Toxicity
Precautions & Contraindications

BY TRACY DOOLE

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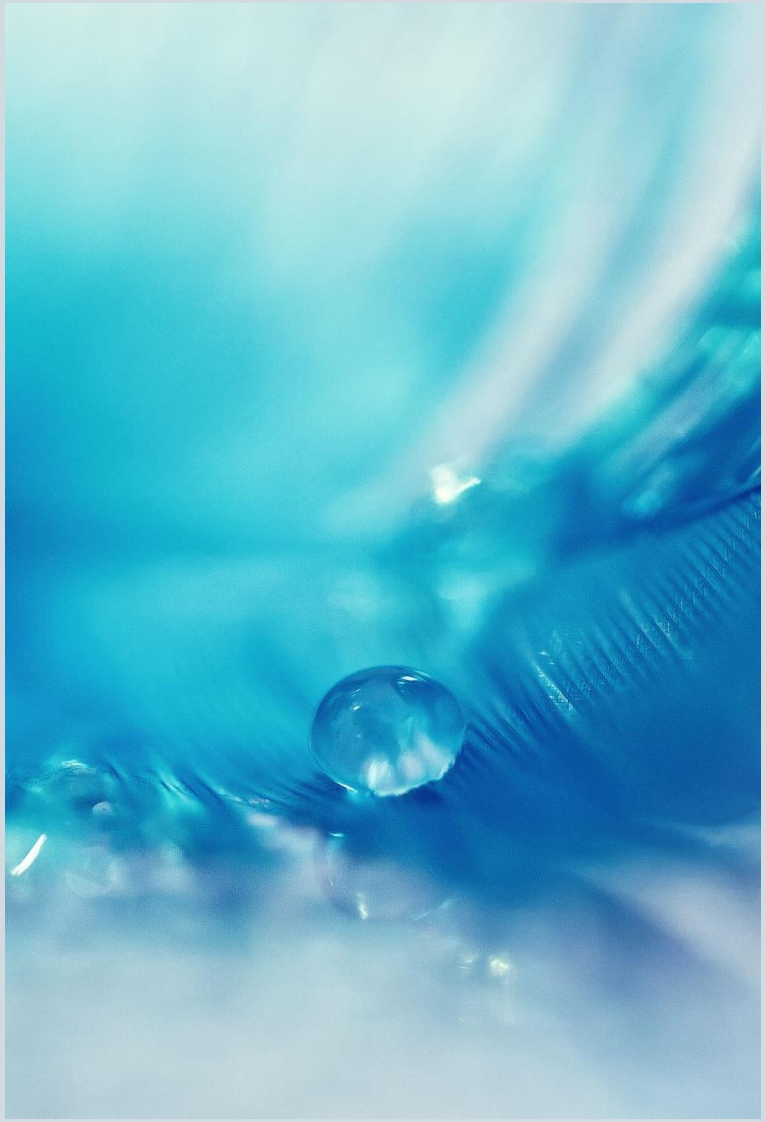
WHO statement

It is estimated that caries of the permanent teeth is the most prevalent of all conditions assessed, with **2.4 billion** people globally suffering from **caries of permanent teeth** and **486 million children from caries of primary teeth**

Public health actions are needed to provide sufficient fluoride intake in areas where this is lacking, so as to minimize tooth decay.

This can be done through drinking-water fluoridation or, when this is not possible, through salt or milk fluoridation or use of dental care products containing fluoride, and by advocating a low-sugar diet



How Safe is Safe?

