# Quality Resource Guide

Second Edition

# Managing Dental Patients with Xerostomia and Hyposalivation


## Author Acknowledgements

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## Educational Objectives

Following this unit of instruction, the learner should be able to:

1. Recognize the functions of saliva in maintaining oral health.
2. Recognize the prevalence and causes of xerostomia and hyposalivation.
3. Recognize the symptoms of xerostomia and signs of hyposalivation.
4. Understand techniques to manage symptoms of xerostomia and hyposalivation.
5. Prevent and treat the complications of hyposalivation.

MetLife designates this activity for **1.0 continuing education credits** for the review of this Quality Resource Guide and successful completion of the post test.

The following commentary highlights fundamental and commonly accepted practices on the subject matter. The information is intended as a general overview and is for educational purposes only. This information does not constitute legal advice, which can only be provided by an attorney.




Orginally published December 2022. Updated and revised October 2025. Expiration date: October 2028.


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## Introduction

This Quality Resource Guide provides readers with a summary of the current knowledge regarding xerostomia and hyposalivation. It contains "evidence-based" recommendations for the practitioner as determined from the latest research and clinical outcomes studies. Practitioners should be aware that xerostomia and hyposalivation have significant consequences on oral quality of life and that evidence continues to accumulate that supports current therapies' efficacy for managing these conditions. Over-the-counter (**OTC**) saliva substitutes and muscarinic agonists are the predominant agents available for the relief of the symptoms of dry mouth. Innovative gene therapies for producing saliva are being evaluated but are not yet available.

## Saliva

Saliva consists primarily of water that continuously irrigates, lubricates, and physically cleanses oral structures. It is essential to oral health. The flow of saliva clears food debris and its degradation products, including bacteria, from the surfaces of the teeth. Enzymes and water in saliva aid digestion, and several innate immune molecules in saliva help fight infection. Bicarbonates, phosphates and proteins in saliva serve as buffering agents against acids that are ingested or generated by bacterial fermentation of simple carbohydrates. Saliva's electrolytes, calcium and phosphate, help prevent the dissolution of enamel and promote remineralization. Consequently, loss of saliva and these critical constituents can lead to significant dental complications and reduced oral health-related quality of life.[1]

## Salivary Flow Rate and Hypofunction/Hyposalivation

At rest, unstimulated saliva is produced at a rate of about 0.3 to 0.4 mL/min as measured by sialometry (the method for measuring the amount of saliva collected within a specified time). Stimulated saliva (by chewing a piece of paraffin/gum) is produced at a rate of 1.0 to 2.0 mL/min. Hypofunction or hyposalivation is defined as the production of < 0.7 mL/min stimulated whole saliva flow or ≤ 0.1 mL/min of unstimulated whole saliva flow.[2] Hyposalivation is often accompanied by a change of taste, oral burning sensations, and xerostomia.

## Xerostomia

Xerostomia is the subjective, self-reported complaint of a "dry mouth." Xerostomia and hyposalivation are typically interrelated, such that when salivary flow is reduced by >50% dry mouth symptoms tend to appear. Hyposalivation, however, may be absent despite the complaint of xerostomia, and patients may complain of dryness irrespective of the amount of saliva in the mouth. This can occur because of low humidity, mouth breathing, sensory variability, and inconsistent patient descriptions of their symptoms. Saliva is a complex fluid composed of major and minor salivary glands secretions. These secretions differ in composition, particularly their water, salivary proteins, and mucin content, which may result in varying perceptions or sensations of "wetness" or "dryness."[3] Clinicians must know that patient symptoms or perceptions may not be reliable measures of xerostomia or salivary gland hypofunction. Thus, clinicians are encouraged to measure the salivary flow rate in patients who complain of xerostomia.

### Prevalence & Etiology

Xerostomia is an age-related symptom affecting about 10% of 30-year-olds and more than 25% of older adults.[4,5] Xerostomia is commonly associated with medical conditions, medication use, stressful conditions, and hyposalivation. There are numerous causes of hyposalivation that can produce symptoms of xerostomia. The etiologies of hyposalivation can variably affect the function of the major and minor salivary glands:

- *Use of xerogenic medications.* There are a large number of medications (over-the-counter [**OTC**] or prescription) that are xerogenic (**Table 1**). These medications reduce saliva flow from the major and minor salivary glands through their anticholinergic effects. The effect of xerogenic medications is compounded by polypharmacy used to treat common chronic conditions such as hypertension, cardiovascular disease, diabetes, chronic obstructive pulmonary disease, and urinary incontinence, particularly in the elderly patient. Multiple psychotropic drugs used for mood disorders, as well as opioid analgesics and other agents affecting muscarinic neurotransmission used for the management of chronic pain, may reduce salivary flow. Patients often have more than one concurrent medical condition or ailment for which they may take several prescriptions and OTC xerogenic medications. Reports indicate that among patients taking one to six or more medications, the odds of developing xerostomia increase from 1.4- to 4.6-fold, respectively.[6] Furthermore, many chronic medical conditions require continuous medication use, resulting in long-term exposure to the drug's xerogenic side effects.

