

Quality Resource Guide

The Role of Fluoride Therapy for Adults

Author Acknowledgements

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Educational Objectives

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

1. Understand the mode of action and the multifunctional role of fluoride in adult patients' oral health care.
2. Understand the caries preventive action of fluorides.
3. Understand the role of fluoride in the treatment of early (initial) caries lesions.
4. Identify different modalities of fluorides available for adult patients' oral health care.
5. Understand how and when to appropriately apply topical fluorides.
6. Be capable of educating patients on the appropriate application of self-applied topical fluorides.

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.

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Introduction

It is important to emphasize that middle-aged and older adults, once generally assumed to be at low risk of dental caries because they were well past the “caries-prone years,” in fact continue to experience new caries lesions at rates comparable to or greater than adolescents.^{1,2} Thus it is prudent to consider caries as a substantial disease among adults. While evidence suggests that these caries-active adults can be identified in dental practice, attention to intensified prevention in this population is not evident in dental practice. This is not surprising considering that the effectiveness of preventive methods in caries-active adults has not been established by quality investigations, and there are no specific guidelines for caries prevention for adults at moderate or high risk of developing caries. Thus, there is a need to identify effective preventive agents for caries-active adults that can be used by dental practitioners and their patients.

Both professionally applied and professionally recommended self-applied preventive regimens represent feasible approaches to reducing the burden of disease in the population.^{3,4} While fluorides are clearly a part of current practice, the extent of their use in caries-active adults can be questioned. Although dentists report anecdotally that they prescribe high-concentration fluoride dentifrices for their adult patients, the only evaluation of this behavior showed, even based on self-reports of prescribing behavior, such prescriptions were extremely infrequent.⁵ The relatively high cost and inconvenience associated with obtaining prescription medications may also mitigate against adoption and long-term use, especially in high-risk elderly individuals. Furthermore, benefits in many dental insurance plans do not include fluoride applications for adults, causing some to refuse the therapy.

This Quality Resource Guide describes the recommended use of fluoride by dental practitioners to reduce the incidence of coronal and root caries in caries-active adults.

Why Fluoride?

There is a large amount of clinical evidence supporting the potent caries preventive and remineralization effects of fluoride, which is based on its well-established ability to protect a tooth from demineralization, promote tooth remineralization, and interfere with bacterial growth and metabolism.⁶ The use of any topical fluoride agent, including fluoridated water, leads to fluoride deposition: on tooth mineral surfaces; within intercrystalline spaces; free or bound in dental biofilm; in saliva and; on oral soft tissues.

The application of any high fluoride concentration agent results in precipitation of calcium fluoride-like globules on the tooth surface providing a reservoir of fluoride ions. Fluoride is made available from these sites during acidic attack to potentiate improvement of apatite crystallinity that increases its resistance to acid attack, inhibition of tooth demineralization and promotion of tooth remineralization. Even a very low fluoride concentration (sub-ppm range) in solution can inhibit acid dissolution of tooth minerals.⁷ However, interference with demineralization and remineralization processes requires fluoride to be consistently present in the vicinity of these processes.⁸ This requirement can be ensured by replenishment of the fluoride in the oral environment by brushing at least twice daily with fluoridated toothpaste, drinking fluoridated water or by professionally applying fluoride products.⁹

Fluoride inhibits the metabolism and proliferation of oral microorganisms in dental plaque, however, this effect is pH and concentration dependent. While a low concentration of fluoride is effective at an acidic pH, effectiveness at neutral pH requires a much higher concentration. Interference with the demineralization and remineralization processes are regarded as the predominant ways by which fluoride exerts its caries prevention and reversal effects.

