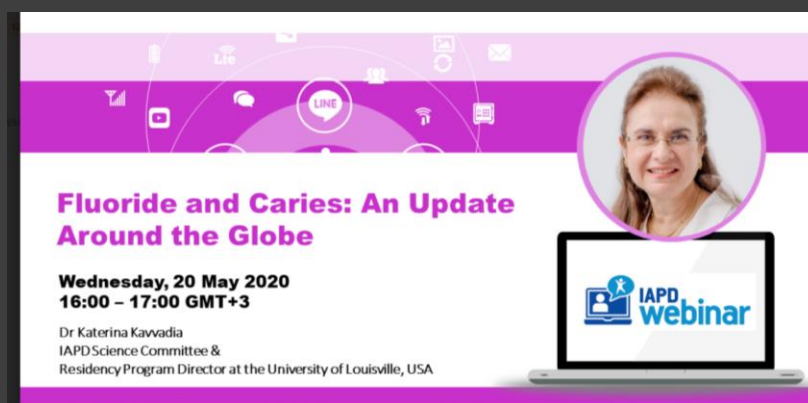


# Fluoride and Caries: An Update Around the Globe



**Fluoride and Caries: An Update  
Around the Globe**

**Wednesday, 20 May 2020  
16:00 – 17:00 GMT+3**

Dr Katerina Kavvadia  
IAPD Science Committee &  
Residency Program Director at the University of Louisville, USA

IAPD Webinar



Katerina Kavvadia DDS, MDent Sc, PhD  
Associate Professor, Residency Program Director  
U of Louisville, KY, USA

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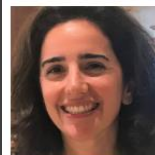
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# IAPD Science Committee

The screenshot shows a web browser window with the URL [iapdworld.org/edu/super\\_pages.php?ID=parents5](http://iapdworld.org/edu/super_pages.php?ID=parents5). The page header features the IAPD logo and the tagline "The Global Voice for Children's Oral Health" alongside a photo of a young girl brushing her teeth. A navigation menu includes links for "About Us", "Board of Directors", "Membership", "National Member Societies", "Publications", "Parents", "Education", "Congress", and "Sponsorship". The "Education" link is circled in red. Below the navigation, a sub-menu for "Education" is also circled in red, listing links such as "Online Continuing Education (OCE) Library", "Learn How to Use OCE Library", "Teachers Educational Program (TTEW)", "IAPD Regional Meetings", "IAPD Education Fund", "IAPD Lecture Video Center", and "Guidelines for Clinical Practice". The main content area is titled "Guidelines for Clinical Practice" and includes a "Background" section with text about foundational articles and consensus recommendations. A "Featured Articles, 2020" section is also circled in red. On the right side, there is a "Join IAPD!" button, a user profile for Dr. Katerina (Aikaterini) Kavvadia with "My Desktop" and "Logout" options, and sections for "2021 Congress" and "Upcoming Events" listing the "2nd Global Summit" and "28th IAPD Congress 2021".



# Use of Fluoride for Caries Prevention: Foundational Articles and Consensus Recommendations, 2020

- 1.** Optimal fluoride levels in water supplies for the prevention and reducing dental caries prevalence is both safe and effective.
- 2.** Dietary fluoride supplements are effective in reducing dental caries and should be considered for children at caries risk who drink fluoride-deficient water.
- 3.** Professionally applied topical fluoride treatments as 5 percent F varnish and 1.23 percent F gel preparations are efficacious in reducing caries in children at caries risk.
- 4.** Brushing child's teeth twice daily with fluoridated toothpaste, containing at least 1,000 ppm fluoride is effective in reducing dental caries in children. Using age appropriate amount of tooth paste on the brush ("smear" for children under age 3; "pea-size" for children 3-6).
- 5.** Prescription strength 0.5 percent fluoride gels and pastes are effective in reducing dental caries in high caries risk children over the age of 6.
- 6.** Use of 38% silver diamine fluoride (5% F) is effective for the arrest of non-cavitated as well as cavitated caries lesions.



# Disclaimers

I have no conflicts of interest to disclose

## AIM

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To give an update on the fluoride guidelines around the world, and present the evidence of anticaries effectiveness for the different fluoride modalities.

Topical Fluorides	
At Home	In Office
Toothpastes	Professionally applied
Mouthrinses	
Prescription strength F products	Silver Diamine Fluoride



# AAPD

AMERICA'S PEDIATRIC DENTISTS  
THE BIG AUTHORITY on little teeth

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Home > Research > Oral Health Policies & Recommendations (The Reference Manual of Pediatric Dentistry)

## Policy on Use of Fluoride

Purpose Methods Background Policy Statement References

SHARE

### Purpose

The American Academy of Pediatric Dentistry (AAPD) affirms that the use of fluoride as an adjunct in

The Reference Manual of Pediatric Dentistry  
2019-2020/P. 55-56

AMERICA'S PEDIATRIC DENTISTS  
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## Fluoride Therapy

Purpose Methods Background Recommendations References

SHARE

### Purpose

The American Academy of Pediatric Dentistry intends these recommendations to help practitioners

The Reference Manual of Pediatric Dentistry  
2019-2020/P. 262-265

## Guidelines for use of fluorides in Australia: update 2019

LG Do,\*  Australian Research Centre for Population Oral Health

*\*National Oral Health Promotion Clearinghouse, Australian Research Centre for Population Oral Health, The University of Adelaide, Adelaide, South Australia, Australia.*





## CDA Position on Use of Fluorides in Caries Prevention

### **Preamble**

The Canadian Dental Association supports the appropriate use of fluorides in dentistry as one of the most successful preventive health measures in the history of health care. Over 50 years of extensive research throughout the world has consistently demonstrated the safety and effectiveness of fluorides in the prevention of dental caries.

Fluorides are found naturally throughout the world. They are present to some extent in all food and water so that all humans ingest some fluoride on a daily basis. In addition, fluorides are used by communities as a public health measure to adjust the concentration of fluoride in drinking water to an optimum level (water fluoridation); by individuals in the form of toothpastes, rinses, lozenges, chewable tablets, drops; and by the dental profession in the professional application of gels, foams and varnishes.

The availability of fluorides from a variety of sources must be taken into account before embarking on a specific course of fluoride delivery to either populations or individual patients. This is particularly important for children under the age of six, where exposure to more fluoride than is required to simply prevent dental caries can cause dental fluorosis. Provided that the total daily intake of fluoride is carefully monitored, fluoride is considered to be a most important health measure in maintaining oral health for all Canadians.


CDA recognizes the need to monitor the scientific literature with respect to levels of exposure to fluoride and general health to ensure the continued safe and effective use of fluorides in dentistry.

European Archives of Paediatric Dentistry  
<https://doi.org/10.1007/s40368-019-00464-2>

INVITED REVIEW



## Guidelines on the use of fluoride for caries prevention in children: an updated EAPD policy document

K. J. Toumba<sup>1</sup>  · S. Twetman<sup>2</sup> · C. Splieth<sup>3</sup> · C. Parnell<sup>4</sup> · C. van Loveren<sup>5</sup> · N. A. Lygidakis<sup>6</sup>

Received: 10 June 2019 / Accepted: 21 June 2019  
© The Author(s) 2019



Public Health  
England

# Delivering better oral health: an evidence-based toolkit for prevention

## Summary guidance tables

Third edition



Department  
of Health



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*Community Dental Health* (2016) 33, 66–68

© BASCD 2016  
doi:10.1922/CDH\_Petersen03



**Editorial**

## **Prevention of dental caries through the use of fluoride – the WHO approach**

Poul Erik Petersen and Hiroshi Ogawa

# Outline

- Fluoride Caries Protective Mechanisms
- Fluoride Modalities, Efficacy & Global Guidelines
  - Systemic Fluorides
  - Topical Fluorides
  - F as therapeutic agents in non-restorative caries treatment - Silver Diamine Fluoride

# Fluoride Caries Protective Mechanisms

- Fluoride effects on enamel
- Antimicrobial effect

## Fluoride effect on enamel

---

- Low levels of F in plaque and saliva **inhibit the demineralization** of sound enamel and **enhance the re-mineralization** of demineralized enamel
- Strong **affinity between F and apatite**, based on the ease of chemical substitution of the hydroxyl component of calcium hydroxyapatite by fluoride
- The **apatite /fluorhydroxyapatite** remains chemically stable until the tissue is resorbed, remodelled, or otherwise metabolized

