

**Table 2:**  
**Emergency action for fluoride overdose**

Amount F ingested	Recommendation
< 5 mg/kg body weight	1. Give calcium orally (milk). Observe for few hours
> 5 mg/kg body weight	1. Give oral calcium 2. Admit to hospital and observe for few hours

### Summary

Professional applications of fluorides play an important and valuable role in the prevention and management of dental caries in moderate- and high-risk patients, but use should be restricted to those categories of patient.

The following are specific numbered recommendations from guidelines for fluoride use in Australia (ARCPDH 2006):

(15) Fluoride varnish should be used for people who have elevated risk of developing caries, including children under the age of 10 years, in situations where other professionally applied fluoride vehicles may be unavailable or impractical.

(16) High concentration fluoride gels and foams (those containing more than 1.5 mg/g fluoride ion) may be used for people aged 10 years or more who are at an elevated risk of developing caries in situations where other fluoride vehicles may be unavailable or impractical.

A summary of recommendations for professional fluoride application is provided in Table 3.

**Table 3:**  
**Summary of recommendations for professional fluoride application**

	12 months to <10 years	10 to 18 years	18+ years
<b>Low risk</b>	–	–	–
<b>Moderate risk</b>	Varnish at 6 monthly intervals	Varnish or gel at 6 monthly intervals	–
<b>High risk</b>	Varnish at 6 monthly intervals	Varnish or gel 6 monthly intervals	Varnish or gel at 3-6 monthly intervals

### Further information

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# Professional Fluoride

## Applications in the dental surgery

### PROFESSIONAL FLUORIDE APPLICATIONS IN THE DENTAL SURGERY

Professional application of fluoride products have been used successfully in dental surgeries for many years. This information sheet aims to update material relating to the use of fluoride products in the dental surgery.

### Professional use of fluoride products

Fluoride products used in dental surgeries include gels and varnish with, on the whole, high doses of fluoride varying from 9,000 ppm to 23,000 ppm. Since the introduction of community water fluoridation and the widespread availability of fluoride toothpastes, their application has been restricted to those patients with moderate to high caries risk. There is now substantial evidence that those at low risk of dental caries are unlikely to benefit from professional application of topical fluoride (Truin & van't Hof 2005; Truin et al. 2007; van Rijkom et al. 1998).

### Action of fluoride in preventing and controlling dental caries

Professionally applied fluorides can be used for both primary and secondary prevention of caries. Primary prevention concerns prevention of carious lesions that develop on sound tooth structure, while secondary prevention is remineralisation treatment of the initial, precavitated lesion and of root caries. The recommended frequency of application of both fluoride varnish and fluoride gels is two to four times per year.

Professionally applied fluorides have a high concentration of fluoride ions. When it comes into contact with the tooth surface, this high concentration fluoride does not enter the crystalline structure of the enamel (Dijkman et al. 1988). Rather, it forms a reservoir of calcium fluoride at the tooth surface which is available to release fluoride for remineralisation when the pH in plaque falls.

Haupt et al. (1983) and Mellberg (1990) found that removal of plaque through prophylaxis is not necessary prior to the professional application of fluoride. As fluoride becomes concentrated in dental plaque, the metabolic activity of cariogenic bacteria that produce acid from carbohydrates is reduced, thus affecting the bacterial production of adhesive polysaccharides (Hamilton 1990).

### Fluoride varnish

Fluoride varnish contains 23 mg/mL fluoride ion suspended in an alcohol and resin base. It is applied directly to dried teeth, where it forms a waxy film that adheres to the teeth until it is worn off by chewing or brushing. Although fluoride varnish contains a high concentration of fluoride ions, it sets immediately on contact with saliva such that little is swallowed. Fluoride varnish may be applied to all teeth or as a spot application on localised areas.

### Effectiveness

Varnish has been shown to be effective when applied approximately every 6 months or annually, although the latter period results in a reduced effect. There is good evidence that varnish is effective for prevention of dental caries in children and adolescents, even as young as 12 months, where other forms of professionally applied fluoride are contraindicated (Weintraub et al. 2006). Varnish can prevent 46% of caries that develops in the permanent dentition and 33% in the deciduous dentition (Marinho et al. 2002a). It offers an alternative vehicle for caries prevention for individuals deemed to be at high risk and in whom other fluoride modalities are not available or suitable. Application twice a year has not been linked to an increased risk of fluorosis or toxic events.