The mode of action of fluoride on dentin and root caries deserves special attention in the adult population. Due to the improvement in oral health care and dental awareness, most people are now

keeping their teeth to old age. However, many of these dentitions suffer from periodontal diseases that expose the roots (dentin) of the teeth. Dentin is more vulnerable to acid dissolution than enamel due to its composition and tubular structure, thus exposed root surfaces are considered a caries risk factor in adult patients. Besides its faster demineralization, dentin also remineralizes more slowly than enamel,¹⁰ and more concentrated fluoride is needed to inhibit demineralization and enhance remineralization in dentin. Root caries prevention and reversal/arrest in adults may require more consistent (daily) frequency of exposure to fluoride, and a combination of fluoride methods.¹¹

Choosing Fluoride Therapy for Adults in Dental Practice

In every treatment procedure in dentistry, establishment of the right protocols can guide the practitioner to a better treatment decision and selection of the right products as well as help to improve patients' oral health. For fluoride therapy in adults, a patient-centered, risk-based approach to caries management that prioritizes prevention, early detection and minimal intervention such as the approach described in the CariesCare Practice Guide would be a useful protocol.¹² This Guide, derived from the International Caries Classification and Management System (ICCMS),¹³ is a consensus guide recently developed by the CariesCare International (CCI™), a consensus meeting of cariologists from around the globe.¹² It steers the dentist through a four-step process (4D cycle system) leading to personalized interventions. This approach employs fluoride therapy to prevent new caries development and arrest/remineralize existing caries. However, this can only be successful by engaging the patient to maintain adequate plaque control, reduce the frequency of intake of simple dietary sugars, and comply with the use of any prescribed self-applied home-use fluoride.

An expanded discussion of caries management in adult patients may be found in the MetLife QRG – Zandona AF: Caries Risk Assessment and Management for Adults in a General Practice.¹⁴

Technologies Available When Using Fluoride Therapy for Adults

The selection of appropriate products for fluoride therapy should be based on the best available evidence and focusing on the caries risk status of the patient (**Figure 1**), but at the same time not neglecting the needs and abilities of the patient. Most fluoride materials available for caries management are tailored to perform the dual functions of caries prevention and remineralization. They are categorized into self-applied and professionally-applied therapies. Numerous fluoride therapies available today are discussed below in a way that is relevant to clinical practice. The level of evidence of effect is variable, as well as the availability in different parts of the world.

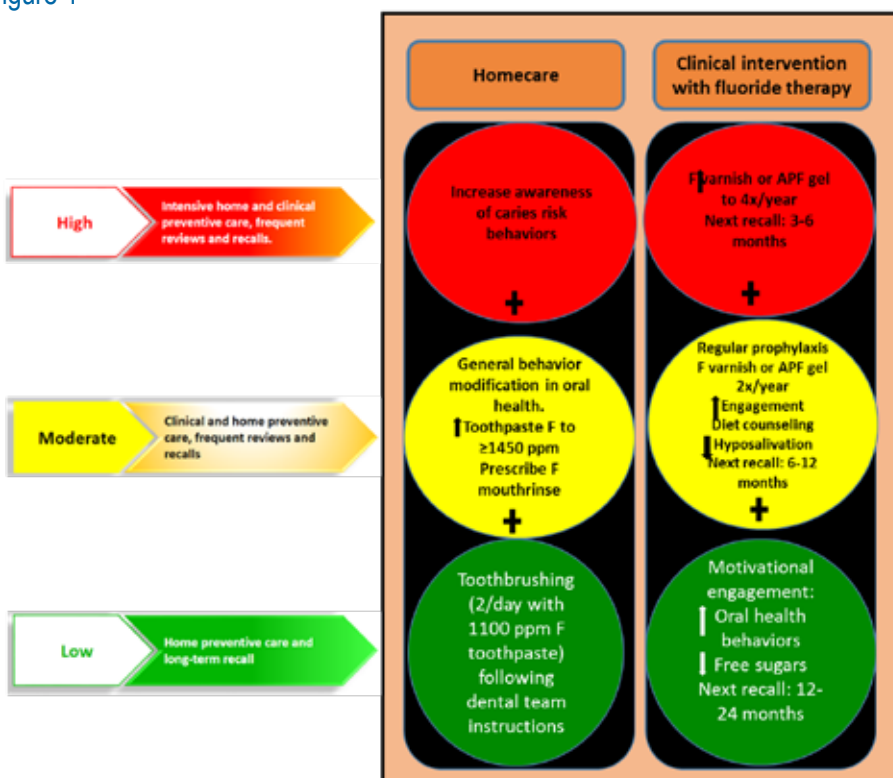
Topical fluorides (toothpastes, mouthrinses, gels and varnishes) have the highest level of supporting evidence and are confirmed to have similar effectiveness for preventing caries. Additional caries reduction is typically obtained when another topical fluoride is combined with fluoride toothpaste.¹⁵