Buzalaf *et al.*, 2011

# F to Remineralize early Enamel Lesions

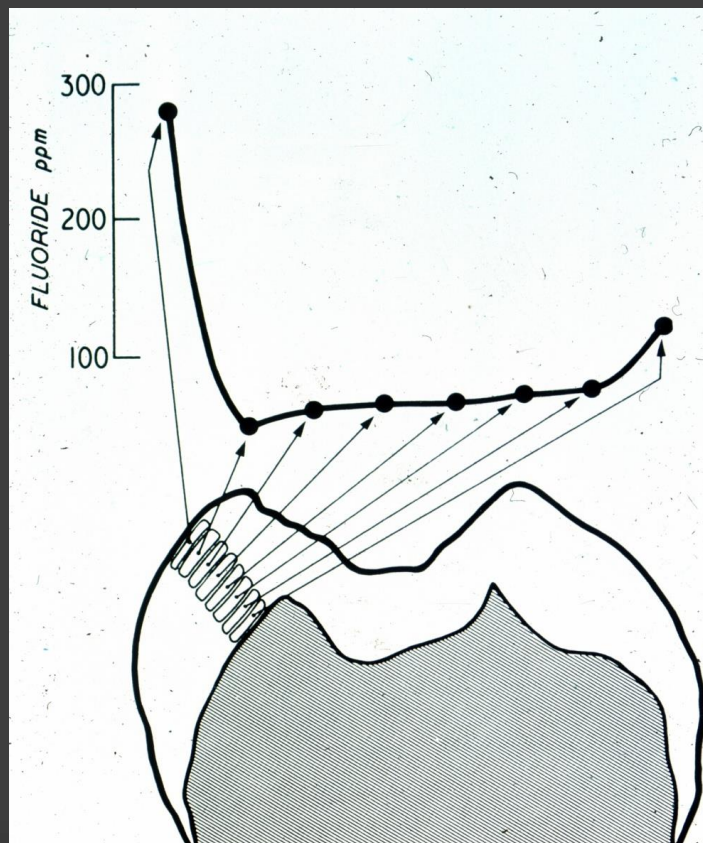
## Smooth surface lesions ICDASII

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# Outer Enamel Fluoride Rich Zone

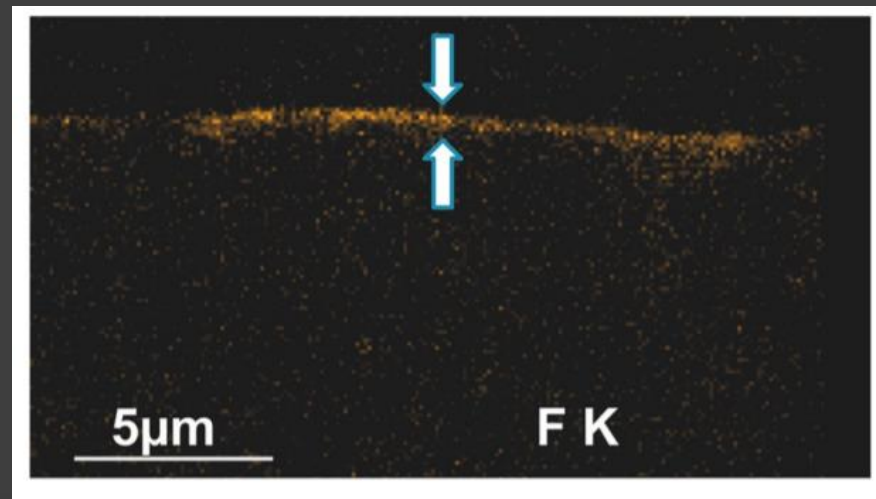


Weatherell Caries Res 17:118-124, 1983

## Exposure of enamel to fluorides leads to precipitation of $\text{CaF}_2$

- Fluoride is released from  $\text{CaF}_2$  when the pH drops in response to acid production and F becomes available to remineralize enamel or affect bacterial metabolism.

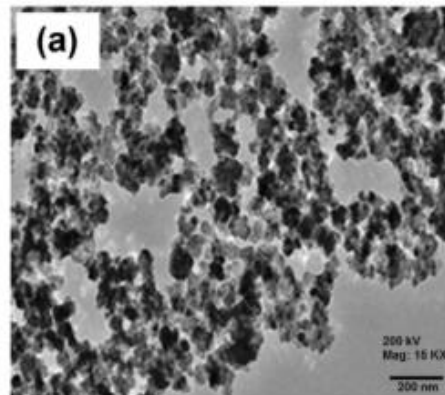
During carious attack fluoride reservoirs in enamel,  $\text{CaF}_2$  and fluoridated hydroxyapatite, liberate F



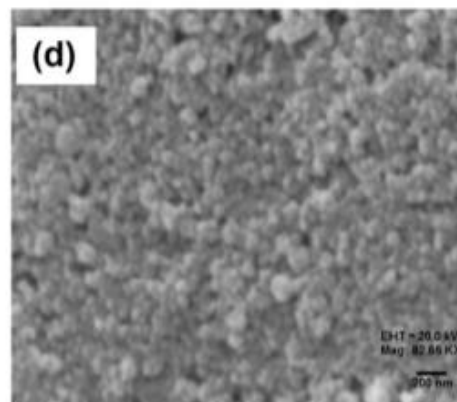
Semiquantitative energy-dispersive X-ray analysis , Scholtz et al 2019

# Calcium Fluoride nanoparticles

- Calcium fluoride nanoparticles induced suppression of *Streptococcus mutans* biofilm, CaF<sub>2</sub>-NPs may be used as a potential antibiofilm applicant against *S. mutans*
- CaF<sub>2</sub> may be applied as a topical agent to reduce dental caries.