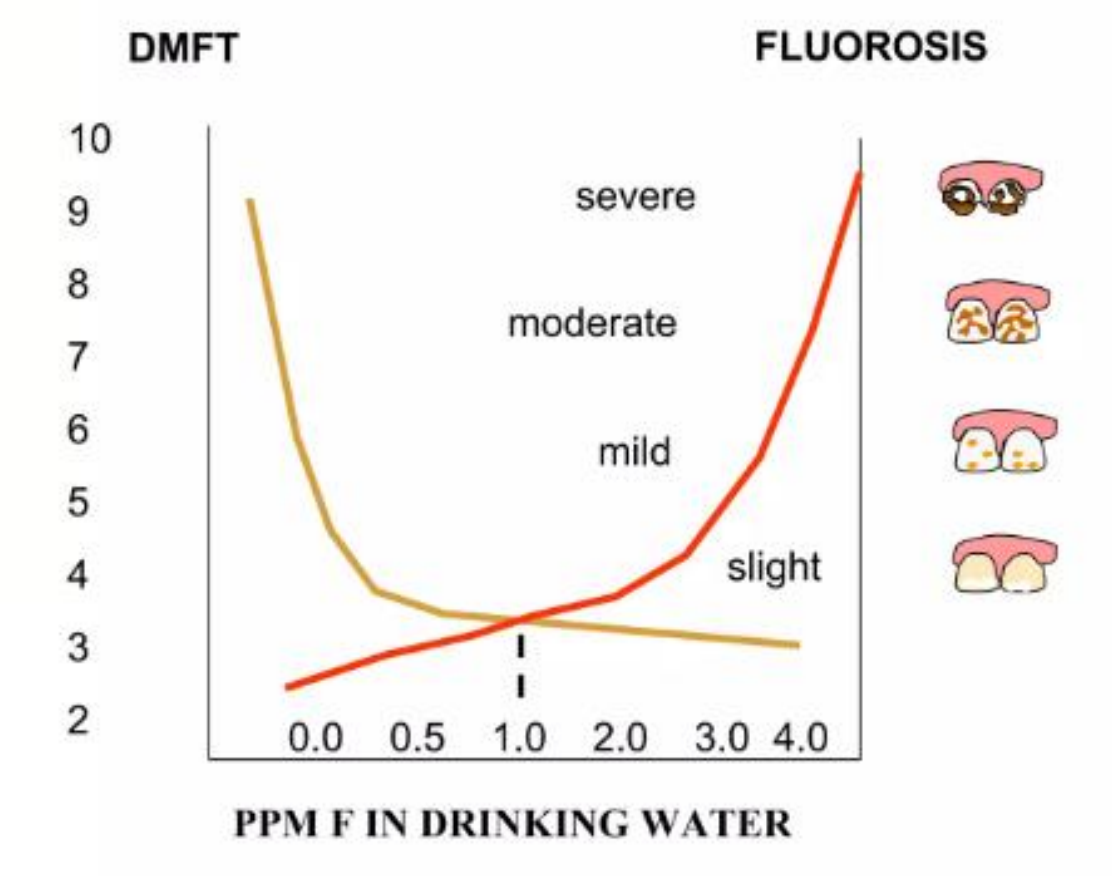
Fluoride intake has both beneficial & negative effects:

- in reducing the incidence of dental caries
- in causing tooth enamel and skeletal fluorosis following prolonged high exposure.

The ranges of intakes producing these opposing effects are not far apart

WHO 1963 recommended optimal level of fluoride in drinking water as 0.5 to 1.0 PPM

How Safe is Safe?



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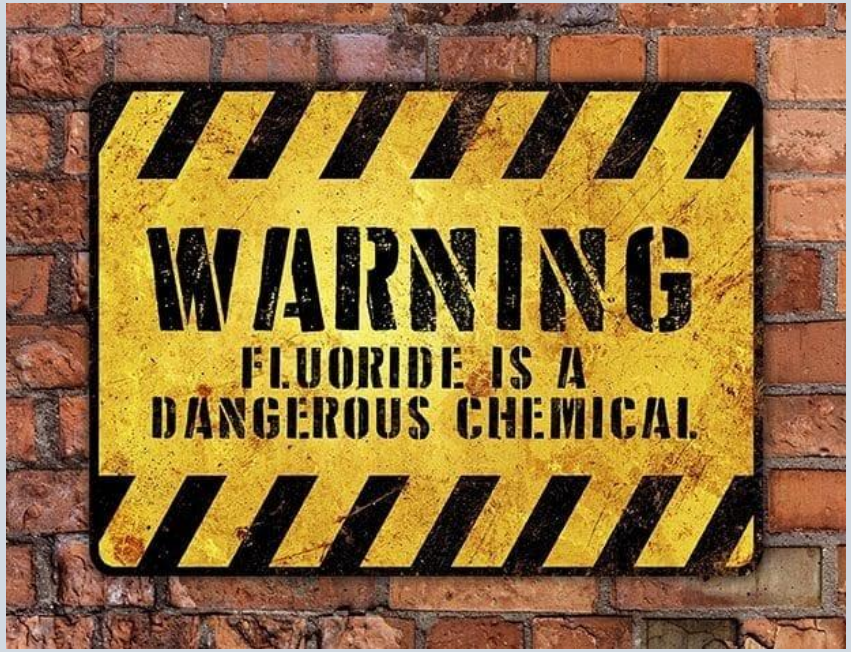


