Review of CDC Recommendations for Fluoride Use

By Caren M. Barnes, R.D.H. and Gwen L. Hlava, R.D.H.

INTRODUCTION

Dental caries is an infectious, multifactorial disease affecting the majority of the population. It has been well established that fluoride reduces the incidence of dental caries and slows or reverses the progression of existing lesions. Although pit and fissure sealants, meticulous oral hygiene, and appropriate dietary practices contribute to caries prevention and control, the most effective and widely-used approaches include the use of fluoride. Today, virtually all residents of the United States are exposed to fluoride to some degree and its widespread use has been a major factor in the dramatic decline, not only in the prevalence but in the severity of dental caries. Even though there has been a major decline in the incidence of dental caries, the disease is still pervasive in all age groups.

The ability of fluoride to inhibit or even reverse the initiation and progression of dental caries is well documented. The first use of fluoride in water for the purpose of caries prevention began in the mid 1940s in the United States and Canada, when fluoride was introduced into the drinking water supplying four communities. The U.S. Public Health Service (PHS) developed recommendations in the 1940s and 1950s regarding fluoride concentrations in public water supplies. At that time, public health officials projected that drinking water would be the major source of fluoride for most U.S. residents. The success of water fluoridation in preventing and controlling dental caries led to the development of fluoride-containing products including toothpastes, mouth rinses, dietary supplements, and professionally-applied or prescribed gels, foams and varnishes. United States residents now have a multitude of fluoride sources available compared to just 30 years ago. Much of the research on the efficacy of individual fluoride modalities in preventing and controlling dental caries was conducted before 1980. Modalities were usually tested individually (not in combination with other methods of delivery) with the assumption that the method being tested would provide the main source of fluoride. Thus, various modes of fluoride use have evolved, each with its own recommended concentration, frequency of use and dosage schedule. Currently, we do not have a set of comprehensive recommendations for caries prevention and control through the use of combinations of all the fluoride modalities available.

PURPOSE

The purpose of this paper is to present information released in the “CDC Recommendations for Using Fluoride to Prevent and Control Dental Caries in the United States” in 2001.

COMMUNITY WATER

During the 1940s, researchers determined that 1 ppm of fluoride was the optimal concentration in community drinking water for climates similar to Chicago. This concentration proved to substantially reduce the occurrence of dental caries. Water fluoridation for caries control began in 1945 and 1946, when the fluoride concentration was adjusted in the drinking water supplying four communities in the United States and Canada.

Today, only about half the population of the U.S. have access to fluoridated public water supplies. Current federal fluoridation guidelines, maintained by the Public Health Service since 1962, state that...
Studies have reported that the prevalence of root caries among adults is inversely related to fluoride concentration in the community drinking water.

Community drinking water should contain 0.7 - 1.2 ppm of fluoride, depending on the average maximum daily air temperature of the area. Temperature-related guidelines stated that a lower fluoride concentration was appropriate for communities in warmer climates because more tap water was consumed. However, social and environmental changes since 1962 such as the increased use of air conditioning and more sedentary lives have reduced the likelihood that people in warmer regions drink more tap water than people in cooler climates.

Initial studies of community water fluoridation demonstrated that reductions of approximately 50% - 60% in childhood dental caries could be attributed to fluoridation. More recent estimates have shown a lower (18% - 40%) reduction percentage. This recent decrease in attributable benefit is likely caused by the increasing use of fluoride from other sources, with the widespread use of fluoride toothpaste probably being among the most important.

Quantifying the benefits of water fluoridation among adults is more complicated because adults are rarely surveyed. Nevertheless, adults are also reported to receive caries preventive benefits from community water fluoridation. These benefits might be particularly advantageous for adults aged >50 years. Older adults typically experience gingival recession, leaving exposed root surfaces that are more susceptible to caries development. Tooth retention among the elderly has increased and the risk for caries will increase as the country’s population ages. Older adults also frequently require multiple medications that can reduce salivary output, directly influencing oral bacteria loads and potential for caries development. Studies have reported that the prevalence of root caries among adults is inversely related to fluoride concentration in the community drinking water. It is suggested that drinking water containing an optimal concentration of fluoride could reduce the risk factors for caries among older adults.