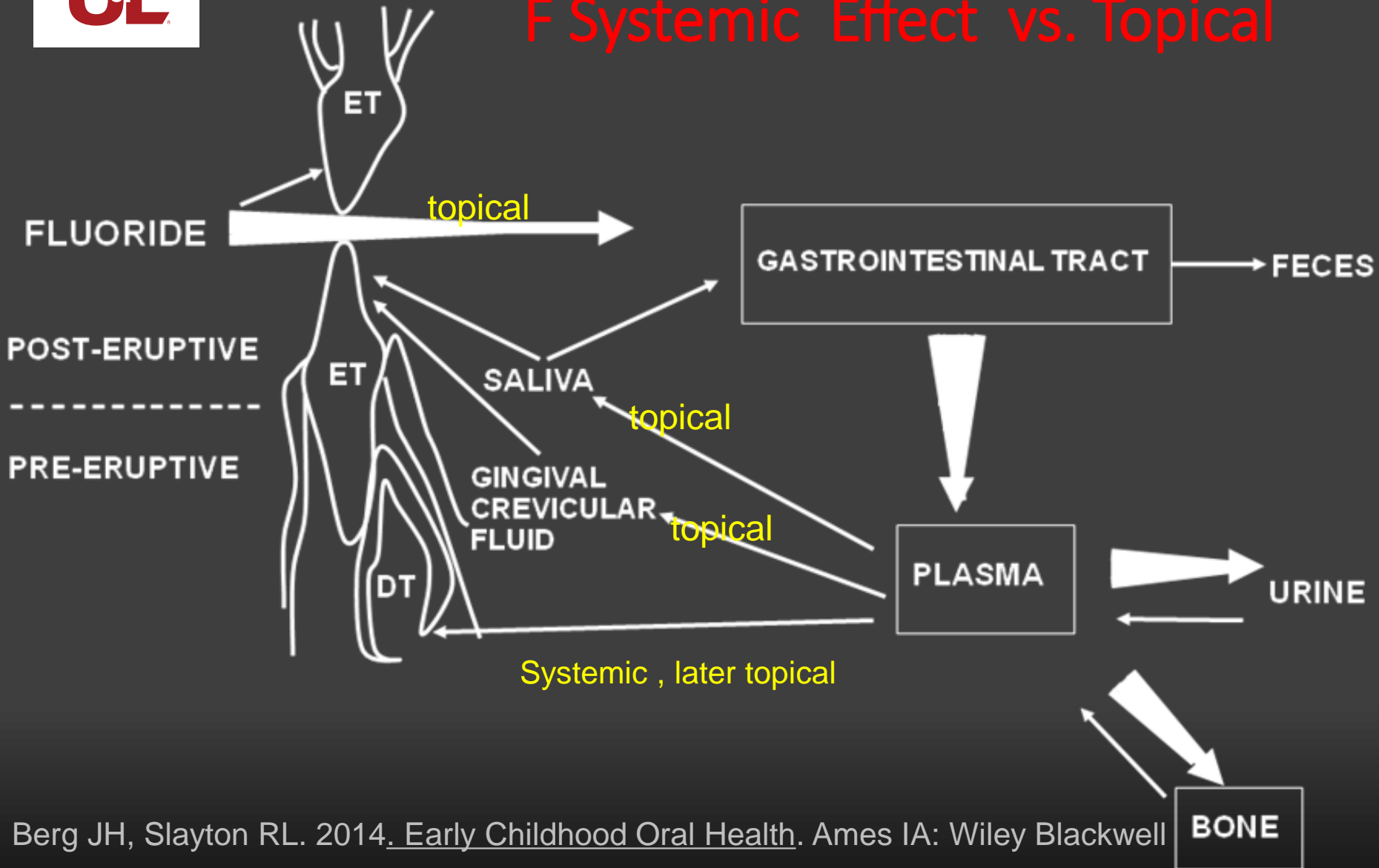
Electron  
Microscopy



SEM

Shatavari et al, 2016

# F Systemic Effect vs. Topical

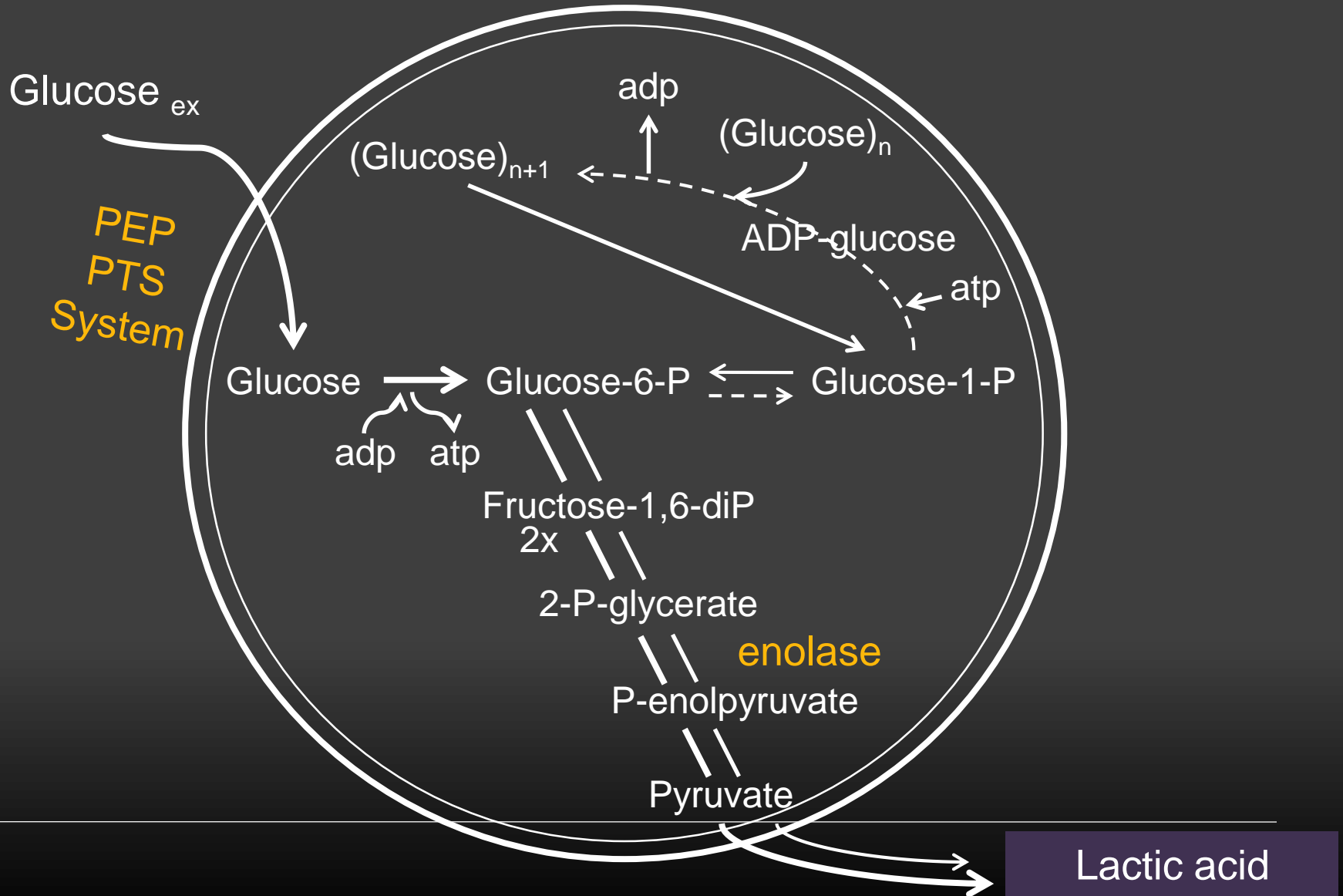


Berg JH, Slayton RL. 2014. Early Childhood Oral Health. Ames IA: Wiley Blackwell



Fluoride inhibits dental caries by affecting  
the metabolic activity of cariogenic bacteria.

# Fluoride's Effect on Cell Metabolism



# Outline

- Fluoride Caries Protective Mechanisms
- Fluoride Modality, Efficacy & Guidelines
  - Systemic Fluorides
  - Topical Fluorides
  - F as therapeutic agents in non-restorative caries treatment - Silver Diamine Fluoride



# Systemic Fluorides

Systemic Fluorides	
Community based	Home based
Water Fluoridation	Supplements
Salt	
Milk	



## Water Fluoridation Facts - WF

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- Water fluoridation is the controlled adjustment of the natural fluoride concentration in community water supplies to the concentration recommended to achieve optimal prevention of dental caries (Centers of Disease Control and Prevention 2016)
- The recommended concentration for fluoride in the water ranges from 0.5- 1.1mg/L
- In the USA, Australia and New Zealand the level is 0.7mg/L. This level effectively reduces tooth decay while minimizing dental fluorosis.
- Sodium fluoride, sodium fluorosilicate and fluorosilicic acid are the three additives approved for use in community water fluoridation in the United States.

## Water Fluoridation Anticaries effect - WF

---

- WF reduces tooth decay by 35% in the primary and 26% in the permanent dentition.
- Access to fluoridated water from an early age is associated with less tooth decay in adults.

Cochrane review by Ileozer –Ejiofor et al. 2015

# WF around the world

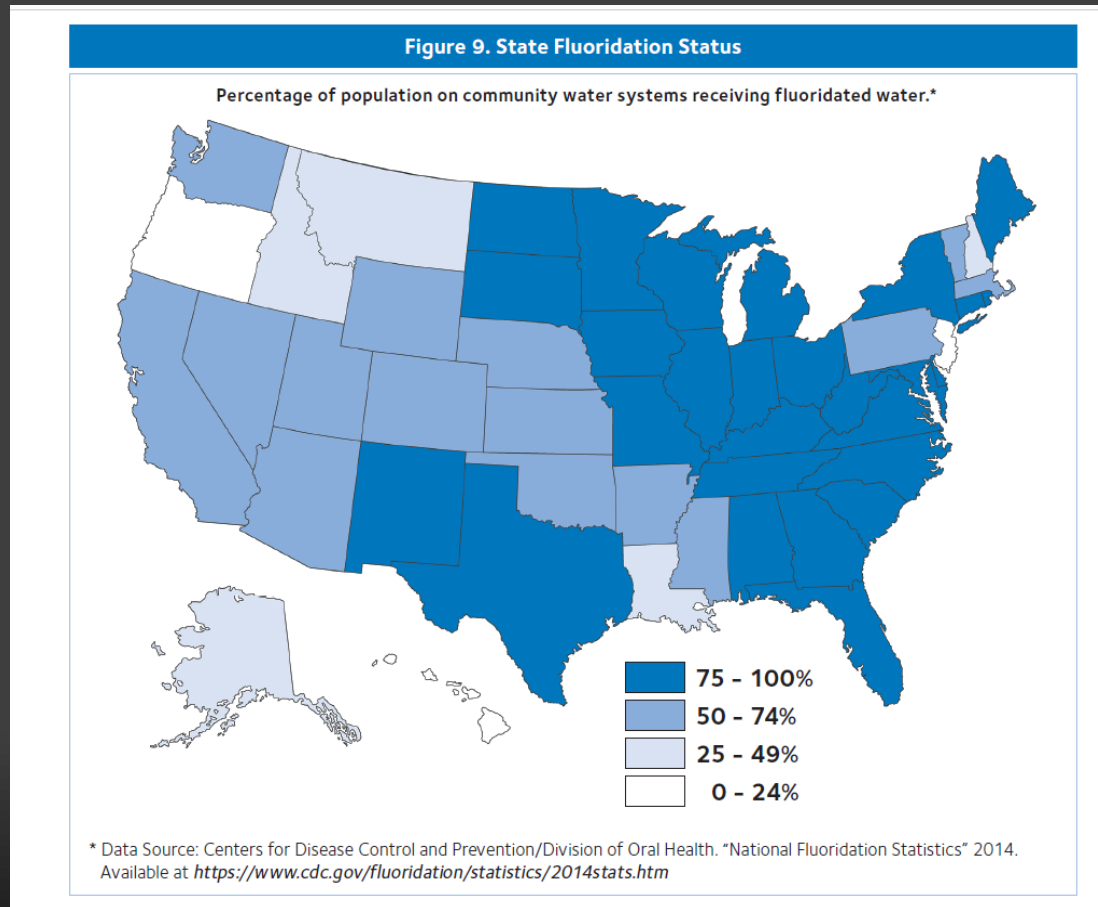
- 435 million drink F water
- 57 million naturally F