Background to Fluoride Toxicity

Excess ingestion of fluoride can lead to dental fluorosis and skeletal fluorosis

1ppm fluoride (Parts per million)

1mg of fluoride per litre

Fluoride toxicity

Acute toxicity: excessive ingestion of fluoride over short period of time produces acute toxicity (Rapid onset minutes to hours)

Chronic toxicity: excessive ingestion of fluoride over long period of time produces chronic toxicity

Fluoride toxicity

Acute toxicity

the speed and severity of the response are dependent on the

amount of fluoride ingested

weight and age of the individual

Signs & Symptoms

ACUTE TOXICITY

- ❑Nausea and vomiting
- ❑Abdominal pain and diarrhea
- ❑Excessive salivation
- ❑Headache and weakness
- ❑Severe cases:
  - ❑Low blood calcium (hypocalcemia)
  - ❑Muscle spasms
  - ❑Heart rhythm disturbances
  - ❑Seizures or death (rare)

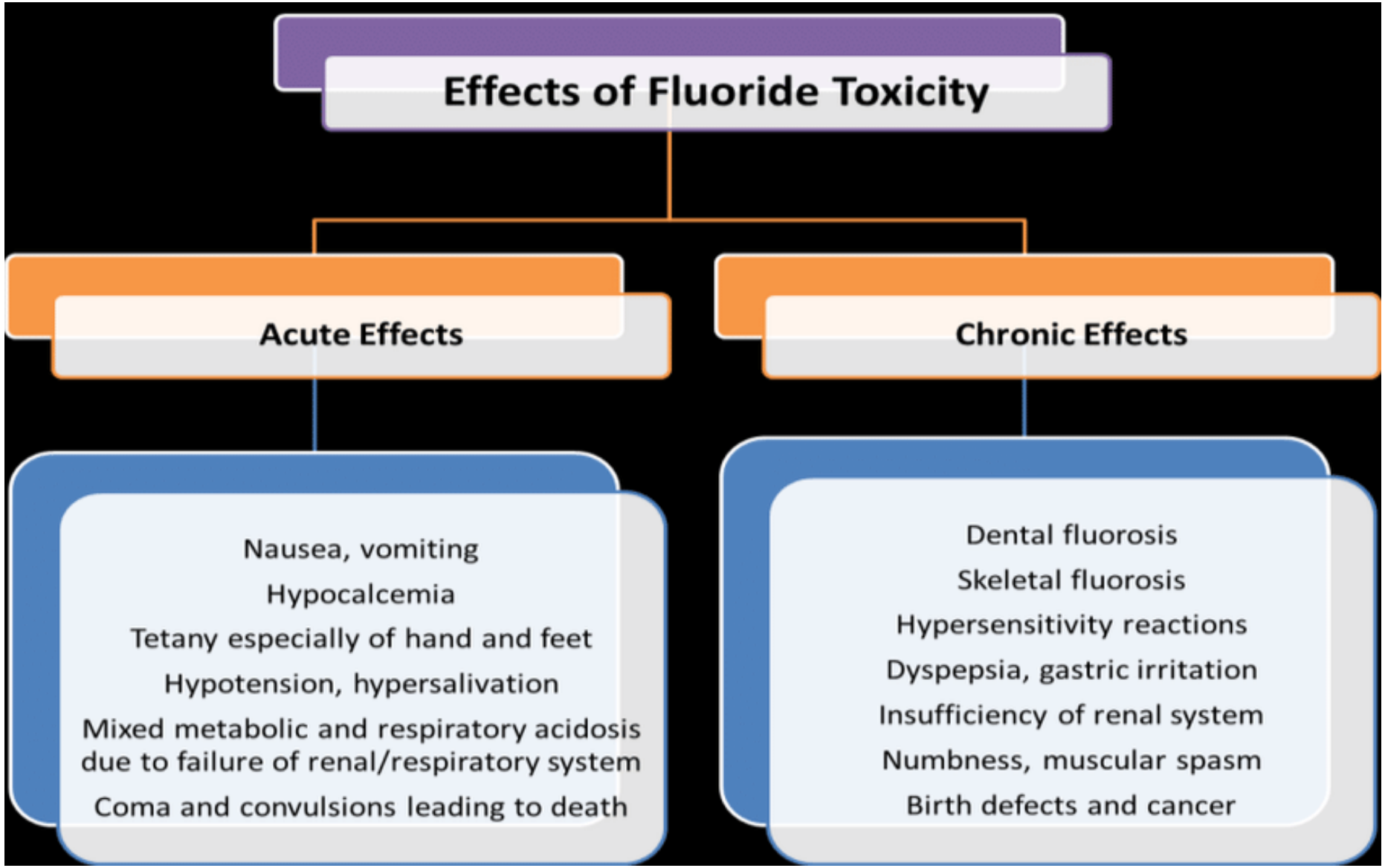
CHRONIC TOXICITY

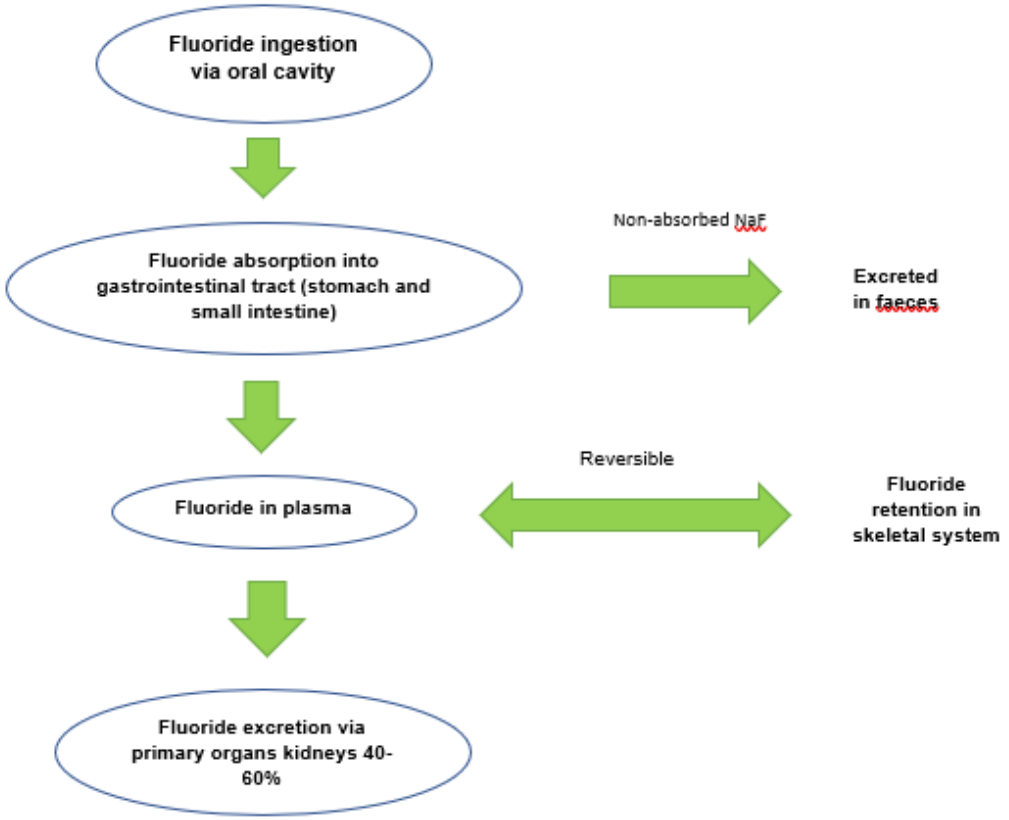
Dental fluorosis

- ❑White streaks, brown stains on teeth
- ❑Enamel pitting in severe cases

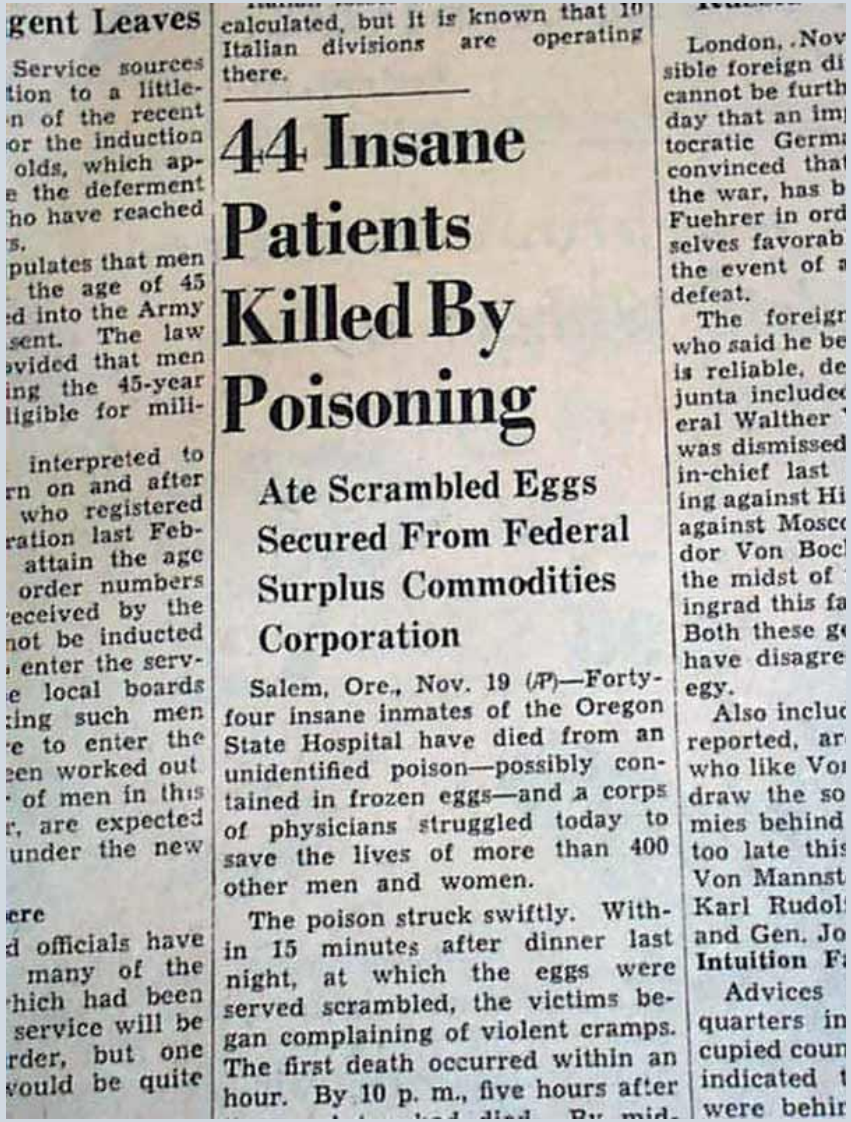
Skeletal fluorosis

- ❑Bone pain and stiffness
- ❑Joint immobility
- ❑Increased fracture risk


Effects of Fluoride Toxicity
Acute Effects
Chronic Effects
Nausea, vomiting
Hypocalcemia
Tetany especially of hand and feet
Hypotension, hypersalivation
Mixed metabolic and respiratory acidosis due to failure of renal/respiratory system
Coma and convulsions leading to death
Dental fluorosis
Skeletal fluorosis
Hypersensitivity reactions
Dyspepsia, gastric irritation
Insufficiency of renal system
Numbness, muscular spasm
Birth defects and cancer



The "choking off" effect in fluoride chemistry describes how topical sodium fluoride (NaF) applications on teeth rapidly self-limit their own penetration. When applied, the fluoride ions react with dental hydroxyapatite to form a protective layer of calcium fluoride (CaF_2). This dense layer acts as a barrier, effectively "choking off" or preventing further diffusion of fluoride into the deeper enamel layers



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44 Insane Patients Killed By Poisoning

Ate Scrambled Eggs Secured From Federal Surplus Commodities Corporation

Salem, Ore., Nov. 19 (AP)—Forty-four insane inmates of the Oregon State Hospital have died from an unidentified poison—possibly contained in frozen eggs—and a corps of physicians struggled today to save the lives of more than 400 other men and women.