**BOTTLED WATER**

Many people drink bottled water, partially or completely replacing tap water as the source for their daily water requirement. Although some bottled water contains an optimal concentration of fluoride (approximately 1.0 ppm), most contain <0.3 ppm. For water bottled in the United States, current FDA regulations require that fluoride be listed in the contents on the label only if the bottler adds fluoride during processing. The concentration of fluoride is regulated, but it does not have to be stated on the label. Few bottled water brands have labels listing the fluoride concentration. This information would be helpful in assessing the total amount and type of fluoride being ingested.

**FLUORIDE TOOTHPASTE**

Fluoridated community drinking water and fluoride toothpaste are the most common sources of fluoride in the United States and are largely responsible for the declining risk for dental caries in this country. By the 1990s, fluoride-containing toothpastes accounted for >90% of the toothpaste market in the U.S. Because water fluoridation is not available everywhere, in many areas, toothpaste may be a very important source of fluoride. It should be noted that caries reduction among children using only fluoridated toothpaste is modest compared with the effect of water fluoridation. However, the combination of fluoridated water and fluoridated toothpaste offers a higher level of protection than either used alone.

Populations of children have typically been used for studies on caries prevention because of the perceived increase in caries susceptibility. In reality, teeth remain susceptible to caries throughout life and topically-applied fluoride could be effective in preventing caries in susceptible patients of any age.

Most people brush at least once per day. It is proposed that more frequent brushing can offer additional protection. However, no definitive data exists currently to prove that increasing the number of daily brushing from two to three results in a lower caries experience. It has been shown that the amount and vigor of rinsing after tooth brushing affects the fluoride concentration in the mouth which reportedly affects caries development. Persons aged >6 years can retain more fluoride in the mouth by either rinsing briefly with small volumes of water or using a very small amount of fluoride toothpaste.
amount of water or not at all. In the U.S., the standard concentration of fluoride in toothpaste is 1,000 - 1,100 ppm. In U.S. and European studies, toothpaste containing 1,500 ppm fluoride has been reported to be slightly more efficacious in reducing dental caries. Products with this fluoride concentration have begun to be marketed in the U.S., but they are not available in all areas.

Children who begin using fluoride toothpaste before the age of 2 years are at higher risk for enamel fluorosis than children who begin later or who do not use fluoride toothpaste at all. For children under two, parents should consult with their physician or dentist regarding the use of fluoridated toothpaste. Use of fluoridated toothpaste for children under 2 years old is generally contraindicated also because the child can swallow the toothpaste. Children aged < 6 years, should place no more than a pea-sized amount (0.25 mg) of toothpaste on the toothbrush. An adult should supervise children's brushing and encourage the child to spit out the excess toothpaste so as not to swallow it.

PROFESSIONALLY-APPLIED FLUORIDE COMPOUNDS

Dental professionals have been applying high-concentration fluoride compounds directly to patients’ teeth for approximately 50 years. It was originally believed that the fluoride would be incorporated into the crystalline structure of the enamel and develop a more acid-resistant enamel. To maximize this effect, an oral prophylaxis was considered mandatory before the application. Research now indicates that high-concentration fluoride compounds (gel, varnish) do not directly enter the enamel's crystalline structure. The compound forms a calcium fluoride-like material on the enamel's surface that releases fluoride for remineralization when the pH in the mouth drops. Therefore, professional tooth cleaning solely to prepare the teeth for application of a fluoride compound is unnecessary. Tooth brushing and flossing appear equally effective in improving the efficacy of high-concentration fluoride compounds.

FLUORIDE GEL AND FOAM

According to the CDC report, the four most beneficial modalities of fluoride applications include community water, topical application of gels / foams, fluoride varnishes and fluoride containing dentifrices. Fluoride rinses were reported as declining in usage. In recent clinical studies, semiannual, professionally-applied fluoride treatments (gel and foam) caused an average decrease of 26% in caries experience in the permanent teeth of children residing in non-fluoridated areas. The application time was four minutes. In clinical practice, applying fluoride gel for one minute rather than four minutes is common, but the efficacy of this shorter application time has not been tested in human clinical trials. The greatest uptake occurs within the first minute of application, however, the maximum benefit is achieved by a four-minute treatment.

The most important factor in professional fluoride treatment delivery is selecting the appropriate fluoride for the patient. Stannous fluoride is contraindicated for use on patients with porcelain restorations and implants. Stannous fluoride and APF have been shown to erode glass ionomers, compomers and composite resin restorations. Neutral sodium fluoride, therefore, is the only fluoride that can be given “generically,” that is, it does not have an interaction with titanium and does not cause staining or erosion of restorative materials. See Table 1 for fluoride compatibilities.