Pollick et al 2015

The Extent of Water Fluoridation in the U.S. and Other Countries: Population Served by Optimally Fluoridated Water

Country	Fluoridated water
United States	204 million
Brazil	73 million
Malaysia	20 million
Australia	17 million
Canada	14 million
Chile	11 million
Hong Kong	7 million
Great Britain	5.8 million
Israel	5.3 million
Singapore	5 million
Spain	4.2 million
Vietnam	3.5 million
Ireland	3.2 million
Argentina	3 million
South Korea	2.8 million
New Zealand	2.3 million
Guatemala	1.8 million
Peru	0.5 million
Panama	0.5 million
Others	52 million
Total	435 million

## Fluoridation Facts. ADA 2018





# Water Fluoridation

## Hospital admissions of children

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- Hospital admissions for caries-related tooth extractions, were 59% lower in areas with fluoride of  $\geq 0.7$ mg/l, compared to areas with  $< 0.1$ mg/L.
- Fluorosis of a level corresponding to at least mild aesthetic concern, was 10.3% in the 2 fluoridated cities and 2.2% in the non-fluoridated cities.

**Health monitoring report for England 2018**

---


# Cost of water fluoridation

2017

Moore et al. *BMC Oral Health* (2017) 17:134  
DOI 10.1186/s12903-017-0433-y

BMC Oral Health

RESEARCH ARTICLE Open Access

The costs and benefits of water fluoridation in NZ 

David Moore<sup>1</sup>, Matthew Poynton<sup>1</sup>, Jonathan M. Broadbent<sup>2</sup> and W. Murray Thomson<sup>2\*</sup>

While fluoridating reticulated water supplies for **large communities is cost-effective**, it is unlikely to be so with populations smaller than 500.

The health benefits—while (on average) small per person—add up to a substantial reduction in the national disease burden across all ethnic and socioeconomic groups.

# Fluoride toxicity facts

- Fluoride optimal dose 0.05mg/Kg/day  
Institute of Medicine 1997
- Fluoride Probable Toxic Dose 5 mg/F-/Kg
- The highest risk of fluorosis is when F exposure takes place in both the secretory and the maturation phase of the enamel
- The susceptibility period for risk for fluorosis of permanent incisors and molars is when above optimal ingestion of F occurs between the age of 15-30 months

EAPD F guidelines 2009, 2019

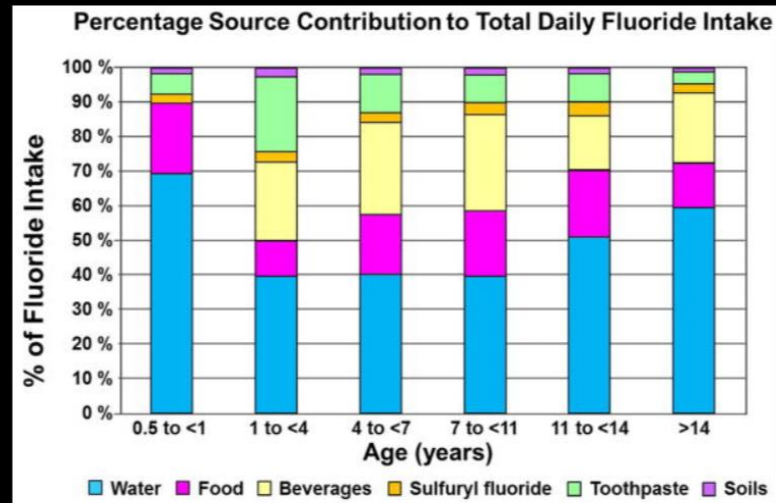
# Mild Fluorosis

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# Fluoride Halo effect



[See this image and copyright information in PMC](#)

**Figure 1. Halo Effect Sources** Percentage source contribution to total daily fluoride intake: 90th Percentile Drinking Water Intakes for Consumers Only and a Fluoride Concentration of 0.87 mg/L. Image from Environmental Protection Agency. Fluoride: Exposure and Relative Source Contribution Analysis. 2010, page 99.

Carey 2014

# Health claims against water Fluoridation

to remove excess iron, magnesium, aluminum, calcium, and other minerals, as well as fluoride, from tap water before the water is used for dialysis.<sup>173</sup>

## 46. What are some of the erroneous health claims made against water fluoridation?

### Answer.

From sources such as the internet, newsletters, social media and personal anecdotes in emails, it is frequently claimed that community water fluoridation causes the following adverse health effects:

- AIDS
- Allergic Reactions (e.g., loss of hair, skin that burns and peels after contact with fluoridated water)
- Accelerated Aging
- Alzheimer's disease
- Arthritis
- Asthma
- Autism
- Behavioral Problems (e.g., attention deficit disorders)
- Bone Disease (e.g., osteoporosis – increased bone/hip fractures)
- Cancer (all types including osteosarcoma or bone cancer)
- Chronic Bronchitis
- Colic (acute abdominal pain)
- Cystic Fibrosis
- Down Syndrome
- Emphysema
- Enzyme Effects (gene-alterations)
- Flatulence (gas)
- Gastrointestinal Problems (irritable bowel syndrome)
- Harmful Interactions with Medications
- Heart Disease
- Increased Infant Mortality
- Low Birth Weight for Infants
- Kidney Disease
- Lead Poisonings
- Lethargy (lack of energy)
- Lower IQ scores

- Sudden Infant Death Syndrome (SIDS)
- Thyroid Problems (goiter and obesity due to hypothyroidism)

AND

- Tooth Decay

### Fact.

As discussed throughout this document, the best available scientific evidence consistently has indicated that fluoridation of community water supplies is safe and effective. The possibility of any adverse health effects from continuous low-level consumption of fluoride has been and continues to be studied extensively. Of the thousands of credible scientific studies on fluoridation, none has shown health problems associated with the consumption of optimally fluoridated water.

*Of the thousands of credible scientific studies on fluoridation, none has shown health problems associated with the consumption of optimally fluoridated water.*

**Fluoridation facts. ADA, 2018**

Despite statistical evidence of associations between exposure to fluoridation and certain health effects in this report, the overall analysis and weight of evidence means causal associations are unlikely.

Water Fluoridation: Health monitoring report for England 2018

## Water Fluoridation around the world

	Optimum F levels	Total F intake/day
AAPD 2018	0.7 mg/L	
Australian Research Center for Population Oral Health 2019	0.6-1.1mg/L	0.05 mg /kg
Canadian 2012	1.5mg/L	0.05 mg /kg
EAPD 2019	0.5-1.1 mg/L	0.07mg/kg
New Zealand 2017	0.7 mg/L	0.05 mg /kg
Public Health England Sign 2018	0.7 mg/L	
WHO 2016	0.5mg/L to 1.0mg/L	

---

<b>IAPD 2020</b>	<b>Optimal fluoride levels in water supplies for the prevention and control of caries is both safe and effective in reducing dental caries prevalence.</b>
<b>WHO 2016</b>	<b>Adequate exposure to fluoride is an essential factor in the prevention of dental caries. An optimal level of fluoride can be obtained from different sources such as fluoridated drinking water, salt, milk and toothpaste</b>

INFORMATION FOR PARENTS AND CARERS

# Fluoridated milk

Primary School Scheme



[www.blackpool.gov.uk/Fluoride](http://www.blackpool.gov.uk/Fluoride)  
f BpoolCouncil

BlackpoolCouncil

# Milk fluoridation as a community preventive measure

- Milk Fluoride concentration from 2.5 to 7.5 mg/L
- Suboptimal fluoride concentration in drinking water
- Caries experience in children is significant
- There is an existing school milk program
- Commence before the children are 4 years of age.