Self-Applied (Home Care) Products

• Toothpastes

The recommendation of fluoride toothpaste should follow the consensus guideline shown in **Figure 1**. As stated in the previous section, fluoride must be consistently present to decrease demineralization and enhance remineralization processes. Fluoride toothpaste, if used as recommended, is most likely to be the best choice to achieve this consistent exposure. However, for F toothpaste to protect against caries in patients at moderate and high caries risk it needs to be used more frequently (at least twice daily) and at a higher (≥ 1450 ppm F) concentration (**Figure 1**).⁹ A review of multiple studies reported 24% caries prevention with F toothpastes, and this preventive effect increases with higher fluoride concentration and when toothpaste is combined with other topical fluoride applications such as F varnish (48%), gel (14%) or mouthrinse (7%).^{15,16} It may be prudent to recommend a prescription toothpaste

Figure 1



Risk-based preventive care. Fluoride therapy protocol in this figure was based on ADA Evidence-based Recommendations for Topical Fluoride application for preventing new caries lesions and CariesCare International recommendation for preventing new caries development and protecting arrested caries lesions.^{3,12}

containing 5,000 ppm or more for moderate and high caries risk patients for their routine daily use to prevent new caries formation,¹⁷ and to enhance the effectiveness of any remineralization therapy (F varnish, gel, infiltration, etc.) applied for control of existing active initial caries.⁴ Toothpaste containing 5000 ppm F is more effective in preventing and remineralizing root caries in elderly people than toothpaste containing either 1,100 ppm or 1450 ppm F.^{18,19} Although toothpastes contain fluoride in various chemical forms mainly as sodium fluoride (NaF), sodium monofluorophosphate (Na₂FPO₃), amine fluoride, stannous fluoride (SnF₂), zinc fluoride or combinations of these, a systematic review concluded that they were equally effective in preventing caries.^{15,20} However, amine, stannous and zinc ions have antimicrobial effects, and therefore effectively lower plaque formation and bacterial acid production.²¹

• Mouthrinses

Sodium fluoride mouthrinse comes in two common formulations; over-the-counter low fluoride (0.05% NaF; 226 ppm) rinse for daily applications and high fluoride (0.2% NaF; 900 ppm) rinse for weekly applications. Both regimens are equally effective and can reduce new caries development by approximately 30%.²²⁻²⁴ Either can be recommended depending on patient preference. Fluoride mouthrinses may be recommended for patients at moderate or high caries risk to complement their daily brushing with toothpaste and professionally-applied fluoride applications.^{3,4} Some mouthrinses are acidified because fluoride uptake by enamel is enhanced in an acidic environment (See discussion under Gels/Foams²⁵).

• Gels

Self-applied fluoride gels commonly come in formulations of 1.1% NaF (5000 ppm) or 0.4% stannous fluoride (1000 ppm). They are prescribed for patients at high caries risk, especially when more severe caries lesions are present. They are complementary to daily brushing with toothpaste and professionally-applied fluoride applications.^{26,27} A review of clinical trials reported an average of 21% caries reduction when daily toothpaste use is complemented with fluoride gels.^{16,21}