FLUORIDE VARNISH

High-concentration fluoride varnish is painted directly onto the teeth. It is not intended to adhere permanently. It is meant to hold high concentration fluoride in close contact with the teeth for several hours. Fluoride varnish has the following advantages:

1. Easy to apply
2. Great taste

Figure 2 — Fluoride gel or foam treatment.

Fluoride can cause staining of porcelain restorations and the acidity can cause an untoward chemical reaction with titanium implants. Acidulated phosphate fluoride is contraindicated on patients with hypersensitivity because it can cause severe erosion and can actually worsen the
3. Smaller amounts required

Available fluoride varnishes are:

1. 2.26% sodium fluoride
   2,600 ppm
2. 0.1% difluorsilane
   1,000 ppm

Fluoride varnish has been widely used in Canada and Europe since the 1970s to prevent caries.27 In the U.S., the FDA has released fluoride varnish as a medical device to be used as a cavity liner and root desensitizer.28 The FDA has not yet approved this product as an anti-caries agent. Caries prevention is a drug claim and appropriate research would be necessary before the product could be marketed as anticariogenic. However, dentists can use fluoride varnish for caries prevention based on their professional judgement.29

Studies in Canada30 and Europe31 have reported that fluoride varnish is efficacious in preventing dental caries in children. Applied semiannually, this modality is as effective as a professionally-applied fluoride gel.32 There is no published evidence indicating that professionally-applied fluoride varnish is a risk factor for enamel fluorosis, even among children aged < 6 years.

**FLUORIDE PROPHY PASTE**

Fluoride-containing prophy paste is routinely used during oral prophylaxis. The paste, which contains 4,000-20,000 ppm fluoride, might replenish the concentration of fluoride in the surface layer of enamel removed during polishing, but it is not an adequate substitute for fluoride gel or varnish in healing persons at high risk for dental caries.14 Fluoride prophy paste is not accepted by the FDA or ADA as an efficacious way to prevent dental caries.

**COMBINATIONS OF FLUORIDE MODALITIES**

Studies comparing various combinations of fluoride modalities have generally reported that their effectiveness in preventing dental caries is only partially additive. The percent reduction in the prevalence or severity of dental caries, from a combination of modalities, is higher than the percent reduction from each modality considered individually, but it is less than the sum of the percent reduction of the combined modalities. In other words, if the first modality reduces caries by 30% and the second modality reduces caries by 20% when tested individually, the assumption that caries will be reduced by a total of 50% is an overestimate and not accurate. A total of 35% - 40% may be more typical and realistic.

**CONCLUSION**

When used appropriately, fluoride is a safe and effective agent that can be used to prevent and control dental caries. Fluoride has contributed profoundly to the improved dental health of vast populations in the United States and

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<thead>
<tr>
<th>Fluoride Type</th>
<th>Stannous Acidulated Phosphate Neutral Sodium</th>
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<tbody>
<tr>
<td>Porcelain</td>
<td>Contraindicated</td>
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<tr>
<td>Composites</td>
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<td>Composers</td>
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<td>Implants</td>
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<td>Hypersensitivity</td>
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**Figure 3 — Application of fluoride varnish.**
Fluoride has contributed profoundly to the improved dental health of vast populations in the United States and other countries.

Figure 4 — Fluoride rinse.

other countries. Fluoride is needed regularly throughout life to protect teeth against tooth decay. To ensure continued gains in oral health, water fluoridation should be extended to additional communities, and the use of fluoride-containing toothpaste should be encouraged. Adoption of these, and other recommendations contained in the CDC report, could lead to considerable savings in public and private resources by substantially improving overall dental health.

References:
“The investigators concluded that glass ionomer restorations provided greater cariostatic effects than amalgam in patients at high risk to develop caries.”

Abstracts

Three Restorative Materials and Topical Fluoride Gels used in Xerostomic Patients. A Clinical Comparison.


INTRODUCTION

Dentists have reported in the past few years an increase in the number of patients who have xerostomia. It is well known that fluoride is widely used to prevent caries in these high-risk patients. However, there is little information regarding the prevention of caries and the clinical effects of using fluoride-releasing restorative materials in addition to topical fluoride and fluoride-releasing restorative materials in these high-risk patients.