## Countries Using Milk Fluoridation on a Limited Basis

Bulgaria

Chile

China

Peru

Russia

Thailand

United Kingdom

*Pollick et al 2015*

RESEARCH ARTICLE

Open Access



## Cost-effectiveness analysis of a school-based dental caries prevention program using fluoridated milk in Bangkok, Thailand

Rodrigo Mariño<sup>1\*</sup>, Fernando Traub<sup>1</sup>, Puangtong Lekfuangfu<sup>2</sup> and Kornkamol Niyomsilp<sup>2</sup>

- N=75.000, children aged 6 to 12-years, duration of study for 6 years
- After 6 years, in the milk-fluoridation program had a significant (34%) reduction in dental caries experience (DMFS: 1.06 vs. 1.60).
- Cost-effectiveness
- In areas where communities are at higher risk of dental caries would provide a more cost-effective result.

## Fluoridated milk

### Systematic reviews

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- The consumption of Fluoridated milk is an effective measure to prevent caries in **primary teeth** and there is a **low level** of evidence **for permanent teeth**.

Cagetti et al 2013

- There is **low-quality** evidence to suggest fluoridated milk may be beneficial to schoolchildren, contributing to a substantial reduction in dental caries in primary teeth.

Yeung et al, 2015

<b>EAPD 2019</b>	<b>Conditional Recommendation</b>
<b>WHO 2016</b>	<b>Encouraging but further research needed</b>





 SCIENTIFIC BACKGROUND

## Fluoridated salt

A cost-effective way to prevent dental caries at community level

Copyright © Toothfriendly Salt

© 2015 Toothfriendly International

# Salt fluoridation as a community-based alternative to water

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- Introduced in Switzerland in the 1950s
- Owing to the risk of increased fluoride intake from both fluoridated water and fluoridated salt, it is recommended that one or the other be used in individual countries
- Planning new salt fluoridation programs requires mapping of the natural fluoride content of water, and necessary measures to keep fluoridated salt away from regions with more than 0.7 ppm F in water.
- Promoting salt fluoridation could be contraindicated from the perspective of general public health, because greater salt consumption is linked to hypertension.

## Salt fluoridation

- Put into salt for 250mgF/Kg
- There is a wide margin of safety regarding fluoride intake from fluoridated salt.
- It is estimated that fluoride intake from fluoridated salt is 0.5–0.75 mg per day.

Countries Using Salt Fluoridation

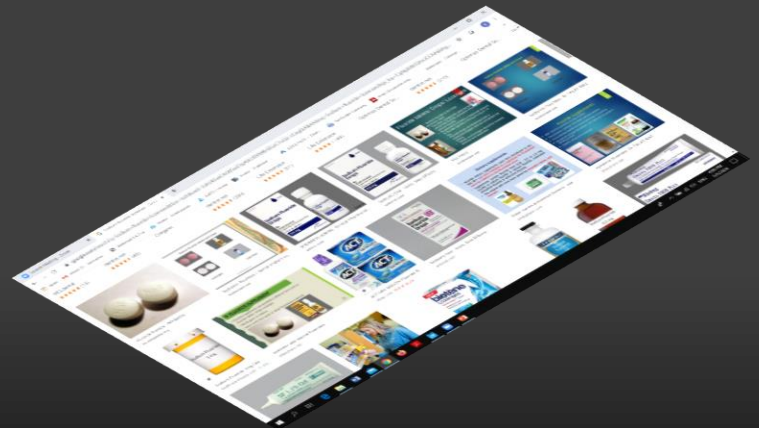
Continent	Country
Europe	Switzerland, France, Germany, Spain, Finland, Poland, Serbia, Czech Republic, Slovakia, Belgium, Denmark, Austria, Romania
North America	Mexico, Jamaica, Belize, Costa Rica, Cuba, Dominican Republic
South America	Colombia, Peru, Bolivia, Ecuador, Uruguay, Venezuela

# Fluoridated Salt

<b>EAPD 2019</b>	<b>Conditional Recommendation</b>
<b>WHO 2016</b>	<b>To be considered when WF is not feasible, economical</b>

# Fluoride supplements

---



# Fluoride supplements

- Effective in reducing prevalence of dental caries and should be considered for **children at high caries** risk who drink fluoride-deficient (less than 0.6 ppm F) water .  
AAPD 2018
- Determination of dietary fluoride before prescribing supplements can help reduce intake of excess fluoride.

AAPD 2018

- There is no evidence that fluoride supplements taken by women during pregnancy are effective in preventing dental caries in their offspring.

Systematic Review Takahashi et al, 2017

# Guidelines on dietary fluoride supplements

		<0.3 ppm F	0.3 to 0.6 ppm F
<b>AAPD 2018</b>  F level in drinking water >0.6 ppmF- no supplements	Birth to 6 months	0	0
	6 mo to 3 years	0.25 mg	0
	3 to 6 years	0.50 mg	0.25 mg
	6 to at least 16 years	1.00 mg	0.50 mg
<b>Australian Research Center for Population Oral Health 2019</b>	Not to use Supplements		
<b>Canadian 2012</b>	Total daily fluoride intake from all sources not to exceed 0.05-0.07 mgF/Kg body weight		
<b>EAPD 2009</b>  (F level <0.3 mg F/L in drinking water)	0 – 24 month	0	
	2-6 years	0.25 mg	
	7-18 years	0.50 mg	
<b>New Zealand GG 2009</b>	3-5 years		0.25 mg fluoride/day
	6-8 years		0.5 mg
	9 years and over		1 mg
<b>Public health England Sign 2017</b>	In favor of using fluoride toothpaste rather than supplements		



## IAPD Consensus Recommendations 2020

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**IAPD 2020**

**Dietary fluoride supplements are effective in reducing dental caries and should be considered for children at caries risk who drink fluoride-deficient water.**



# Outline

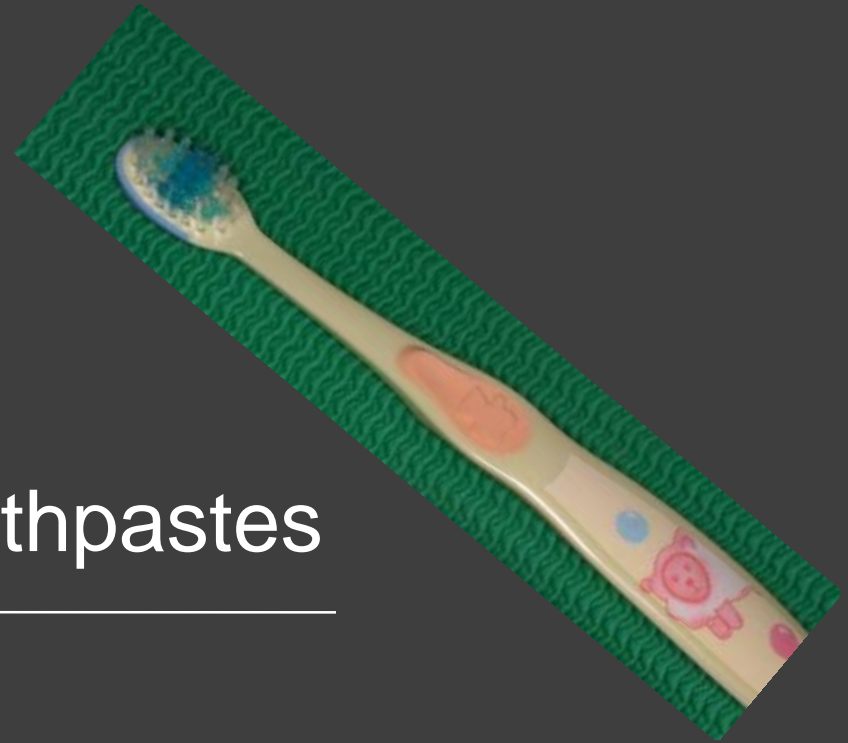
- Fluoride Caries Protective Mechanisms
- Fluoride Modality, Efficacy & Guidelines
  - Systemic Fluorides
  - Topical Fluorides
  - F as therapeutic agents in non-restorative caries treatment - Silver Diamine Fluoride

## Topical Fluorides

At Home	In Office
Toothpastes	Professionally applied
Mouthrinses	
Prescription strength F products	Silver Diamine Fluoride

# Fluoride Toothpastes

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[Intervention Review]

## Fluoride toothpastes of different concentrations for preventing dental caries

Tanya Walsh<sup>1</sup>, Helen V Worthington<sup>2</sup>, Anne-Marie Glenny<sup>1</sup>, Valeria CC Marinho<sup>3</sup>, Ana Jeroncic<sup>4</sup>

<sup>1</sup>Division of Dentistry, School of Medical Sciences, Faculty of Biology, Medicine and Health, The University of Manchester, Manchester, UK. <sup>2</sup>Cochrane Oral Health, Division of Dentistry, School of Medical Sciences, Faculty of Biology, Medicine and Health, The University of Manchester, Manchester, UK. <sup>3</sup>Clinical and Diagnostic Oral Sciences, Barts and The London School of Medicine and Dentistry, Queen Mary University of London, London, UK. <sup>4</sup>Department of Research in Biomedicine and Health, University of Split School of Medicine, Split, Croatia

**Contact address:** Tanya Walsh, Division of Dentistry, School of Medical Sciences, Faculty of Biology, Medicine and Health, The University of Manchester, Coupland Building 3, Oxford Road, Manchester, M13 9PL, UK. [tanya.walsh@manchester.ac.uk](mailto:tanya.walsh@manchester.ac.uk).