In addition to xerogenic prescription medications, innumerable products are available OTC that have the potential to reduce salivary function. These include antihistamines, decongestants, and preparations for gastrointestinal ailments such as reflux. The therapeutic categories and examples of drugs that have been reported to cause xerostomia are summarized in **Table 1**.[7]

- *Mouth breathing* is unique in that it causes symptoms of a dry mouth, either in the presence of normal or abnormal salivary flow. Mouth breathing is often associated with restriction in nasal airway breathing due to congestion or anatomic abnormalities. Many people experience mouth breathing when lying down and while asleep. Mouth breathing is most detrimental to the oral cavity when persistent and can lead to prolonged drying of the oral mucosa, gingiva, and teeth.

- *Aging* impacts salivary gland function. Unstimulated and stimulated whole salivary flow decreases as we age,[8] however, parotid and minor gland salivary flow rates do not appear to be significantly reduced with increasing age.[9]

- *Dehydration* is known to be associated with decreased salivary gland flow rates.[10] The effect is age-independent; however, the elderly are known to have a lowered thirst response, drink less fluids, and have less water reserve, which, combined with polypharmacy, can result in xerostomia and significant hyposalivation.[11]

• *Viral infections* can cause a dry mouth. Dry mouth has been reported to occur during infection with Sars-CoV2 (Covid-19). Human immunodeficiency virus infection also damages salivary glands, leading to various manifestations, including HIV salivary gland disease (HIV-SGD) and significantly reduced salivary flow rates.[12]

• *Sjögren disease* is a chronic autoimmune disorder involving frequent/constant dryness of the eyes and mouth. It is caused by interferon-mediated inflammatory destruction of the exocrine glands. Sjögren disease is estimated to affect 0.5 to 1% of the population, more commonly in women than men (9:1). Symptoms generally develop after the age of 35 years, and up to half of those affected develop extra-glandular involvement of the joints, lungs, gastrointestinal tract, and kidneys. Secondary Sjögren disease occurs when a person has an autoimmune disease such as rheumatoid arthritis or lupus erythematosus and develops sicca syndrome (dry eyes and dry mouth). It is estimated that 30% of patients with systemic lupus erythematosus, 25% with systemic sclerosis, and 15% with rheumatoid arthritis become xerostomic due to the development of secondary Sjögren disease.[13]

• *Diabetes mellitus* is associated with hyposalivation and xerostomia due to poor hydration, frequent urination, increased blood sugar levels, increased blood osmolality, kidney dysfunction, and eventually renal failure and dialysis. The Centers for Disease Control and Prevention (CDC) estimate that 38 million people (11.6%) of the U.S. population have diabetes. The incidence of hyposalivation and xerostomia increases in persons whose diabetes is poorly controlled. Other diseases associated with salivary gland dysfunction and xerostomia are listed in **Table 2**.

## Table 1 - Therapeutic Categories of Prescription Drugs That May Reduce Saliva

| | |
|---|---|
| Alzheimer disease agents | Donepezil (Aricept®), Memantine (Nemenda®) |
| Anorexiants | Amfepramone (Tenuate®) |
| Antianxiety agents | Alprazolam (Xanax®), Buspirone (BuSpar®), Chlordiazepoxide (Librium®), Lorazepam (Ativan®) |
| Antispasmodic/anticholinergic agents | Benzatropine (Cogentin®), Tolterodine (Detrol®) |
| Anticonvulsants | Carbamazepine (Tegretol®), Gabapentin (Neurontin®) |
| Antidepressants | Fluoxetine (Prozac®), Trazodone (Desyrel®), Buproprion (Wellbutrin®) |
| Antiemetics | Dimenhydrinate (Dramamine®), Meclizine (Antivert®) |
| Antihistamines | Brompheniramine (Dimetane®), Loratadine (Claritin®) |
| Antihypertensives | Clonidine (Catapres®), Enalapril (Vasotec®) |
| Antiinflammatory analgesics | Ibuprofen (Advil®), Naproxen (Aleve®) |
| Antineoplastic agents | Busulfan (Myleran®), Interferon-a (Roferon®-A) |
| Antiparkinsonian agents | Carbidopa / Levodopa (Sinemet®) |
| Antipsychotics | Chlorpromazine (Thorazine®), Haloperidol (Haldol®), Prochlorperazine (Compazine®) |
| Bladder control | Oxybutynin (Ditropan XL®) · Tolterodine (Detrol®), Solifenacin (Vesicare®), Tamsulosin (Flomax®) |
| Bronchodilators | Ipratropium bromide (Atrovent®), Albuterol (Ventolin®) |
| Decongestants | Pseudoephedrine (Sudafed®), Fluticasone propionate/Salmeterol (Advair®) |
| Diuretics | Bumetanide (Bumex®), Chlorothiazide (Diuril®), Furosemide (Lasix®), Triamterene (Dyazide®) |
| Muscle relaxants | Cyclobenzaprine (Flexeril®), Orphenadrine (Norflex®) |
| Narcotic analgesics | Hydrocodone/acetaminophen (Norco®), Oxycodone/acetaminophen (Percocet®) |
| Sedative hypnotics | Diazepam (Valium®), Zolpidem (Ambien®) |
| Stimulants | Amphetamine (Adderall®, Methylphenidate (Ritalin®), Methyphenidate ER (Concerta®) |