### Safety

A major concern in relation to fluoride varnishes (and gels) is the high fluoride concentration and the possibility of fluorosis or more serious toxicity. Ekstrand et al. (1980) compared fluoride levels in peripheral blood and urine in children for up to 48 hours following both fluoride varnish and fluoride gel applications. The application of varnish resulted in a peak plasma concentration 2 hours later in the range 3.2–6.3 µmol/L of fluoride, while peripheral blood levels following application of gel were 16–76 µmol/L after 1 hour. The fluoride varnish levels were comparable to those for toothpaste or the ingestion of a 1 mg fluoride tablet. The authors suggested that the lower levels for varnish were the result of slower ingestion of the retained varnish as it is removed from the enamel hours after application and the slower absorption of varnish within the gut.

### ***Use in the dental surgery***

Within the dental surgery, use 0.25 mL of varnish for a full mouth application for a preschool child and up to 0.40 mL for an adult.

Beginning with the posterior teeth, dry the teeth with gauze or cotton roll and then paint fluoride varnish onto the occlusal surfaces. Because the varnish will only stick well if the tooth is dry, you will need to dry a few teeth at a time and then paint, and then dry more teeth and paint them. The child can have a rest before you move on to the contra-lateral posterior teeth, the upper anterior teeth, the palatal and labial surfaces, and the lower anterior teeth.

Advise parents/patients:

- to wait at least 30 minutes before eating, and longer if possible
- that the teeth will look yellow for a few days
- not to brush the teeth until the next day
- that best results are obtained if teeth are painted twice a year, about once every 6 months.

### ***Fluoride gels and foams***

Fluoride gels for prevention of dental caries were developed to enable topical application to the whole dentition simultaneously. The gels were formulated so that they flowed under pressure and could be applied using a tray. They were made widely available in the mid 1960s. More recently, a fluoride foam which performs similarly to a gel has been marketed in some countries. Their attraction is that less of the foam is used, which may reduce the amount swallowed by young children (Wei et al. 1990). There are few clinical studies of their effectiveness, although a study by Jiang et al. (2005) found foams to be effective in the primary dentition.

### ***Neutral vs acidulated***

Acidulated-phosphate fluoride (APF) with 1.23% fluoride ion and a pH of approximately 3 was developed because it allows greater uptake of fluoride by enamel in an acidic environment.

Neutral fluoride gels have become more popular in recent years for use in mouths with high levels of acidity. Sodium fluoride neutral gels of 5,000 ppm for daily home use and 12,000 ppm for professional application at 3–4-monthly intervals have been available since the early 1990s for individuals with high caries rates, xerostomia or multiple sites with active root caries. However, there is little evidence of their effectiveness compared to other fluoride modalities.

### ***Effectiveness***

The Cochrane review by Marinho et al. (2002b) found that 6-monthly applications of fluoride gels applied for 4 minutes or more resulted in a 28% reduction in caries experience in

the permanent dentition. This confirms work by van Rijkom et al. (1998), Newbrun (2001) and Ripa (1990). There is little evidence available on the use and effectiveness of fluoride gels in the deciduous dentition or on acceptability or adverse events. In addition, there is little clinical evidence on the effectiveness of fluoride gels applied for shorter periods of time, e.g. 1 minute.

### ***Use in the dental surgery***

Within the dental surgery the most frequent fluoride therapy is the application of a fluoride gel. The operator should remember that each millilitre of gel contains 12.3 mg of fluoride. With quantities of APF gel dispensed usually in the vicinity of 5 mL, this raises concerns about toxicity in young children. For this reason the following recommendations should be followed:

- do not use fluoride gel in children younger than 10 years of age;
- minimise the amount of gel used and in no case exceed a total of 2.0 mL per tray;
- seat the patient in an upright position and incline the head slightly forward;
- apply the fluoride gel for 4 minutes;
- use a saliva ejector during the procedure;
- instruct the patient to expectorate for 30 seconds after the procedure; and
- preferably use a tray with absorbent liners.

### ***Safety***

Ekstrand et al. (1981) conducted analyses of peripheral blood and urine in children after application of APF gel. Peak plasma fluoride concentrations of 16–76 µmol/mL for APF gels found 1 hour after application were considerably higher than the 3.2–6.3 – µmol/mL found within 2 hours of varnish treatment (Ekstrand et al. 1983). These data indicate that the risk of acute toxic reactions with gels is greater than with varnish as it is more readily swallowed and absorbed. Hence, the use of fluoride gels is contraindicated in children below the age of 10 years.