**Editorial group:** Cochrane Oral Health Group

**Publication status and date:** Edited (no change to conclusions), published in Issue 11, 2019.

**Citation:** Walsh T, Worthington HV, Glenny AM, Marinho VCC, Jeroncic A. Fluoride toothpastes of different concentrations for preventing dental caries. *Cochrane Database of Systematic Reviews* 2019, Issue 3. Art. No.: CD007868. DOI: [10.1002/14651858.CD007868.pub3](https://doi.org/10.1002/14651858.CD007868.pub3).

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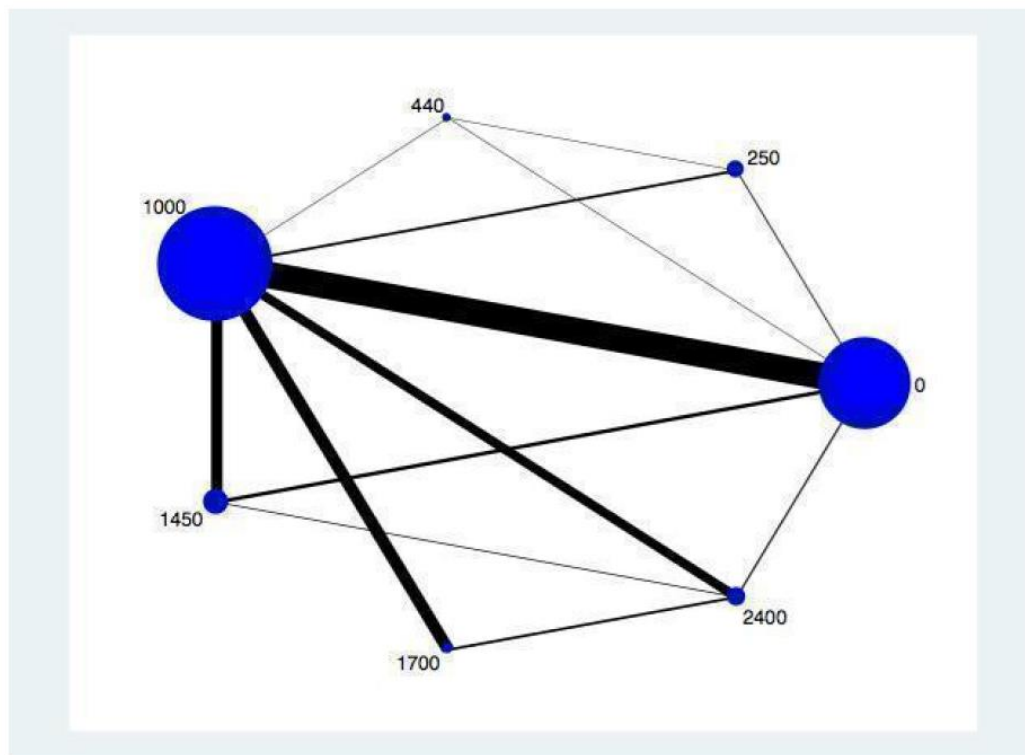
- 96 randomised controlled trials published between 1955 and 2014, 13 were new
- GRADE methodology (GRADE 2004)

# Network Meta Analysis Diagram

**Walsh et al, 2019**

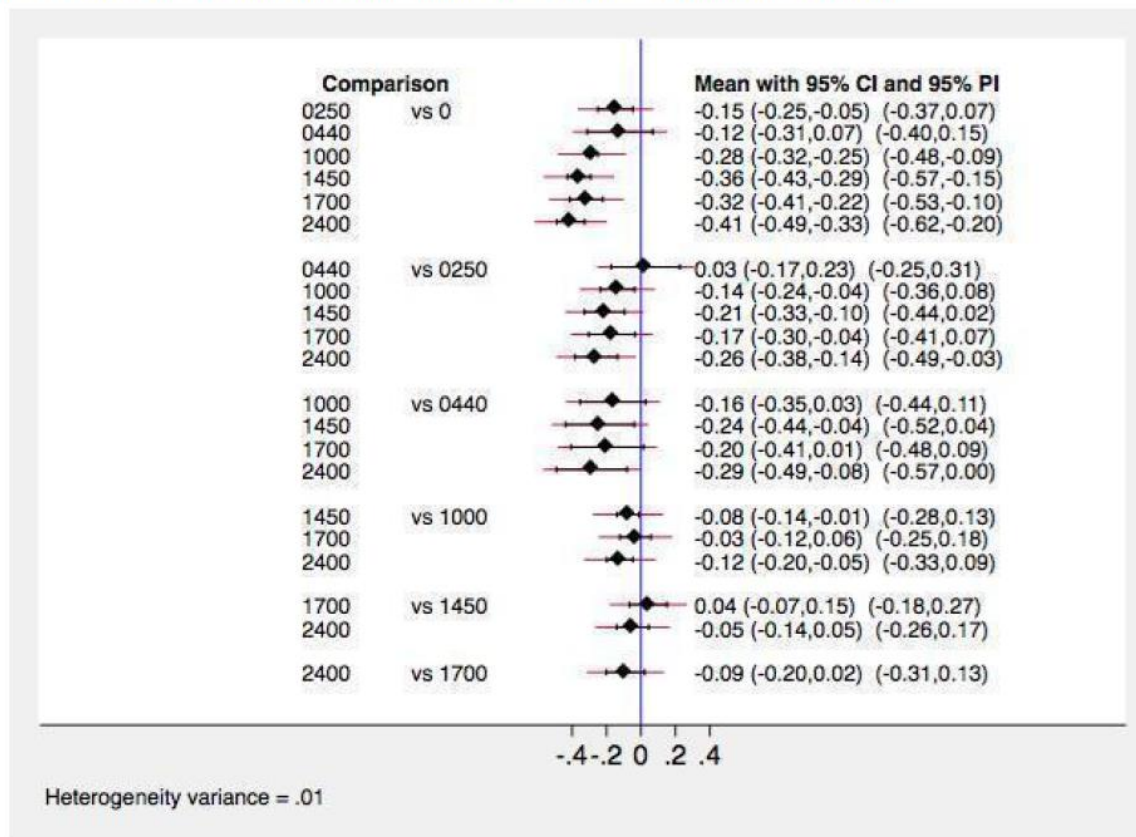
comparator group (lower fluoride concentration).

Figure 4. Plot of the decayed, missing, filled surfaces (D(M)FS) network in children and adolescents (immature permanent dentition).



# F toothpastes of different concentrations for preventing dental caries

Figure 5. Forest plot of 95% confidence intervals (CI) and predictive intervals (PI) for the decayed, missing, filled surfaces (D(M)FS) network in children and adolescents (immature permanent dentition).



Walsh et al, 2019

## Primary dentition

- 1500 ppm F toothpaste reduces dfs when compared with placebo.
- 550 ppm with 1055 ppm F toothpaste similar
- 1450 ppm F slightly reduces deft when compared with 440 ppm F toothpaste.

## Immature permanent dentition

- 1000 to 1250 ppm or 1450 to 1500 ppm preventive benefit when compared with non-fluoride toothpaste
- 1450 to 1500 ppm slightly reduces DMFS compared to 1000 to 1250 ppm
- DMFS similar for 1700 to 2200 ppm and 2400 to 2800 ppm toothpaste when compared to 1450 to 1500 ppm

## Mature permanent dentition

- Toothbrushing with 1000 or 1100 ppm fluoride toothpaste reduces DMFS compared with non-fluoride toothpaste