## Table 2 - Diseases Associated with Xerostomia

**Alcoholism**

**Diabetes mellitus**

**Graft-versus-host disease**

**HIV infection or AIDS**

**Renal failure; renal dialysis**

**Sarcoidosis**

**Primary Sjögren Syndrome**

**Secondary Sjögren Syndrome**
in conjunction with:

- Rheumatoid arthritis
- Systemic lupus erythematosus
- Systemic sclerosis (scleroderma)
- Fibromyalgia
- Chronic fatigue syndrome
- Primary biliary cirrhosis
- Hepatitis C
- Autoimmune hepatitis

**Sleep apnea**

• *Radiation therapy,* used to combat cancers of the oral cavity and oropharynx, leads to cell death by damaging tumor cell DNA. Radiation is used when surgery alone is insufficient or contraindicated, or for radiosensitive cancers. Many head and neck cancers are treated with external beam radiation therapy delivered in daily fractions that total 55 - 70 grays (Gy) over 6 to 7 weeks. The effect on salivary glands is dose and location-dependent. External beam radiation above 25 Gy that encompasses or is in proximity to the parotid or submandibular salivary glands can permanently damage the glands and cause loss of saliva production. There are more than 30,000 new patients undergoing head and neck cancer radiation protocols annually. These patients typically develop xerostomia within two weeks of radiation therapy.[14]

Radioactive iodine ($131^{I}$) is used to treat thyroid cancer. Currently, about 44,000 new cases of thyroid cancer occur annually in the U.S., with women being diagnosed about 2.5 times more frequently than men. $131^{I}$ is administered orally in a single dose, generally when the risk of disease progression is high. Radioactive iodine has an affinity for accumulating in the major salivary glands (parotid > submandibular), targeting sodium/iodine symporters. Evidence suggests that a significant and persistent degree of salivary gland hypofunction can occur when the dose of $131^{I}$ exceeds 100 microcuries. Generally, salivary hypofunction is evident within four weeks of therapy, and significant progression of salivary gland dysfunction occurs within three years of a $131^{I}$ ablation.[15]

**Recognition**

Recognition of xerostomia begins by asking the patient, "*Do you experience a dry mouth?*" This is followed by a review of the medical history and their list of medications to determine potential associations. If the patient is experiencing a dry mouth, the clinician should consider administering a questionnaire that explores the symptoms a bit more. The Fox criteria[16] explores questions where the patient may indicate having at least one or more symptoms related to dry mouth. These questions include:

- Does your mouth usually feel dry?
- Does your mouth feel dry while eating a meal?
- Do you have difficulties swallowing (dry) foods?
- Is the amount of saliva in your mouth too little most of the time, or don't you notice it?

Patients may report the need to sip or drink liquids while eating and problems with speaking. Since less saliva is typically produced at night, awakening and experiencing a dry mouth may be another manifestation. Saliva also is required to mediate taste perception, thus insufficient saliva can lead to a loss or or altered taste. A perception of malodor (bad breath) is a frequent complaint of dry mouth patients.

Additional questionnaires that can be used to explore these complaints include the *Xerostomia Inventory*, which consists of 14 questions involving swallowing, eating, drinking, burning sensations, whether the eyes, lips or mouth feel dry or itch, and what provides relief. The *Xerostomia Inventory* uses five choices from "*Never*", "*Hardly Ever*", "*Occasionally*", "*Fairly Often*", to "*Very Often*" to determine the frequency of the complaint.