The poison struck swiftly. Within 15 minutes after dinner last night, at which the eggs were served scrambled, the victims began complaining of violent cramps. The first death occurred within an hour. By 10 p. m., five hours after

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Oregan 1942

In 1942 Mass poisoning at Oregan hospital with fluoride

NaF was mistaken for powdered milk

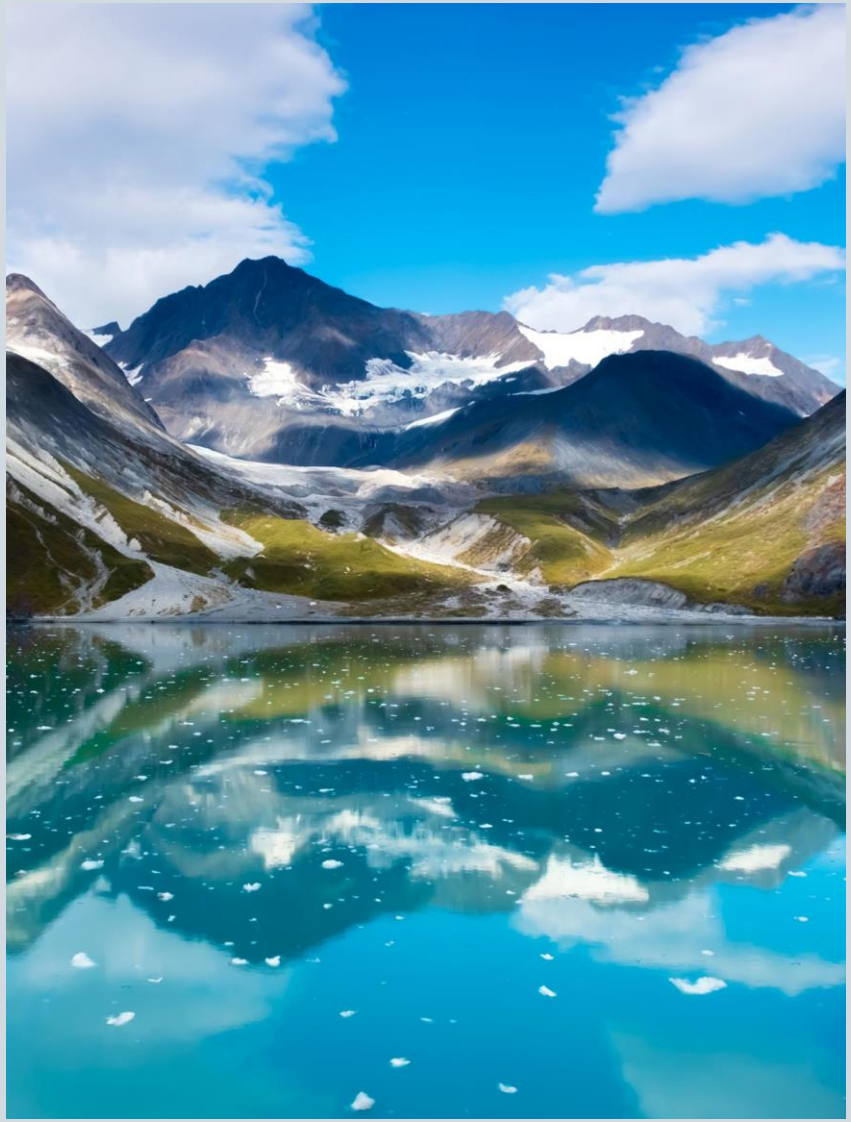
Approx 17 pounds of NaF was added to 10 gallons of egg

There were 263 cases of acute poisoning and 47 fatalities

Milk fluoridation

There are a few community schemes in England which supply children with fluoridated milk at early years and school settings. They are provided in areas that are not fluoridated and where levels of dental caries are high. In 2016 an evidence review and guide for local authorities commissioning programmes such as fluoridated milk classified these as of limited value for oral health[footnote 4].

