, and this age cohort has higher rates



**Figure 2. Sjögren's Syndrome.**  
Image courtesy of Dr. Géza T. Terézshalmi.

of polypharmacy. It is estimated that those above the age of 60 take, on average, three medications daily, increasing the overall risk for dry mouth.<sup>2,31,38</sup>

### Lifestyle Issues

Contemporary lifestyles can add to the development of dry mouth syndrome.<sup>2,31</sup> Insufficient fluid intake or prolonged exposure to low levels of humidity in desert climates, cold winter air, or indoor air that is either artificially heated or cooled can set the stage for dehydration.<sup>76</sup> Headaches or dizziness can be signs of dehydration. Emotional conditions, such as stress and anxiety, can have negative effects on salivary flow.<sup>2,31</sup> Heavy exercise induces mouth breathing.<sup>77</sup> Pregnant women and nursing mothers should be advised to increase fluid intake. Patients with cognitive issues may forget to drink enough fluids and those who suffer from urinary tract incontinence may choose to limit fluid intake, especially before sleeping. Laxative abuse can lead to dehydration.

Cigarette smoking, vaping, and recreational drugs like methamphetamines and cannabis are known causes of dry mouth. Caffeine and alcoholic beverages are diuretics. Foods high in sodium, like salty snacks and highly processed foods, increase the potential for dry mouth. Most mouth rinses contain a significant amount of alcohol, a necessary ingredient to

keep therapeutic ingredients active, but alcohol can exacerbate oral dryness for those at risk.<sup>78</sup>

Oral appliances such as partial dentures, sports mouth guards, removable orthodontic aligners, bruxism appliances, and whitening trays create a physical barrier between teeth and saliva, creating a temporary dry environment. Moist mucosa is necessary for full denture comfort. Seemingly innocuous activities like strenuous exercise,<sup>77</sup> wearing a C Pap machine or prolonged speaking or singing can contribute to dry mouth.

### Conclusion

Today's dental professionals need a deep understanding of multiple factors that cause dry mouth, the prevalence in various populations, salivary composition and flow rates. Substantial scientific evidence demonstrates how dry mouth syndrome contributes to a multitude of dental disorders including caries, erosion, hypersensitivity, erosive tooth wear, and candida infections. A strong scientific foundation in dry mouth syndrome prepares clinicians to take a more effective role in early diagnosis of this complex, multifactorial syndrome, with the goal of preventing, minimizing, and reversing the effects of this modern-day condition. Dry mouth can be episodic or chronic and affects all age groups.



## Course Test Preview

***This course is no longer offered for Continuing Education credit.***

1. **The new global definition of oral health includes all but the following:**
  - A. Is a significant part of overall health and well-being.
  - B. Is a dynamic process that is not isolated.
  - C. Takes into account an individual's values, perceptions, and expectations.
  - D. All of the above.
2. **In understanding the epidemic of dry mouth syndrome, which concept is of limited value?**
  - A. Salivary flow and composition
  - B. Impact on a patient's quality of life
  - C. Prevalence in a population cohort
  - D. Each factor is a key to understanding dry mouth
3. **Dry mouth syndrome \_\_\_\_\_.**
  - A. is an annoying, but inconsequential issue
  - B. plays a role in caries, erosion, and dentinal hypersensitivity
  - C. does not contribute to dental disease
  - D. is rarely progressive, but typically is a more singular event
4. **Today's dental clinicians should be expected to do all but one of these actions:**
  - A. accurately diagnose dry mouth
  - B. suggest ways to improve saliva quality
  - C. wait for the patient to bring the subject up
  - D. understand strategies to increase salivary flow rates
5. **Which of the following about hyposalivation is incorrect?**
  - A. clinical diagnosis
  - B. measurable
  - C. the same as xerostomia
  - D. defined as decreased salivary flow or insufficient saliva
6. **Xerostomia \_\_\_\_\_.**
  - A. is a subjective perception of a having a dry mouth
  - B. can be due to changes in salivary composition
  - C. can be a patient perception, even in the presence of adequate moisture
  - D. All of the above.
7. **Which one of the following attributes of healthy saliva in sufficient quantities is correct?**
  - A. Enhances respiration
  - B. Makes it hard to talk
  - C. Causes gagging while eating
  - D. Makes it hard to swallow energy drinks
8. **Adequate saliva helps people taste food, chew, and swallow their food. Enzymes in saliva breakdown starch molecules in food.**
  - A. Both statements are true.
  - B. Both statements are false.
  - C. The first is true and the second is false.
  - D. The first is false and the second is true.

9. **The benefits of healthy saliva include all but one of the following:**
- A. Support remineralization via pH stabilization
  - B. Help form the protective pellicle on enamel
  - C. Retards healing and cleansing
  - D. Improves oral comfort levels
10. **Saliva contains the following:**
- A. Digestive enzymes
  - B. Acid-buffering compounds
  - C. Calcium and phosphate
  - D. All of the above.
11. **Most cases of dry mouth are chronic and have complex, multifactorial etiologies. Chronic dry mouth syndrome does not have a negative impact on quality of life.**
- A. Both statements are true.
  - B. Both statements are false.
  - C. The first is true and the second is false.
  - D. The first is false and the second is true.
12. **Which statement is false about dry mouth?**
- A. Only affects those over the age of 50 years old.
  - B. Affects at least 30% of the population.
  - C. Females have higher rates of dry mouth complaints than male.
  - D. Can affect children, adolescents, and young adults.
13. **A visual inspection always reveals early dry mouth issues. Patients may not report early stages of dry mouth syndrome.**
- A. Both statements are true.
  - B. Both statements are false.
  - C. The first is true and the second is false.
  - D. The first is false and the second is true.
14. **Clinical signs of dry mouth include the following. Which group is correct?**
- A. Red, glossy, parched mucosal tissue, fissured and/or red tongue
  - B. Chapped/cracked lips
  - C. Thick, ropy, foamy saliva
  - D. All of the above.
15. **Which of the following does not describe classic symptoms of dry mouth syndrome?**
- A. Burning sensation in the mucosa or tongue
  - B. Getting a restful sleep at night with no interruptions to urinate
  - C. Complaints of stickiness, hoarseness, halitosis., frequent thirst
  - D. Difficulty in talking, eating, chewing, swallowing
16. **Those with dry mouth may experience the following:**
- A. Altered sense of taste
  - B. Dentinal hypersensitivity
  - C. Need to chew gum or suck on candies/lozenges throughout the day
  - D. All of the above.