Alternatively, clinicians can use the *Summated Xerostomia Inventory* which consist of the following five questions:

- "My mouth feels dry when eating a meal"
- "My mouth feels dry"
- "I have difficulty in eating dry foods"
- "I have difficulties swallowing certain foods"
- "My lips feel dry"

The *Summated Xerostomia Inventory* is scored 1= *never*, 2 = *sometimes*, 3 = *often*, 4 = *always* for each question. A score of > 11 is highly specific for detecting salivary hypofunction.[17]

After the medical history and symptomatology are explored, the clinical examination should include assessing the size and shape of the major salivary glands, palpation of the glands, and milking of fluid from the salivary glands. An enlarged major salivary gland, saliva that appears "frothy", "thick", or "stringy" (**Figure 1**), or difficulty in eliciting secretions from the parotid or submandibular gland duct orifices is associated with Sjögren disease, blockage of a salivary gland, and hyposalivation.

Clinicians should be aware that salivary secretions from the submandibular, sublingual and minor salivary glands contain high levels of mucins that lubricate and contribute to the "moistness" of the oral mucous membranes.[2] As a result, hyposalivation may lead to various oral manifestations (**Table 3**). One common sign is erythema of the tongue, with loss of filiform papillae and increased fissuring (**Figure 1**). The oral mucous membranes may appear parched; rubbing a finger or mouth mirror over their surfaces may result in sticking rather than sliding over the tissues. Lack of saliva also contributes to the development of oral infections, including dental caries, candidiasis, and sialadenitis (see Complications). However, the onset of these features is typically insidious, and patients often demonstrate several of these features before they complain of xerostomia.

**Diagnosis**

The term xerostomia is the subjective complaint of a dry mouth by the patient; it is not a diagnosis. When the patient reports this complaint, the clinician should perform assessments to formulate a diagnosis consistent with the complaint. The clinician should carefully review the medical history

Figure 1

*This xerostomic patient exhibits an inflamed and fissured tongue with atrophy of the filiform papillae and frothy saliva. There is also angular cheilitis secondary to candidiasis. Courtesy of Dr. J. Guggenheimer*

to rule out medical conditions, medical treatments, and the use of xerogenic medications associated with a dry mouth (**Table 1**).

Questionnaires such as the Fox criteria, the Xerostomia Inventory, and the Summated Xerostomia Inventory-Short Form can help identify the diverse symptoms of xerostomia and its severity. After the patient discloses information regarding these questions, the clinician should perform a thorough examination to determine if extraoral or intraoral manifestations are consistent with dehydration or disturbances of salivary secretion.

The use of the Clinical Oral Dryness Score developed by Osailan and Challacombe, as shown below, is a clinical assessment checklist that can help determine the presence of oral dryness and its severity.[18]

1) mirror sticks to the buccal mucosa
2) mirror sticks to the tongue
3) frothy saliva
4) no saliva pooling on the floor of the mouth
5) tongue shows loss of papillae
6) altered/smooth gingival architecture
7) a glassy appearance of other oral mucosae, especially palate
8) tongue lobulated/fissured
9) active or recently restored (last six months) cervical caries (2 teeth)
10) debris on the palate (excluding under dentures).

The total score (*i.e.*, each feature scores 1 point) reflects an approximate severity scale of Oral Dryness' for the patient.

To establish the diagnosis of hyposalivation, clinical measures of unstimulated and stimulated salivary flow by sialometry are required. Hyposalivation is defined as <0.1 mL/min, which is determined by collecting unstimulated saliva during a specified time. A simple method involves asking the patient to swallow, then starting a timer and asking them to allow saliva to pool in their mouth and spit the saliva every 20 to 30 seconds into a small (3-ounce) disposable cup. After 5 minutes, the collected saliva is poured into a graduated cylinder or a 5 mL plastic syringe, and the total amount is measured. The total unstimulated flow rate (mL/min) is determined by dividing the total amount by five.

Stimulated salivary flow is measured similarly while the patient is chewing on paraffin wax or a piece of sugarless chewing gum or sucking on a lemon-flavored sugar-free lozenge. Alternatively, 2% citric acid can be painted or dropped onto the tongue every 30 seconds to stimulate whole saliva flow rates. The standard flow rate is 1.0 to 3.0 mL/min.

Salivary gland disturbance may be assessed by imaging techniques such as sialography, radionuclide scintigraphy, magnetic resonance sialography, computerized tomography, and ultrasonography. These specialized studies are notably time-consuming and costly. Clinicians should determine whether the results of these tests may be of additional value for the diagnosis or management of patients who complain of xerostomia or have definitive features of hyposalivation.

Additional testing is appropriate when one needs to rule out Sjögren disease. The diagnosis of Sjögren disease is made when the following criteria are met, and other causes of ocular or oral dryness have been excluded: 1) objective findings of ocular or oral dryness or glandular parenchymal damage, and 2) serologic and histopathologic evidence of autoimmune abnormalities (patient has anti-Ro/SSA antibodies with or without anti-La/SSB antibodies). The patient with Sjögren disease may or may not have bilateral enlargement of the major salivary glands, reduced tear production, the presence of other autoantibodies, a positive rheumatoid factor, or an elevated antinuclear antibody titer.