Chapter 9: Fluoride - GOV.UK (www.gov.uk)



Alaska, 1992

150ppm F was present in the water due to miscalculations

Almost 300 people had nausea, vomiting, abdominal pain, diarrhoea, pain and **one** death occurred

What does this mean for applying fluoride varnish?

Lots of the information relates to water fluoridation

Patients attending may be getting fluoride from other sources and may have questions relating to this

Important to understand other sources of fluoride intake patient may be getting

In simple terms

Is Fluoride Varnish Toxic For A Child?

Levels of fluoride within the body that prove to be toxic and lead to harmful effects in a person, these levels are based upon weight and apply to both children and adults.

The ***accepted toxic level is 5 mg/kg of weight for a person*** which can lead to side effects such as nausea, vomiting, hypotension, renal and respiratory complications, and coma in its acute form

Lesser toxic levels can lead to more chronic side effects such as dental and skeletal fluorosis and gastric concerns

N.B These symptoms usually appear within an hour of ingestion so may not manifest until sometime after the patient has left the surgery.

(Ullah, R et al 2017)

Is Fluoride Varnish Toxic For A Child?

Example: If your child weighs approximately 13 kg or 2 stone, they would need to ingest over 65 mg of fluoride to show signs of toxicity

It should be stated that while this does mean that there is in fact a toxic level of fluoride, keep in mind that there are toxic levels of several things that we as humans consume and come in constant contact with on a daily basis

(Ullah, R et al 2017)

Is Fluoride Varnish Toxic For A Child?

Anyone recommending the use of fluoride containing dental preparations should be aware of the fluoride content and the potential health hazards

All evidence on the toxicity of fluoride in humans is gathered from recorded cases of deliberate or accidental overdosage!

THE ACUTE LETHAL DOSE IS APPROXIMATELY 15MG/KG OF BODY WEIGHT, ALTHOUGH A DOSE AS LITTLE AS 5MG/KG OF BODY WEIGHT MAY KILL SOME CHILDREN.

A DOSE OF 5MG/KG SHOULD TRIGGER IMMEDIATE EMERGENCY TREATMENT. AS LITTLE AS 1MG/KG OF BODY WEIGHT CAN PRODUCE SUB-LETHAL TOXIC EFFECTS

Fluoride toothpaste toxicity

Example:

Children under 3 years old using a smear of toothpaste

Toothpaste 1’000ppm = 0.1mg Fluoride

Overall absorbable dose of only 0.007-0.01mg per KG if swallowed by a child weighting 15KG

What to do if high levels are ingested

A small quantity of fluoride, less than 5mg/kg body weight, is neutralised by drinking a large volume of milk.

However, if there has been more than this ingested, or there is some doubt about the exact quantity consumed, the child should be taken immediately to hospital and given gastric lavage.

Speed is of the utmost importance because fluoride is absorbed very rapidly

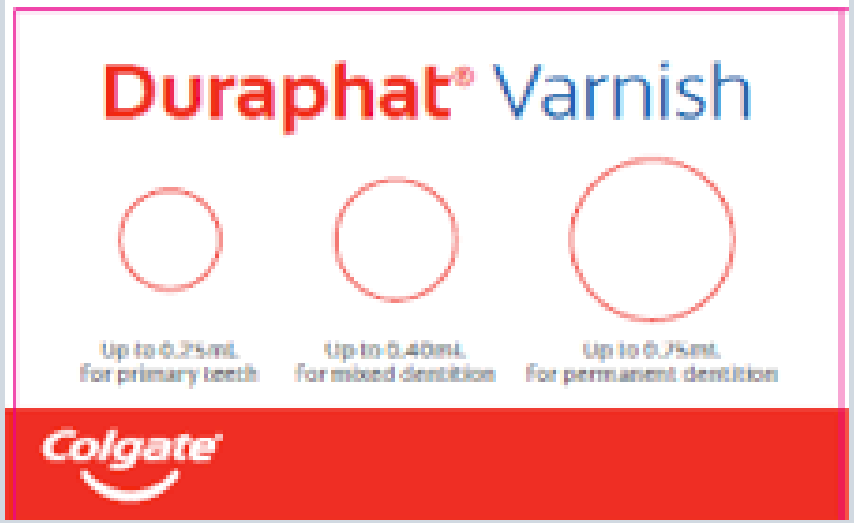
Precautions

Fluoride varnish should therefore be used with extreme care and only used in exceptional cases with pre-school children

Although no cases of acute toxicity due to ingestion of fluoride toothpaste have been reported so far

A 5 year old could be severely poisoned by consuming about two thirds of a 100ml tube of 1500ppm toothpaste, and a 1 year old would need to consume only half this amount.