Professionally-Applied (In-Office Care) Products

• Fluoride Varnish

Most fluoride varnishes (FV) come in a formulation of 5% NaF (22,600 ppm fluoride) in a resin base that allows the varnish to adhere to tooth surfaces in the presence of saliva. The recommendation of FV should follow the consensus guideline shown in **Figures 1 and 2** and **Table 1**.^{3,4,28} FV should

be applied for patients at moderate (apply 2x/year) or high (apply 4x/year) caries risk to prevent new caries and remineralize/arrest initial caries.²⁹ Its effectiveness in reversing and arresting active enamel and root lesions, including proximal caries, has been reported in several clinical studies.^{3,4,29,30} These trials reported 46% (95% CI, 30% to 63%) caries reduction in permanent teeth.³⁰

• Fluoride Gels/Foams

The most common gel or foam for professional application is the acidulated phosphate fluoride (APF), a mixture of 0.1% orthophosphoric acid and 1.23% NaF buffered with phosphate ions. It is professionally applied with custom-made trays for four minutes, 2-4 times per year (or 4 times over 2-4 weeks for root caries). Similar to FV, its recommendation should follow the guideline shown in **Figures 1 and 2** and **Table 1**.^{3,4,28} and should be applied for patients at moderate (2x/year) or high (4x/years) caries risk for prevention of new caries and remineralization/

arrest of existing initial caries.^{3,4,28} A single application of APF gel plus the daily use of a dentifrice (1,100 ppm F) has been shown to inhibit enamel demineralization as effective as a highly fluoridated dentifrice (5,000 ppm F).³¹ The idea of acidulating gels, foams and mouthrinses is rising, and it is based on the fact that reducing the pH of the fluoridated vehicle enhance the uptake of mineral ions into the tooth tissue through mild etching that increases the enamel microporosity.²⁵ Thus the use of acidulated preparations either alone or in combination with other fluoride vehicles, such as FV, would greatly facilitate the caries prevention and reversal effectiveness of those vehicles.^{16,25,26} However, acidic topical fluoride preparations degrade glass-ionomer materials, porcelain crowns and veneers, and should be avoided in these cases, rather neutral 2% NaF gel or foam professionally-applied with custom-made trays should be used in such cases.³² Acidic formulations (APF) may not be well-tolerated in some elderly adults due to tooth sensitivity.

Table 1 - ADA Evidence-based Recommendations for topical Fluoride Application.³

Risk Group	Application Method	< 6 Years	6 - 18 Years	> 18 Years
Low	Professionally-Applied Fluoride products	May not receive additional benefit from topical fluoride.		
	Self-applied Prescription-Strength Fluoride products	May not receive additional benefit from topical fluoride.		
Moderate	Professionally-Applied Fluoride products	Varnish every 6 months	Fluoride gel (applied for 4 minutes) or Fluoride varnish every 6 months	
	Self-applied Prescription-Strength Fluoride products		0.09 percent fluoride mouthrinse at least weekly or 0.5 percent fluoride gel or paste twice daily	
High	Professionally-Applied Fluoride products	Varnish every 3 months	Fluoride gel (applied for 4 minutes) or Fluoride varnish every 3 months	
	Self-applied Prescription-Strength Fluoride products		0.09 percent fluoride mouthrinse at least weekly or 0.5 percent fluoride gel or paste twice daily	
Root Caries	Professionally-Applied Fluoride products		Fluoride gel (applied for 4 minutes) or Fluoride varnish every 3 months	
	Self-applied Prescription-Strength Fluoride products		0.09 percent fluoride mouthrinse at least weekly or 0.5 percent fluoride gel or paste twice daily	