The following ICD-10-CM Diagnosis Codes are used for medical billing:

- **K11.7**: disturbance of saliva secretion
- **R68.2**: dry mouth, unspecified

## Table 3 - Manifestations of Xerostomia and Hyposalivation

**SYMPTOMS**

- Complaint of dry mouth during day or night
- Complaint of lack of moisture in the mouth
- Complaint of thick saliva
- Complaint of a rough, dry or sore tongue
- Complaint of change in taste or loss of taste
- Complaint of bad breath
- Difficulty with eating, swallowing or speaking
- Increased need to keep the mouth moist
- Sensations of burning, tingling or soreness

**SIGNS**

- Loss of lingual filiform papillae, fissured tongue
- Frothy, stringy saliva
- Difficulty in eliciting secretions from the parotid or submandibular gland duct orifices
- Erythema of the oral mucosa
- Accumulation of plaque
- Gingivitis, bleeding
- Evidence of candidiasis
- Cervical decalcification
- Cervical caries
- Crack and chapped lips

**Complications**

*Dental caries.* Loss of saliva, along with its caries-protective electrolytes, calcium and phosphate, buffering proteins, and antimicrobial enzymes, can increase susceptibility for the development of dental caries, which can be devastating and irreversible. This is compounded if patients initially resort to frequent use of sugar-containing candies, lozenges, or similar products to stimulate saliva and keep the mouth moist. The ingestion of fermentable carbohydrates creates an environment that

increases the cariogenic oral flora in conjunction with a reduced capacity to recalcify dental enamel. A person's preference for carbonated soft drinks, fruit juices, and sports drinks has an additive effect on caries susceptibility. Initially, areas of demineralization at the cervical areas develop that can progress (**Figures 2, 3**) and subsequently extend to the interproximal surfaces (**Figure 4**) and even involve the cusp tip (Class VI caries).

Hyposalivation following head and neck radiation therapy places patients at the most significant risk for developing a particularly aggressive form of "radiation caries" that has been reported to begin within weeks after initiation of radiation therapy.

Increased susceptibility to dental caries also places xerostomic patients at a greater risk for tooth loss. Dental implants are the preferred replacements over other types of fixed or removable prostheses. Studies of xerostomic patients have determined that lack of saliva does not adversely affect the integrity of dental implants, osseointegration or implant survival. Dental implants are successfully retained in patients with Sjögren disease and those practicing adequate oral hygiene who have had radiation therapy.[19]

*Gingivitis.* Decreased saliva results in increased supragingival dental plaque, leading to susceptibility to gingivitis, often accompanied by bleeding upon brushing or flossing. Persistent plaque retention can lead to gingival recession with exposure of the root surfaces. The large multicenter OraRad study, which prospectively examined over 500 participants receiving radiation therapy for head and neck cancer, found reductions in salivary flow correlated in a dose-dependent manner with an increase in gingival recession.[20] As a consequence, xerostomic patients appear to be more susceptible to gingival recession and root caries development (**Figure 3**).

*Candidiasis.* Colonization by the fungus Candida albicans is more likely to develop in xerostomic patients.[21] Extraorally, this can manifest as angular cheilitis (seen at the lip commissures in **Figure 1**).

Figure 2

*Cervical decalcification with progression to dental caries is shown in a xerostomic patient. Courtesy of Dr. J. Guggenheimer*

Figure 3

*An elderly patient has hyposalivation-related cervical caries involving multiple teeth. Courtesy of Dr. J. Guggenheimer*

Figure 4

*A radiograph of a xerostomic patient with advanced rampant cervical and interproximal caries - Courtesy of Dr. J. Guggenheimer*

Within the oral cavity, candidiasis appears as erythematous, inflamed mucosa. It also can appear as dense, raised white plaques with erythematous borders. The hard and soft palate can be the first sites to be affected. The infection on the tongue may appear as a well-defined area of atrophy of the keratinized filiform papillae that is usually confined to the midline of the dorsal surface (median rhomboid glossitis (**Figure 1**).

Patients with low salivary flow are at increased risk of developing oral candidiasis if they smoke, wear dentures, have diabetes, or take antibiotics or medications with immunosuppressant properties such as corticosteroids. Inhalers for asthma or chronic obstructive pulmonary disease (COPD) not only contain bronchodilators that can cause dry mouth, but may be combined with a corticosteroid that increases the risk of developing candidiasis. Treatment of candidiasis is with topical antifungal agents.

*Dentures.* Hyposalivation is associated with a decreased performance of complete dentures and removable partial dentures.[22] Edentulous xerostomic patients also are at greater risk for developing candidal infections.