PURPOSE

It was the purpose of this study to compare the clinical performance and recurrent caries associated with two fluoride-releasing glass ionomers and one non-fluoride releasing amalgam used for Class III and V restorations in patients with a low salivary rate who were also instructed to use a topical fluoride daily. The investigators hypothesized that no difference would be detected in the recurrent caries rates adjacent to fluoride-releasing and non-fluoride releasing materials in any of the subjects in the study.

MATERIALS AND METHODS

The investigators placed 111 restorations in nine patients classified as xerostomic, based on subjective symptoms and a resting salivary flow of less than 0.2 ml/minute. The fluoride-releasing materials used were Ketac-Fil Aplicap™ (3M ESPE), Vitremer Core Buildup/Restorative™ (3M ESPE) and the non-fluoride releasing material, Tytin™ (Kerr) amalgam. All restorations were evaluated at six months, one year and two years, using scoring that evaluated marginal adaptation, anatomical form, caries in adjacent tooth structures and caries at the cavosurface margin.

At the initiation of the study, patients were provided with instruction on oral hygiene and home care that included the daily application of fluoride gel (1.1% sodium fluoride, pH 7.0 PreviDent™ brush-on gel, Colgate Oral Pharmaceuticals) delivered via a custom-made tray or applicator brush. Subject compliance was assessed by having the subjects record the amount of fluoride gel used and by questioning the patient. At the completion of the study, subjects were divided into two groups: fluoride users (compliant at least 50% of the time) and fluoride nonusers (compliant less than 50% of the time.

RESULTS

The investigators evaluated 86% of the 111 restorations (95) at the 2-year recall appointment. Caries did not develop at the cavosurface margin of 85% on the Ketac Fil restorations, 88% of the Vitremer restorations or 56% of the Tytin restorations. All of the restorations with caries at the cavosurface margin developed in three of the subjects who were compliant less than 50% of the time with the fluoride. The cumulative findings for restorations with caries at the margins were as follows: 36% of the Ketac-Fil restorations, 27% of the Vitremer restorations and 68% of the Tytin restorations. None of the patients who complied with the fluoride instructions developed caries at the cavosurface margin of the restorations.

The analysis demonstrated a significant difference between materials regarding the development of caries at the cavosurface margin in patients who were less than 50% compliant with the daily use of fluoride. Subjects with the glass ionomer restorations had a significantly lower rate of caries at the cavosurface margin than did the subjects with the amalgam restorations (p< .05), which caused the investigators to reject their original hypothesis. Regarding marginal integrity and anatomical form, no statistically significant differences were found in the clinical success of the three restorative materials at the two-year recall appointment.

CONCLUSIONS

The investigators concluded that glass ionomer restorations provided greater cariostatic effects than amalgam in patients at high risk to develop caries. Notably, in six subjects in the study who were at least 50% compliant with the use of daily fluoride, no caries were exhibited within 3 mm of the margins of their restorations. Further, the investigators concluded that significantly less caries developed at the cavosurface margin of the fluoride-releasing glass ionomer restorative materials compared with amalgam even in the subjects that were less than 50% compliant with regard to the daily use of fluoride.

Comparison of Two Commercially-Available Chlorhexidine Mouth Rinses.


INTRODUCTION

Of the chemical agents utilized to control the development of dental biofilm, the most recognized is the guanide substance, chlorhexidine. Chlorhexidine (CHX) is a bisguanide that has been demonstrated to prevent plaque formation and therefore, prevent gingivitis. In vitro and in vivo studies have shown that rinsing with CHX twice a day will inhibit biofilm formation, prevent inflammation of the gingiva and prevent tooth decay. Notably, plaque inhibition is dose dependent and biofilm inhibition can be achieved with larger volumes of lower concentration solutions. Chlorhexidine concentrations between 0.01% and 0.05% have produced the greatest decreases in plaque scores. Chlorhexidine doses, at a concentration of 0.02% used twice daily, appear to be optimal; balancing efficacy against local side effects, use compliance and acceptability.

PURPOSE

Presently, there are two commonly used CHX concentrations available: a 0.2% concentration with a dosage of 10 ml and a 0.12% concentration with a dosage of 15 ml. The rationale for developing the lower concentration CHX was to reduce side effects while maintaining efficacy. Further, these two concentrations have differing rinsing times. The 0.12% CHX has a recommended rinsing time of 30 seconds, while the 0.2% concentration has a recommended rinsing time of 1 minute.
It was the purpose of this study to assess the effect of these two CHX concentrations on plaque growth inhibition in order to evaluate the effect of the different rinsing times.