### ***Fluoride prophylaxis paste***

Prophy pastes containing fluoride are sometimes used for dental prophylaxis. Their function is to restore the concentration of fluoride in the surface layer of enamel which is removed by polishing. However, the abrasive paste, which contains varying levels of fluoride (4,000–20,000 ppm), is not an adequate substitute for fluoride gel or varnish in treating persons at high risk for dental caries (Mellberg 1990).

## ***Topical fluoride as a treatment of dental caries***

### ***Deciduous caries***

Fluoride varnish applied 3-monthly has been recommended as a treatment for deciduous caries (Newbrun 2001;

Pienihäkkinen et al. 2002). Other work suggests that silver diamine fluoride may be even more effective (Chu et al. 2002), but has the side effect of blackening the dentine. More research is needed in this area.

### ***Permanent caries***

Use of professionally applied fluorides at least twice-yearly is now commonly recommended for the management of active caries prior to clinical cavitation. Fluoride varnishes and gels have been shown to be effective in the remineralisation of such lesions on smooth surfaces of permanent teeth, particularly in moderate-risk patients (Newbrun 2001). High-risk patients should also receive high concentration fluoride treatment, but may need additional measures to control their disease.

### ***Orthodontic associated demineralisation***

Demineralised areas associated with orthodontic bands and brackets have long been an unwanted outcome in some patients under orthodontic care. Recent work confirms the role of fluoride varnish in reducing both the size and likelihood of occurrence of demineralised areas associated with bonded brackets (Stecksén-Blicks et al. 2007; Derks et al. 2004).

### ***Root caries***

Studies provide consistent evidence showing that professional fluoride applications at least twice a year, regular home use of high-dose fluoride toothpastes, and home use of fluoride gels or daily fluoride mouth rinsing result in the remineralisation of root caries (Leake 2001).

### ***Safe use of fluoride in dental clinics***

When handled appropriately by practitioners and patients, fluoride products pose very little risk of adverse effects.

**Table 1:**  
**Fluoride levels in various dental products**

Form of fluoride (F)	Conversion factors	Typical products	Per cent F	ppm F
Fluoride gel: acidulated phosphate fluoride			1.23% F	12,300
Fluoride varnish: sodium fluoride	2.2 mg NaF = 1 mg F <sup>-</sup>	5% NaF	2.26% F	22,600
Mouthrinse: sodium fluoride	2.2 mg NaF = 1 mg F <sup>-</sup>	0.2% NaF	0.09% F	900
Adult toothpaste monofluorophosphate (MFP)	7.6 mg MFP = 1 mg F <sup>-</sup>	0.76% MFP	0.1% F	1,000
Junior toothpaste monofluorophosphate	7.6 mg MFP = 1 mg F <sup>-</sup>	0.304% MFP	0.04% F	400

An example showing calculation of the amount ingested by a child brushing with an adult toothpaste and swallowing 20% is illustrated by the following two equations:

$$\% \text{ F in the compound ingested (0.1\%)} \times \text{quantity used in the treatment (0.25gm)} = \text{F dose (0.25 mg)}$$

$$\text{F dose (0.25 mg)} \times \text{amount actually swallowed (20\%)} = \text{mg F ingested (0.05 mg)}$$

Emergency recommendations for fluoride overdose are presented in Table 2.

It is the responsibility of the dental practitioner to ensure they are aware of the concentrations and the appropriate use and storage of the products they are administering and prescribing, and to pass this information on to their patients. Small amounts of these tasty materials can be ingested by curious young children looking for interesting things in a dental surgery.

Two safety issues need to be considered—toxicity and fluorosis. The probable toxic dose is 5 mg of fluoride per kilogram of body weight. The dose generally recognised as leading to fluorosis is 0.05–0.07 mg/kg body weight/day (Burt et al. 1992) at the time of enamel calcification.

### ***Calculation of dosage***

In calculating dosage, a number of factors need to be considered:

- the amount and type of fluoride in the product
- the amount of fluoride swallowed, which varies with the age of the child (younger children have less control of the swallowing reflex) and with the amount placed in the mouth and the ability to swallow the material (more difficult with fluoride varnishes which adhere well to the dry tooth and break down slowly)
- the rate of absorption from the gut (the bioavailability) of the product, which will be important although less is known about this factor.

APF is the only product for which a percentage of fluoride is given (1.23%). However, per cent fluoride can be calculated when ppm is known: in Australia junior toothpaste is 0.04–0.05% (400–500 ppm) and normal toothpaste is 0.1% (1000 ppm).

The amount of fluoride ion available varies with the particular compound. The conversion factors and fluoride levels in dental products are listed in Table 1.