*Sialadenitis.* The elderly, chronically ill, and persons with hyposalivation due to radiation treatment or the use of xerogenic medications are at risk for acute bacterial infections of the salivary glands (sialadenitis). These at-risk persons often develop obstructions in the ducts of the parotid and submandibular glands. Features include pain, swelling, tenderness, redness and either no flow from the salivary gland duct or visible pus emanating from the duct orifice. Treatment is with broad-spectrum antibiotics, moist heat, and mucolytic agents.

*Sjögren disease.* Persons who have Sjögren disease are at increased risk for developing non-Hodgkin lymphoma. The dentist and physician should routinely monitor these patients for unexplained swellings in the major salivary glands, soft/hard palate, or Waldeyer's ring.

**Prevention & Treatment**

Ongoing dental care for patients with xerostomia must be provided with an emphasis on preventing dental caries, irrespective of the cause of xerostomia. The practitioner can provide guidance and monitor the patient, but patients must comply with and adhere to a meticulous oral hygiene regimen. Hygiene can be augmented with a power toothbrush and other oral physiotherapy aids. It is essential that patients frequently apply fluoride-containing dentifrices augmented with OTC or higher concentrations of prescription fluoride mouth rinses, chewable tablets, or gel applications with custom tray carriers for the prevention of the initial demineralization process (**Figure 2**) (**Table 4**). Fluoride applications also enhance the remineralization of exposed root surfaces. Carious lesions can be restored with glass ionomer materials that provide ongoing fluoride release to the teeth.

Recall visits at shorter intervals should be encouraged to monitor compliance with home care, promptly identify areas of demineralization, and restore early carious lesions. Office visits should include prophylaxis and the application of fluoride varnish. Dietary counseling should reinforce avoiding foods and beverages that contain fermentable carbohydrates and "hidden sugars." The detriment of frequent sugar intake should be explained to the patient, and between-meal snacks discouraged.

The patients' physicians should be consulted to determine if their medication(s) can be substituted with alternate classes of drugs with less xerogenic side effects or if the dose can be reduced. Patients also should be educated about beneficial foods, weight loss, and exercise that could replace the need for medications. Alternatively, taking medication(s) in divided doses and not taking xerogenic medications before bedtime may provide additional benefit since saliva production is diurnal, with less secretion at night.

Protocols for dry mouth generally include informing the patient to drink 6 to 8 glasses (8 ounces) of water daily and frequently sip dissolved ice chips, use of emollients (coconut oil), and a humidifier in the bedroom. Frozen water can provide additional benefits. Small ice cubes containing a drop of lemon flavoring cool and moisten the mouth and stimulate salivary flow. Patients should be advised to avoid caffeine, tobacco, and alcohol, which are dehydrating and avoid certain dentifrices that contain sodium lauryl sulfate, which removes the protective mucin layer of the oral mucosa. Alcohol-free mouthwash products are advised.

Patients are encouraged to use citrus-flavored sugarless gum/mints/candies. Sugar-free chewing gum (*i.e., Migthteaflow* gum and lozenges) can be used to stimulate salivary flow. However, this is only be effective if the patient has residual and functional salivary gland tissue with some natural salivary flow.

Many OTC products are available as oral solutions, aerosols, sprays, gels, lozenges or troches to alleviate the discomfort associated with xerostomia (**Table 5**). They are formulated to function as saliva substitutes and replicate some of the constituents in natural saliva. These moistening agents may have a limited duration of action and require frequent re-administration; thus, the cost can be a consideration. The relative effectiveness of these products is patient and use-dependent and generally is best when combined with additional aspects of a dry mouth protocol.

Two pharmacologic agents, pilocarpine and cevimeline (**Table 5**), can stimulate salivary secretion provided the patient has residual and functional glandular tissue. Since these drugs require systemic administration to stimulate the cholinergic receptors of the salivary glands, they can cause side effects such as flushing, sweating, rhinitis, abdominal cramping, nausea, vomiting, and increased frequency of urination. It is advisable to consult with the patient's physician before prescribing these drugs because of potentially medically significant systemic effects, including dizziness and blurred vision. Furthermore, they are contraindicated in patients with narrow-angle glaucoma, obstructive urinary or gall bladder disease, or a history of cardiovascular disease, particularly cardiac arrhythmias.

Saliva electrostimulation devices are available OTC for extraoral or intraoral use. One intraoral device (Salipen®) designed to stimulate the lingual nerve effectively increased salivary flow and reduced xerostomic symptoms among patients with Sjögren disease and other causes of xerostomia. A similar device, by prescription, can be embedded in a prosthesis, but both types can only be effective if the patient has residual salivary gland function.