## Caries preventive effect of F toothpaste

**Table 3** Caries-preventive effect of fluoride toothpaste

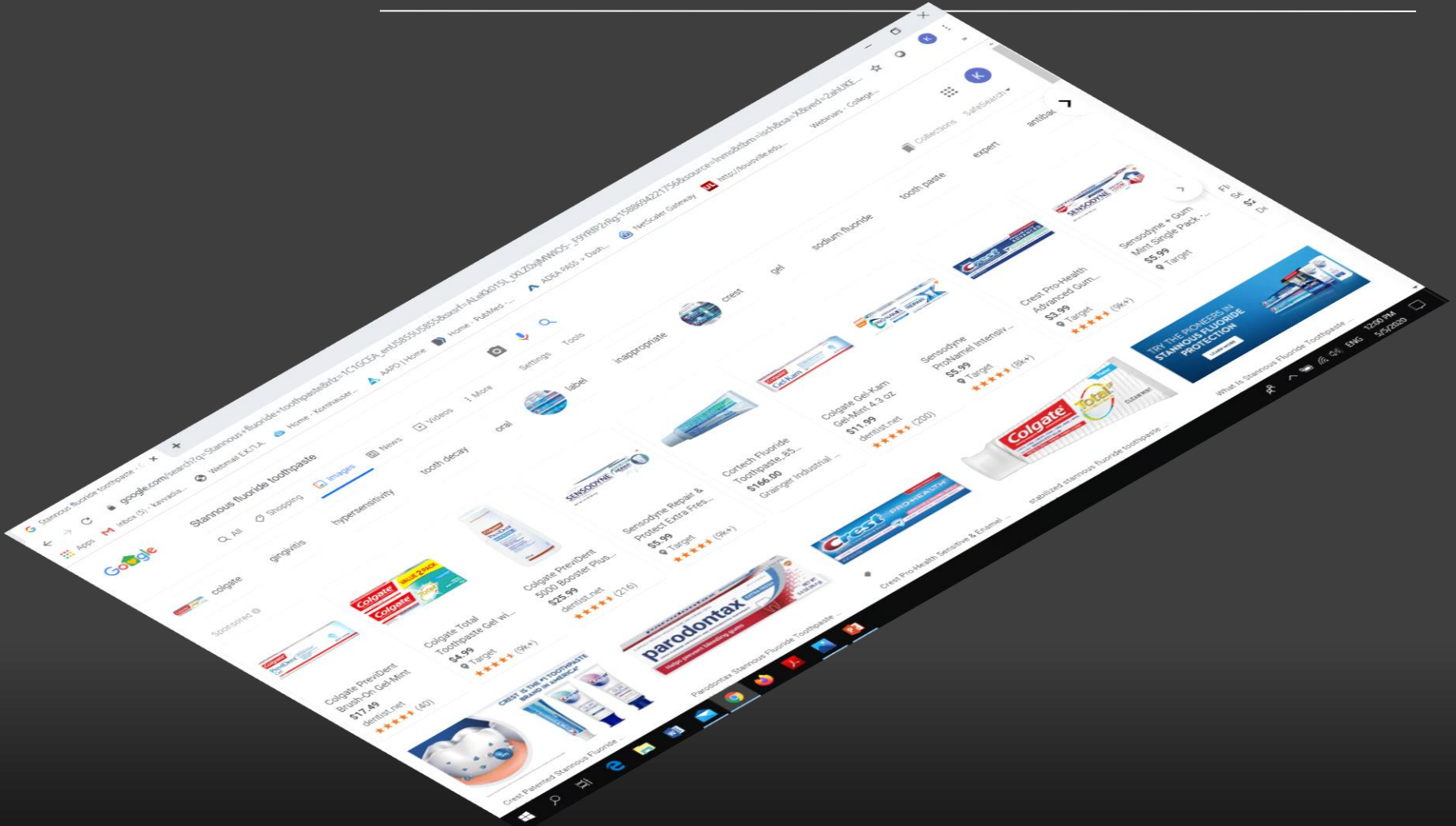
Intervention	Control	PF % (95% CI)
Fluoride toothpaste	Placebo	24 (21–28)
Supervised brushing	Non-supervised	11 (4–18)
Brushing twice per day	Once per day	14 (6–22)
1450–1500 ppm F	1000–1100 ppm F	8 (1–16)
Fluoride toothpaste + other sources*	Fluoride toothpaste	10 (2–17)

Marinho 2009, EAPD Guidelines 2019

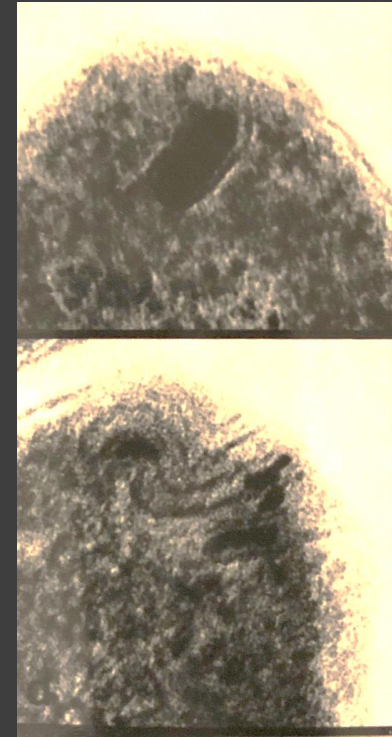
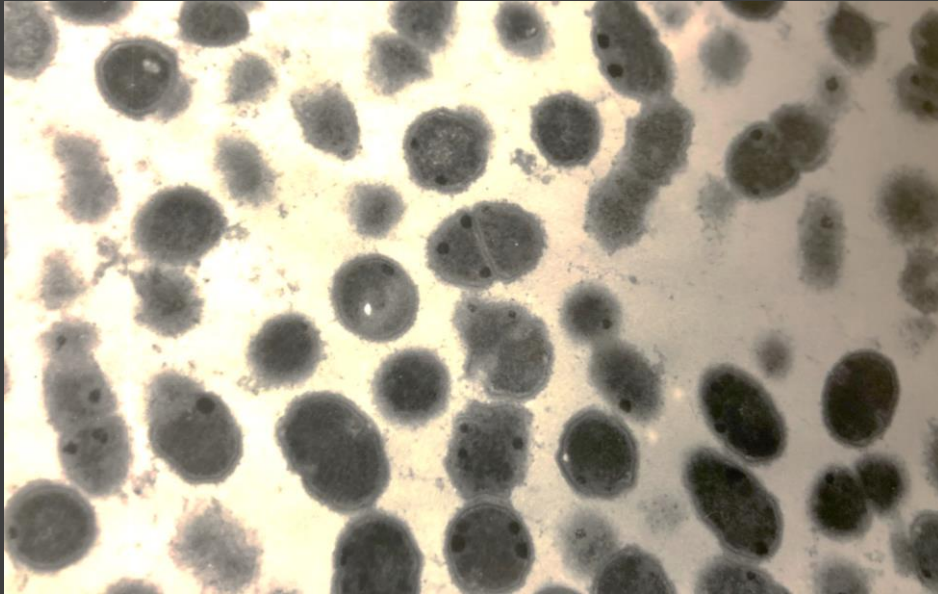




# Stannous Fluoride Toothpastes



# Stannous Fluoride Antimicrobial Effect



Stannous Fluoride Effects on Growth and Viability of Selected oral Bacteria E  
Kavvadia, University of Connecticut Digital Commons@UConn, 1988



## Recommended use of fluoride toothpaste in children

	Age group	Fluoride ppm F-	Daily use	Amount daily
AAPD 2018	<3 yrs	1000	twice	Smear/Rice size
	3-6	1000	twice	Pea size
Australian 2019	18months-5yrs	500-550	twice	Small Pea size
	6 >	1000-1450	twice	
	Teenagers at high risk	5000		
EAPD 2019	1 <sup>st</sup> tooth -2 yrs	1000	twice	Grain of rice- 0.125g
	>2-6 yrs	1000 (+)	twice	Pea size- 0.25g
	>6 yrs	1450	twice	1-2cm- 0.5-1.0g
NZ	<6	1000		Smear layer
	>6	1000		Pea size
Public Health England Sign 2017	<3	1000	twice	Smear layer
	3-6	1000	twice	Pea size
	0-6 at high risk	1350-1500	twice	
	7>	1350-1500	twice	
	10-16 t high risk	2800	twice	
	>16 at high risk	5000	twice	



## IAPD Consensus Recommendations 2020

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**IAPD 2020**

**Fluoridated toothpaste is effective in reducing dental caries in children. Using measured amounts in children under 6 years of age may decrease risk of fluorosis**

# The Evidence, recommendations and good practice points for the use of fluoride mouthrinses

<i>Modality</i>	<i>Grade of the Evidence</i>	<i>Recommendations</i>	<i>Good practice points and clinical advice</i>
<b>Mouthrinse</b> Daily: 0.05% NaF (225ppm F)	<b>Primary teeth</b> <b>No evidence</b>	NOT to be used under 6 years of age due to risk of swallowing	
Weekly : 0.2% NaF (900 ppm F)	<b>Permanent teeth</b> <b>Moderate</b>	<b>Conditional</b>	<ul style="list-style-type: none"> <li>• Supervised use more efficacious than unsupervised</li> <li>• 10 ml of solution should be kept in the mouth for 1'</li> <li>• No food and liquid consumption for 20'-30'</li> </ul>