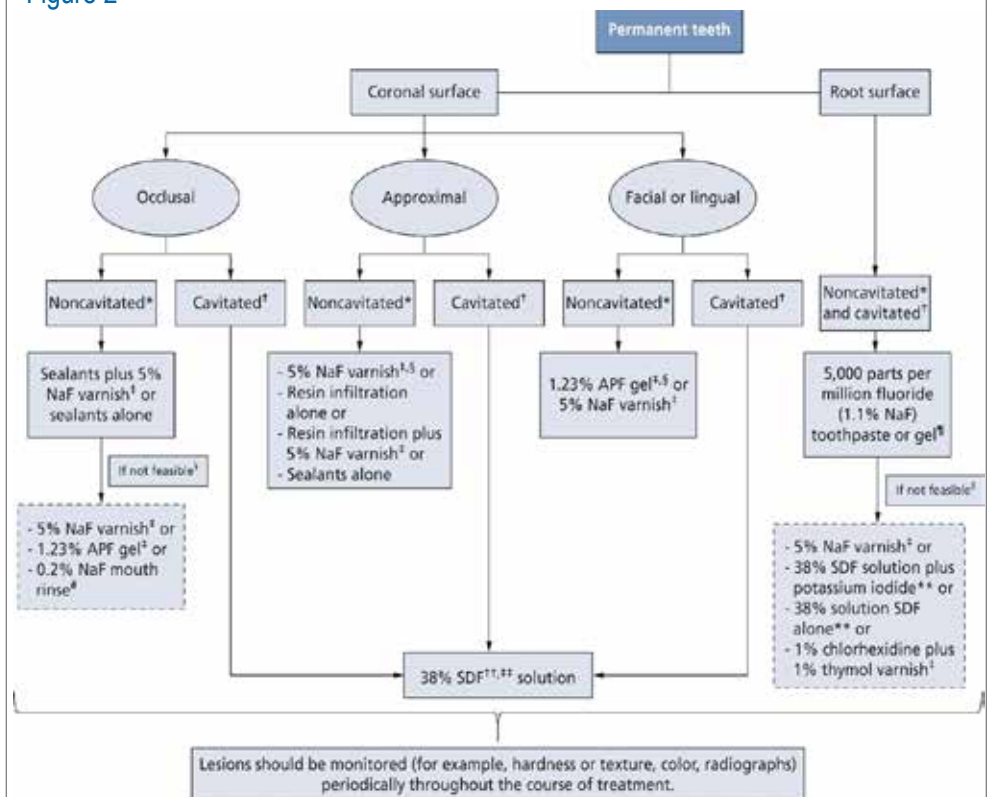
• Silver Diamine Fluoride

The commercially available 38% silver diamine fluoride (SDF) is composed of 25% silver that causes hardening of a carious lesion as well as serves an antimicrobial function and inhibits biofilm formation, 5% fluoride ions that promote remineralization and 8% ammonia that stabilizes high concentrations in solution.³³ The recommendation of SDF should follow the consensus guideline shown in **Figure 2**.²⁸ Studies in adults have shown 38% SDF (44,800 ppm fluoride) to be effective in arresting root caries³³ and coronal caries (including proximal caries lesions).³⁵ When used in cavitated lesions, without any excavation of soft dentin, the silver reacts with dentin protein and lays down a layer of silver protein that increases the hardness of the treated surfaces,^{34,35} rendering it more resistant to bacterial acids as well as less susceptible to biofilm formation due to its antimicrobial effect.³⁶ SDF can be used to arrest the progression of a cavitated caries lesion while waiting for definitive operative management. Annual applications of SDF arrested more active initial caries and reduced more new caries formation than three-monthly application of FV, although increasing the frequency of application to every six months can increase the caries arrest rate and is recommended for moderate and high-risk patients.³⁷ SDF has the drawback of black staining of the arrested lesion due to the reduction of silver ions to metallic silver and silver oxide.³⁷ Attempts have been made to mitigate this drawback by immediate application of potassium iodide solution following SDF application; however, randomized controlled clinical studies demonstrated that this method does not reduce the black staining of arrested caries in the long term (30 months of the study).³⁸ A study has also shown that the potassium iodide significantly reduces the bond strength of adhesives.³⁹ It is advisable to obtain the consent of the patient before using this fluoride vehicle, especially in the esthetic region of the dentition.

Conclusions

Based on available evidence and in line with the consensus guidelines for the use of fluoride therapy, twice daily (at least) use of fluoride toothpaste is adequate for caries prevention in patients with low caries risk status, while additional professionally-applied fluoride is needed for prevention of new caries and remineralization/arrest of existing initial caries in patients at moderate or high caries risk status.