## Table 4 - Fluroide Products for the Prevention and Control of Dental Caries

**Over-the-Counter Fluoride Supplements**

- ACT® mouth rinse
- ACT® Anticavity Zero Alcohol Fluoride Mouthwash
- Fluorigard® alcohol-free mouth rinse
- Gel-Kam® fluoride gel to be brushed on teeth
- Karidium® chewable tablet
- Luride® chewable tablet
- Sensodyne Pronamel® Intensive Enamel Repair Mouthwash
- Thera-Flur® drops
- Xerostom® Anticavity Mouthwash

**Prescription Only Fluorides**

- Fluororinse®
- Fluoritab® drops
- Karidium®
- Karigel®
- PreviDent® 5000

Fluoride gels can be used with custom trays to be worn overnight for patients who have developed hyposalivation secondary to radiation therapy.

Complications such as dental caries and candidiasis are best managed by prevention. If dental caries develop, patients are optimally served if restorations are completed early in the course of the infection and accompanied by a thorough explanation of the importance of saliva, a low sugar diet, and the daily use of fluoride. Candidiasis is managed with antifungal agents listed in **Table 5**. These should be used daily for at least two weeks for the infection to resolve. If tolerated, alcohol-free chlorhexidine gluconate-containing mouthwash (Peridex®) can prevent recurrent infections in more susceptible patients. Keeping the mouth moist and using any of the agents listed in **Table 5** may also reduce the risk of reinfection.

The future holds much promise for patients who have hyposalivation. A clinical trial using viral vector delivery of an aquaporin gene is underway for patients with radiation-induced dry mouth. *Aquaporin* is a transmembrane channel protein that helps water diffuse across cell membranes.

## Table 5 - Products and Preventive Strategies for Xerostomic Patients

### Alcohol-free mouth rinses

- Biotene Dry Mouth Oral Rinse®
- Biotene Dry Mouth Gentle Oral Rinse®
- Crest Pro-Health Advanced Multi-Protection Alcohol Free Mouthwash®
- Listerine Total Care Zero Anticavity Mouthwash®

### Artificial Saliva/Moisturizing Saliva Substitute Sprays/Gels

- Allday® Dry Mouth Gel
- Biotene Oral Balance® Moisturizing Products
- Biotene Dry Mouth Moisturizing® Spray
- Biotene Dry Mouth Oral Balance Moisturizing® Gel
- GC Dry Mouth Gel
- Lubricity® Dry Mouth Oral Spray
- MEDActive® Oral Relief Spray For Dry Mouth
- Moi-Stir® Dry Mouth Relief Oral Spray
- Mouth Kote® Dry Mouth Spray
- NeutraSal®
- OraCoat XyliGel® For Dry Mouth and Lip
- Oralube® Saliva Substitute
- SalivaMAX® Supersaturated Calcium Phosphate Rinse – dissolve powder in water
- TheraBreath Dry Mouth® Oral Rinse
- Xerostom With Saliactive Gel For Dry Mouth

### Candidal Infections

- Nystatin (Mycostatin®) oral suspension
- Clotrimazole (Mycelex®) troches
- PerioGard®, Peridex® alcohol-free oral rinse

### Lozenges and Patches

- ACT Dry® Mouth Lozenges
- JellyDrops®
- MEDActive® Oral Relief Lozenges
- OraMoist® Dry Mouth Relief Patches
- Smart Mouth Dry Mouth Dual Action Mints
- TheraBreath Dry Mouth® Lozenges
- XyliMelts For Dry Mouth

### Salivary Stimulants

Prescription Pharmacologic Agents

- Pilocarpine (Salagen®)
- Cevimeline (Evoxac®)

Over-the-Counter Electrostimulation Devices (SaliPen®,Saliwell™)

### Xylitol-containing Lozenges

- ACT Dry Mouth Lozenges With Xylitol®
- MighTeaFlow Natural Dry Mouth Lozenge with Xylitol®
- Oracoat Xylimelts® Dry Mouth Stick-On Melts

### Xylitol-containing Candies/Mints/Tablets

- Dr. John's® Xylitol Healthy Sweets Tooth Shaped Fruit Lollipops
- Hager Dry Mouth Drops
- Ice Breakers® Sugar Free Mints
- PRO-SYSTM Xylitol Lollipops®
- Spry Xylitol Mints®
- XyliDENT Dry Mouth Moisturizing Tablets
- 3M ESPE TheraMints 100% Xylitol®

### Xylitol-containing Chewing Gums

- Epic Sugar-Free Xylitol Gum®
- Ice Breakers® Sugar Free Gum (Ice Cubes)
- Mighteaflow® Dry Mouth Gum with Xylitol
- PRO-SYS™ Chewing Gum
- Pür Gum Aspartame Free®
- Spry Xylitol Gum®
- XyliChew® Sugar Free Xylitol Gum

### Xylitol Sprays

- Allday 100% Xylitol Dry Mouth Spray®
- Biotene Dry Mouth Moisturizing Spray
- Spry Xylitol Moisturizing Mouth Spray®

## Conclusions

This Guide provides the practitioner with information to help identify the causes, diagnosis, and management of xerostomia and hyposalivation and their complications. It is evident that managing patients with xerostomia and hyposalivation is challenging, and therapies continue to be developed. Irrespective of its cause, xerostomia or hyposalivation have the potential to become a chronic condition that may be irreversible. Treatment should focus primarily on the causes so that oral complications can be prevented.