**METHODS AND MATERIALS**

This single, blind, two-group parallel investigation utilized 80 subjects, 40 male and 40 female, with an age range of 25-45 years. At baseline, the subjects received a thorough supragingival scaling and polishing to remove plaque, calculus, and stains. Subjects were randomly assigned to the test or control group and were provided with the appropriate CHX mouthrinse. All subjects were instructed to rinse in the morning and evening. All participants were instructed to refrain from using any other form of oral hygiene for the experimental period of 72 hours.

The test group used a 0.12% CHX mouthrinse twice a day for 30 seconds and the control group used a 0.2% CHX mouthrinse twice a day for 60 seconds. After the 72 hours, subjects returned and dental biofilm was disclosed. The biofilm was recorded at six sites per tooth using the Quigley and Hein Plaque Scoring Method as modified by Turesky et al. All measurements were made by the same investigator who was masked to the group. Additionally, each subject was asked to complete a questionnaire using a visual analog scale (1-10, with 10 being extremely positive) to evaluate their attitudes regarding taste disturbances, mucosal sensitivities, taste, rinsing time, and assessment of treatment success with the mouthrinse they used.

**RESULTS**

All subjects completed the 72-hour rinse period. The group that used the 0.12% CHX rinse (test group) had a mean whole mouth PI (Plaque Index) of 1.65, while the group that used the 0.2% CHX rinse (control group) had a mean whole mouth PI of 1.60. Analysis revealed that the test would have been able to discern with 80% power a significant difference of 0.23 between groups in PI. On the questionnaire, both groups answered the questions regarding taste perception, duration of taste and alteration of taste perception with all answers between 4.0 and 5.0, with no statistically significant difference between groups. Both groups considered plaque control to be adequate. Subjects did prefer the 30 second rinsing time, with the difference being statistically significant at p=0.048.

**CONCLUSION**

The results of this study indicate that a 30-second rinsing time is sufficient for an 18 mg dose of CHX in a 0.12% solution to be effective and that the subjects preferred the shorter rinsing time, which can have a positive effect on compliance.

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**The Effectiveness of Two Different Battery-Powered Toothbrushes on Whitening Through Removal of Stain.**


Reviewed by Caren M. Barnes

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**INTRODUCTION**

It is now generally recognized that powered toothbrushes have been proven superior to manual toothbrushes in the clinical removal of dental biofilm. This assessment includes both battery and rechargeable powered toothbrushes and includes the Crest® Spinbrush™. The development of the Crest® Spinbrush™ was followed by the development of a novel powered toothbrush (Spinbrush Pro™) that has a dual moving head design, with one part of the head oscillating and the other part translating back and forth.

**RESULTS**

A total of 80 subjects were enrolled in the study; 70 demonstrated measurable tooth stain and were included in Phase B. For Phase B, there were 49 females and 21 males with ages ranging from 20 to 65 years and a mean age of 37.6 years. The treatment groups were demographically balanced. All of the Lobene measures, all subjects demonstrated statistically significant (p<0.001) reductions in stain scores from baseline after two weeks and four weeks usage of the Crest® Spinbrush Pro™ and the Crest® Spinbrush™. There was no statistical difference between brushes. Regarding safety, only one subject in each group reported gingival irritation.
**Frequently Asked Questions**

1. **Can I use an ultrasonic scaler on restorative surfaces?**

   Although there are many beneficial uses for the ultrasonic scaler, care should be exercised when a patient has had restorative work. Ultrasonic scalers are not indicated for the removal of material on any restorative surface. Its use can disrupt the surface integrity and potentially could remove substantial amounts of the restorative material, rendering the restoration clinically unacceptable. Ultrasonic vibrations can weaken the restoration, causing it to fail more quickly. Porcelain may shatter due to the vibration. The luting cement along the edge of a crown or inlay may be removed during the procedure, which compromises the marginal seal of the restoration.

2. **When is it appropriate to use a metal prophylaxis angle?**

   A metal prophylaxis angle has a very different feel and balance than a disposable angle. It can be a matter of preference as to what feels the practitioner prefers. If the procedure is going to require changing to different cups, such as a polishing point and a brush, a metal angle can easily accommodate these changes of attachments. Also, some special cups, brushes or points are not available on a disposable angle. Metal angles can also be sterilized if that is a necessity for a particular procedure or patient.