Figure 2



Clinical pathway for the nonrestorative treatment of non-cavitated and cavitated carious lesions on permanent teeth. APF: Acidulated phosphate fluoride. NaF: Sodium fluoride. SDF: Silver diamine fluoride.

* Defined as ICDAS 1-2

† Defined as ICDAS 5-6

‡ Application every 3 to 6 months

§ The order of treatments included in this recommendation represents a ranking of priority defined by the panel when accounting for treatment effectiveness, feasibility, patients' values and preferences, and resource utilization. Considerations such as a particular patient's values and preferences, special needs, or insurance status should inform clinical decision making.

At-home use once per week

†† Biannual application

¶ At-home use at least once per day

** Annual application

‡‡ In keeping with the concept of informed consent, all nonsurgical and restorative treatment options and their potential side effects (such as blackened tooth surfaces treated with SDF) should be offered and explained to all patients.²⁸

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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. Choose the **INCORRECT** statement with regard to **Acidulated Phosphate Fluoride (APF)**:
 - a. Acidulation enhances fluoride diffusion into the tooth tissue by increasing the porosity of the tooth tissue through mild etching.
 - b. It is applied 4 times per year for patient at high caries risk status.
 - c. It is best left in contact with teeth for 4 minutes during application.
 - d. The acidity of APF makes it the best choice of treatment for patients with porcelain crowns.
 - e. The use of acidulated preparations in combination with fluoride varnish would greatly facilitate the caries prevention and reversal effectiveness of fluoride varnish.
2. Application of highly concentrated fluoride products prevents new caries development by deposition of globules of calcium fluoride for slow and continuous release of calcium and fluoride ions during acidic challenge.
 - a. True
 - b. False
3. Toothpastes containing amine, stannous or zinc ions have antimicrobial effects, and therefore effectively lower plaque formation and bacteria acid production.
 - a. True
 - b. False
4. Choose the **INCORRECT** statement with regard to root exposure in adults:
 - a. It can place the adult at a high risk for root caries .
 - b. Dentin demineralizes at a slower rate than enamel.
 - c. Dentin demineralizes at a faster rate than enamel.
 - d. Exposed dentin can be protected from future caries by the use of high fluoride concentration vehicle.
 - e. The most common cause is periodontal disease.
5. Root caries in an adult patient can be arrested using 38% Silver Diamine Fluoride applied every 6 months.
 - a. True
 - b. False
6. Choose the most appropriate correct response. 38% Silver Diamine Fluoride prevents progression of cavitated caries by:
 - a. reaction with dentin protein to lay down a layer of silver protein that is resistant to bacterial acids.
 - b. silver infiltration into the demineralized tooth tissue increasing hardness.
 - c. inhibition of biofilm formation due to the antimicrobial effect of silver ion.
 - d. All of the above
 - e. Only B and C
7. Fluoride mouthrinses should be recommended for patients at moderate or high caries risk as complementary to their daily brushing with toothpaste and professionally-applied fluoride applications.
 - a. True
 - b. False
8. With regards to clinical pathway for the nonrestorative treatment of noncavitated and cavitated carious lesions (Figure 2),
 - a. noncavitated caries lesions on coronal facial or lingual surfaces of a tooth can be treated with either 5% NaF fluoride varnish or 1.23% NaF APF gel.
 - b. cavitated caries lesions on the nonapproximal coronal surfaces of a tooth can be arrested with 38% Silver Diamine Fluoride pending definitive restorative treatment.
 - c. noncavitated caries lesions on coronal approximal surface of a tooth can be treated with 5% NaF fluoride varnish.
 - d. Only A and C are correct
 - e. A, B and C are correct
9. Fluoride must be consistently present in the vicinity of the demineralization and remineralization processes to be able to interfere with these processes, and F toothpaste is most likely to be the best choice for achieving this due to the frequency of use.
 - a. True
 - b. False
10. A whitespot (early caries) lesion located in plaque stagnation area and covered by a sticky/visible plaque is unlikely to be active, and as such should not receive fluoride therapy.
 - a. True
 - b. False