## Acknowledgement

The first five editions of this Guide, *Xerostomia Revisited*, were authored by Dr. James Guggenheimer, Professor, Oral Medicine and Pathology, Department of Diagnostic Sciences, University of Pittsburgh, School of Dental Medicine. Dr. Craig Miller reviewed and updated the subsequent current versions, *Managing Dental Patients with Xerostomia and Hyposalivation.*

## Additional Online Resources

- https://www.nidcr.nih.gov/health-info
    - Dry mouth
    - Saliva and Salivary Gland Disorders
    - Sjögren Disease
    - Taste Disorders
- Sjögren's Foundation: http://www.sjogrens.org
- https://oralcancerfoundation.org
- https://www.mayoclinic.org/diseases-conditions/dry-mouth/diagnosis-treatment/drc-20356052
- Oral Complications of Chemotherapy and Head/Neck Radiation (PDQ®)–Health Professional: https://www.cancer.gov/about-cancer/treatment/side-effects/mouth-throat/oral-complications-pdq

## Other Reading

- Clinician's Guide to Salivary Gland and Chemosensory Disorders. 2nd edition (2019) Brennan MT, Fox PC, eds. Available from the American Academy of Oral Medicine: https://www.aaom.com/clinicians-guides

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# POST-TEST

Internet Users: This page is intended to assist you in fast and accurate testing when completing the "Online Exam." We suggest reviewing the questions and then circling your answers on this page prior to completing the online exam.

(1.0 CE Credit Contact Hour) Please circle the correct answer. 70% equals passing grade.

**1. Xerostomia is:**
a. a symptom.
b. a sign.
c. a diagnosis.
d. a complaint associated directly with the amount of saliva in the mouth.

**2. Which of the following is TRUE?**
a. Xerostomia occurs in more than 25% of 60-year-olds.
b. Xerostomia is equivalent to hyposalivation.
c. The most common cause of xerostomia is Sjögren disease.
d. Treatment of xerostomia requires the production of more saliva.

**3. Features of a dry mouth include the following EXCEPT:**
a. A dental mirror sticks to the tongue or buccal mucosa.
b. Thick stringy saliva.
c. Loss of filiform papillae of the tongue.
d. Loss of gingival papillae.

**4. Which of the following is the LEAST viable option for managing patients with xerostomia and concurrent cardiac arrhythmia?**
a. Changing their medications.
b. Stimulating more saliva production.
c. Providing artificial substitutes for saliva.
d. Providing sources for consistent oral moisture.

**5. The most reliable method for determining if a patient has hyposalivation is to:**
a. administer the Fox questionnaire.
b. examine the oral mucosa.
c. perform sialometry.
d. determine the number of xerogenic medications being taken.

**6. At rest, unstimulated whole saliva is normally produced at a rate of:**
a. 0.1 to 0.2 mL/min.
b. 0.3 to 0.4 mL/min.
c. 0.5 to 0.6 mL/min.
d. 1.0 to 2.0 mL/min.

**7. The most reliable method for validating a patient's symptoms of xerostomia should be based on:**
a. Measuring the amount of saliva production.
b. The ability to elicit secretions from the salivary gland ducts.
c. Patient responses to a xerostomia questionnaire.
d. Positive laboratory tests for any of the diseases associated with xerostomia.

**8. Radiation caries have been reported to begin:**
a. when the salivary flow rate drops below 1.0 mL/min.
b. within weeks after initiation of head and neck radiation therapy.
c. on occlusal surfaces, then spreading apically.
d. after a single dose of radiative iodine therapy for thyroid cancer.

**9. Several specific and specialized laboratory studies are available to determine:**
a. which medications cause xerostomia.
b. which patients are more susceptible to dental caries.
c. which patients have developed Sjögren disease.
d. which patients have lost oral lubrication.

**10. Treatment of oral candidiasis is more effective when:**
a. there is "frothy" saliva.
b. when the patient swallows their medication.
c. antifungal treatment is administered for about five days.
d. antifungal treatment is administered for 14 days.

## Registration/Certification Information (Necessary for proper certification)

Name (Last, First, Middle Initial): _____

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Preferred Dentist Program ID Number: _____ ☐ Check Box If Not A PDP Member

AGD Mastership: ☐ Yes ☐ No

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## Evaluation - Managing Dental Patients with Xerostomia and Hyposalivation 2nd Edition

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