Fluoride toothpaste and mouthwashes should always be kept out of the reach of small children



Colgate Duraphat

At present Colgate® Duraphat® Varnish 50mg/ml Dental Suspension 2.26% (22,600ppm) Sodium Fluoride (Duraphat Varnish) is the only product licensed specifically for caries prevention

Clinical trials on Duraphat

The first clinical trial to see the efficacy of Duraphat was carried out by **Heuser and Schmidt in 1968**. One application of Duraphat was done on 224, 11-14 year old children & showed a 30% reduction DMFT after a period of 15 months

Majority of clinical trials were in the 1970s

Efficacy reported 10-45% DMFT reduction after 23 months **(Maiwald and Geiger 1973)**

Precautions relating to fluoride varnish

The evidence based guidance for fluoride varnish states:

- All children aged three years and above should have fluoride varnish applied twice yearly (2.26% NaF)
- Those children giving concern should receive two or more applications per year

As a precaution

Parents should be asked to let the dental practice know if fluoride varnish has recently been applied at nursery or school

This allows the dental practice to space out your child's fluoride varnish applications to ensure maximum benefit & reduce risk of toxicity from overuse

Contraindications

DO NOT USE IF:

- ❑Allergy to sodium fluoride, colophony or other ingredients
- ❑Patient has mouth ulcers or gum disease (active)
- ❑Patient has ulcerative colitis
- ❑Patient has stomatitis (inflammation of the mouth)
- ❑Patient has asthma
- ❑Latex allergy

Contraindications

Not recommended for use on individuals with a history of allergies – to the **colophony** component.

In patients with ulcerative colitis and stomatitis burning sensation is a side effect when comes into contact with the gingival tissue and also causes discolouration of the teeth.

Children with Asthma

Delivering Better Oral Health includes the following statement:

"The use of Duraphat is contraindicated in patients with ulcerative gingivitis and stomatitis. There is a very small risk of allergy to one component of Duraphat (colophony), so for children who have a history of allergic episodes requiring hospital admission, including asthma, varnish application is contraindicated. Other brands of varnish may have different constituents"

Prescribing Dentist/Clinicians should use their clinical judgement when deciding to use fluoride varnish.

References

Chapter 2: Summary guidance tables for dental teams - GOV.UK (www.gov.uk)

Delivering better oral health toolkit:Chapter 9: Fluoride - GOV.UK (www.gov.uk)

Ullah, R., Zafar, M.S. and Shahani, N., 2017. Potential fluoride toxicity from oral medicaments: A review. *Iranian journal of basic medical sciences*, *20*(8), p.841.

WHO

Preventive dental advice, care and treatment for children from 0-3 years Welsh Government: preventive-dental-advice-care-and-treatment-for-children-from-0-3-years.pdf (gov.wales)

References

Colgate Duraphat Varnish information available: **www.colgateprofessional.co.uk/products/Colgate-Dur...** (http://www.colgateprofessional.co.uk/products/Colgate- Duraphat-Varnish-50mgml-Dental- Suspension/details)

Fluor Protector s information available: **www.ivoclarvivadent.com/.../media/document/16351/F...**

Daly et al. 'Essentials Dental Public Health'. (2007). Oxford University Press.

Department of Health and the British Association for the Study of Community Dentistry. 'Delivering Better Oral Health. An evidence-based toolkit for prevention – third edition'. (2017). DH

General Dental Council. 'Standards for Dental Professionals'. Available: **www.gdc-uk.org**

Kidd E. 'Essentials of Dental Caries' (2005). Oxford University Press.

(http://www.colgateprofessional.co.uk/products/Colgate-Duraphat-Varnish-50mgml-Dental-Suspension/details)

https://www.ivoclar.com/en_gb/products/prevention-and-care/fluor-protector-s

(http://www.gdcuk. org)