- 17. Which statement about saliva is false?**
- A. Contains proteins, enzymes, mucins, and buffering compounds.
  - B. Readily abundant to all patients.
  - C. Makes up 99% of overall salivary volume.
  - D. Is composed of 99% water.
- 18. Ninety percent of whole saliva comes from three major glands. Which is true?**
- A. Most minor salivary glands are found on the inside surface of the lower lip.
  - B. All major salivary glands are located in the mouth.
  - C. The parotid gland contributes 90% of salivary volume.
  - D. The sublingual and submandibular salivary gland produce 50% of whole saliva.
- 19. Which statement is true about saliva glands?**
- A. All salivary glands contribute equal amounts of water.
  - B. The parotid gland secretes mostly mucins and enzymes.
  - C. Minor salivary glands deliver 50% of the daily mucins.
  - D. Saliva from all glands contributes to oral wetness and comfort.
- 20. Mucins control salivary viscosity, elasticity, and keep saliva in contact with oral structures. The serous component of saliva lubricates oral tissues.**
- A. Both statements are true.
  - B. Both statements are false.
  - C. The first is true and the second is false.
  - D. The first is false and the second is true.
- 21. Which statement about salivary protein functions is false?**
- A. Antiviral, antifungal, antibacterial
  - B. Demineralization and wound exacerbation
  - C. Buffering acids and tasting food
  - D. Digestion and tissue coating
- 22. The following statement about salivary flow rates is true:**
- A. The parotid gland is the largest producer of saliva.
  - B. Stimulated saliva accounts for nearly all of the daily salivary production.
  - C. Salivary stimulation comes from chewing, smell, taste, lip and tongue movements.
  - D. All of the above.
- 23. Which of the following statements about salivary flow rate is/are not accurate?**
- A. The total volume of saliva is constant
  - B. Saliva pooling in the mandibular vestibule is not an indicator of flow.
  - C. It is difficult and time consuming to take a flow rate measurement.
  - D. All of the above.
- 24. Salivary pH is important. Which statement is true?**
- A. Resting healthy pH is 9.
  - B. A safe pH range suppresses pathogenic microbes.
  - C. Calcium is not found in healthy saliva.
  - D. Patients with low salivary flow rates do not have acidic saliva.

- 25. Hard tooth structures exposed to repeated low pH levels are not at risk for caries or erosion. The oral environment is never stable regardless of the pH level.**
- A. Both statements are true.
  - B. Both statements are false.
  - C. The first is true and the second is false.
  - D. The first is false and the second is true.
- 26. Which dentin property is false?**
- A. 70% hydroxyapatite and 30% organic material
  - B. Softer than enamel
  - C. Hydroxyapatite crystals that are 30% smaller than those in enamel
  - D. The same chemical composition as enamel
- 27. Erosion is common in those with dry mouth and is a leading cause of dentinal hypersensitivity. Which statement is true?**
- A. The prevalence of hypersensitivity is declining.
  - B. Erosion does not have a bacterial component.
  - C. Only adults suffer from hypersensitivity.
  - D. Erosion rarely occurs in those with dry mouth syndrome.
- 28. Dry mouth syndrome can be a symptom of a wide range of diseases and conditions which include:**
- A. Parkinson's disease, thyroid disease, and diabetes
  - B. Nasal blockage, sleep apnea, chronic obstructive pulmonary disease
  - C. Gastric esophageal reflux disease and high fevers
  - D. All of the above.
- 29. Those over the age of 60 take an average of three or more medications daily. Dry mouth is a rare side effect for both prescribed and over-the-counter medications including herbal preparations and supplements.**
- A. Both statements are true.
  - B. Both statements are false.
  - C. The first is true and the second is false.
  - D. The first is false and the second is true.
- 30. Which of the following lifestyle factors contributes to the risk for dry mouth syndrome?**
- A. Living in a desert climate, mouth breathing during exercise, emotional stress.
  - B. Eating salty or highly processed foods, not drinking enough water.
  - C. Tobacco or vaping, caffeine, alcohol consumption, recreational drugs.
  - D. All of the above.

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### Additional Resources

- No Additional Resources Available.

## About the Author

### Anne N. Guignon, RDH, MPH, CSP



Anne Nugent Guignon, MPH, RDH, CSP is a visionary thinker with a passion for improving the clinical environment and patient health. She began dental hygiene practice in 1971. She is an international speaker, prolific author, faculty member, and has received numerous accolades for mentoring, research, and guiding her profession including being honored as the 2009 ADHA Irene Newman Award and chosen as RDH readers' Most Effective Educator in 2016. She is an active member of ADHA and the National Speakers' Association.

Email: [anne@anneguignon.com](mailto:anne@anneguignon.com)