3. **How do I handle an extremely sensitive tooth?**

   First, you want to use the least abrasive polishing or cleaning agent as an abrasive agent will only make the tooth more sensitive. ProCare® Cleaning Solution from Young is an example of a non-abrasive cleaning agent. It is also advisable to try to reduce the amount of instrumentation to the least possible level. An ultrasonic scalar should not be used. The only fluoride that should be administered to a patient with hypersensitive teeth is a neutral sodium fluoride. Stannous fluoride and acidulated phosphate fluoride are too acidic and can exacerbate tooth sensitivity.

4. **What special concerns are there for treating a cancer patient?**

   This is a very complex subject and involves consultation with the physician, the laboratory and the oncologist. It involves a special regimen during treatment and care and a lifelong change in hygiene protocols for the patient. This is an important subject and will be the topic of the next issue of The Preventive Angle.

5. **What do you recommend for bad breath?**

   There can be many causes. In some cases bad breath could be a systemic or non-oral problem. However, in most cases it originates in the oral cavity. A daily regimen of microbial plaque control as well as cleaning of all fixed and removable prostheses and implants is required. The most important thing is to get as much bacteria out of the oral cavity as possible. Bacteria must be removed not only from the tooth surface with a brush, but also interproximally. Brushing and scraping of the surface of the tongue is also helpful.

6. **What can you recommend for dry mouth?**

   Dry mouth, or xerostomia, can be caused by several factors: temporary illness, high fever, dehydration, cancer therapy, Sjogren’s Syndrome, other medical issues and even from various prescription medications. A complete medical history and clinical evaluation should be conducted to determine treatment. Pharmacological treatment may be called for in some cases. There are several saliva substitutes available from the drug store that can be used as often as needed by the patient to provide relief. In addition, without the cleansing action provided by saliva, a rigorous plaque control effort by the patient is needed. Special home or office fluoride treatments may be necessary. Also, the patient should be cautioned to avoid sugar-containing gums, drinks, candies and even glycerin swabs. It is very important to keep the mouth as clean and bacteria free as possible or rampant decay can quickly develop.

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Review of CDC Recommendations for Fluoride Use

1. Fluoridation is the adjustment of the fluoride ion content to optimum level in:
   - a. A gel solution.
   - b. A water supply.
   - c. An aerosol spray.
   - d. An ingestible tablet.

2. Which statements about Bottled Water are correct?
   - a. Most bottled water contains less than 0.3 ppm of fluoride.
   - b. Fluoride must be listed on the label only if the bottler adds fluoride during processing.
   - c. The fluoride concentration is regulated but does not have to be stated on the label.
   - d. Few brands have labels listing the fluoride concentration.
   - e. All of the above.

3. Which of the following age groups is MOST susceptible to rampant dental caries?
   - a. Young children with poor oral hygiene and adults with gingival recession.
   - b. Young children with poor oral hygiene.
   - c. Adults with gingival recession.
   - d. Rampant caries are not age-related.

4. Older patient (>50 years) benefit from fluoride because:
   - They often experience gingival recession leaving exposed root surfaces.
   - Tooth retention has increased.
   - Medications frequently reduce salivary output directly influencing bacteria loads.
   - All of the above.

5. Fluoride varnish, applied semiannually, has been reported to be as effective as a professionally applied fluoride gel.
   - True
   - False

6. The combination of fluoridated tooth paste and fluoridated water offer a higher level of protection than either used alone.
   - True
   - False

7. According to the CDC the four most beneficial modalities of fluoride applications are:
   - Community water.
   - Fluoride containing gums.
   - Topical application of gels / foams.
   - Bottled water.
   - Fluoride varnishes.
   - Fluoride prophy paste.
   - Fluoride rinses.
   - Fluoride containing dentifrices.

8. Which of the following types of fluoride is/are reported to cause staining of demineralized enamel and porcelain?
   - a. Stannous fluoride.
   - b. Acidulated phosphate.
   - c. Neutral sodium fluoride.

9. Ideally, the optimum concentration of fluoride in community drinking water is in the range of:
   - a. 0.2 – 1.0 parts per million (ppm)
   - b. 0.7 – 1.2 ppm
   - c. 1.0 – 2.0 ppm
   - d. 1.2 – 2.5 ppm

10. Acidulated phosphate fluoride is contraindicated for use on which of the following:
    - a. Implants
    - b. Porcelain crowns
    - c. Composites
    - d. Glass ionomers
    - a, b and c
    - b, c and d
    - a and d
    - all of the above

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