AAPD 2018, EAPD 2019, Australian 2020

## Fluoride mouthrinses

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<b>IAPD 2020</b>	<b>0.09 percent fluoride mouthrinse-are effective in reducing dental caries</b>
<b>WHO 2016</b>	<b>School mouthrinse programs in communities with low F exposure based on the cost and caries status of the community Concerns for the ethanol content</b>

- Evidence for adults to prevent root caries (Twetman et al 2004)
- Caries reduction 26% (Marinho et al, 2003)



# Home use of 0.5 percent fluoride gels & pastes

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# Effect of 0.5% Fluoride Pastes and Gels on Caries Prevalence or Increment

Outcome Measures	Number and type of studies	Number of participants	Standardized Mean Difference [95% Confidence Interval] (negative favors intervention)
0.5% fluoride paste, permanent teeth			
DMFT prevalence	1 CCT	236	-0.43 [-0.69, -0.17]
0.5% fluoride gel applied professionally or supervised at school, primary teeth			
dmfs increment	1 RCT	676	-0.16 [-0.31, -0.01]
0.5% fluoride gel applied professionally or supervised at school, permanent teeth			
DMFS increment	6 RCT	2,653	35.6 % reduction from 6 trials

Weyant et al 2014





## Fluoridation Facts. ADA 2018

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IAPD 2020

Home use of 0.5 percent fluoride gels and pastes; and prescription-strength, are effective in reducing dental caries.

# Professionally applied F gels

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**Cochrane  
Library**

Cochrane Database of Systematic Reviews

**2015**

**Fluoride gels for preventing dental caries in children and adolescents (Review)**

Marinho VCC, Worthington HV, Walsh T, Chong LY

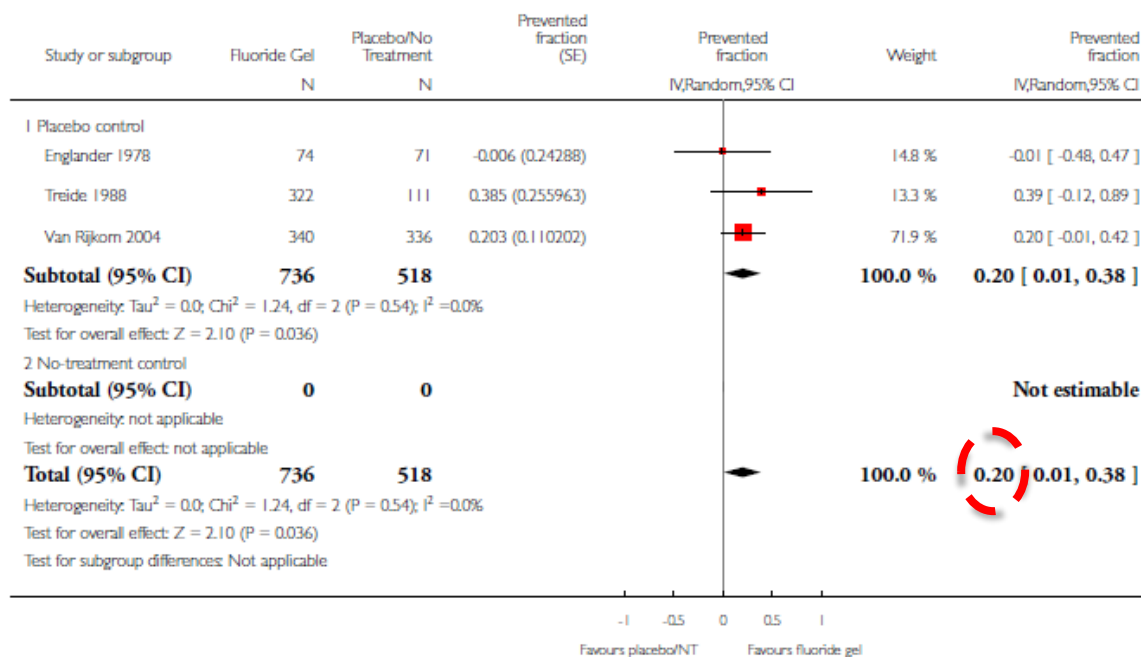
- Permanent dentition : moderate quality evidence of a large caries-inhibiting effect
- Primary dentition: shows a large effect based on low quality evidence

## Analysis 1.3. Comparison 1 Fluoride gel versus placebo or no treatment, Outcome 3 d(e/m)fs increment - nearest to 3 years (3 trials).

Review: Fluoride gels for preventing dental caries in children and adolescents

Comparison: 1 Fluoride gel versus placebo or no treatment

Outcome: 3 d(e/m)fs increment - nearest to 3 years (3 trials)



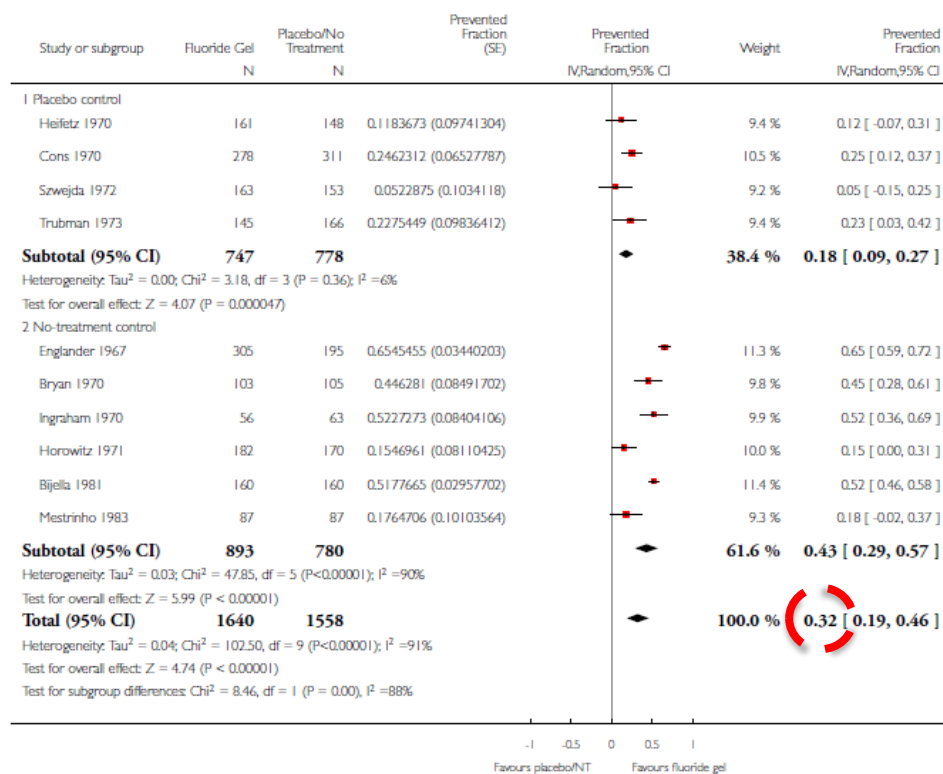
Marinho et al 2015

## Analysis 1.2. Comparison 1 Fluoride gel versus placebo or no treatment, Outcome 2 D(M)FT increment - nearest to 3 years (10 trials).

Review: Fluoride gels for preventing dental caries in children and adolescents

Comparison: 1 Fluoride gel versus placebo or no treatment

Outcome: 2 D(M)FT increment - nearest to 3 years (10 trials)



Marinho et al 2015

## The Evidence, recommendations and good practice points for the use of fluoride Gels

<i>Modality</i>	<i>Grade of Evidence</i>	<i>Recommendations</i>	<i>Good practice points and clinical advice</i>
Gel (5000-12500 ppm F)	<b>Primary teeth</b> None	Not recommended in children < 6 Australia 10 Risk of swallowing	<ul style="list-style-type: none"> <li>• Application 2-4 times per year , depending on patient's caries risk</li> <li>• Dental plaque removal before the application</li> <li>• Caution to prevent toxicity ( 5 mg/kg)</li> <li>• No food and liquid consumption for 20'-30'</li> </ul>
	<b>Permanent teeth</b> Moderate	Conditional	

Australia 2019, AAPD 2019, EAPD 2019

## Prophylaxis before APF gel application

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- No benefit was found for performing prophylaxis before the application of 1.23 percent fluoride (APF) gel for the primary and permanent dentition of children.

Weyant et al 2014

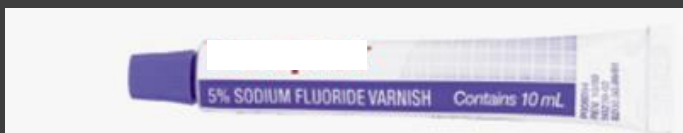
# Professionally applied F varnishes

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# Fluoride Varnish



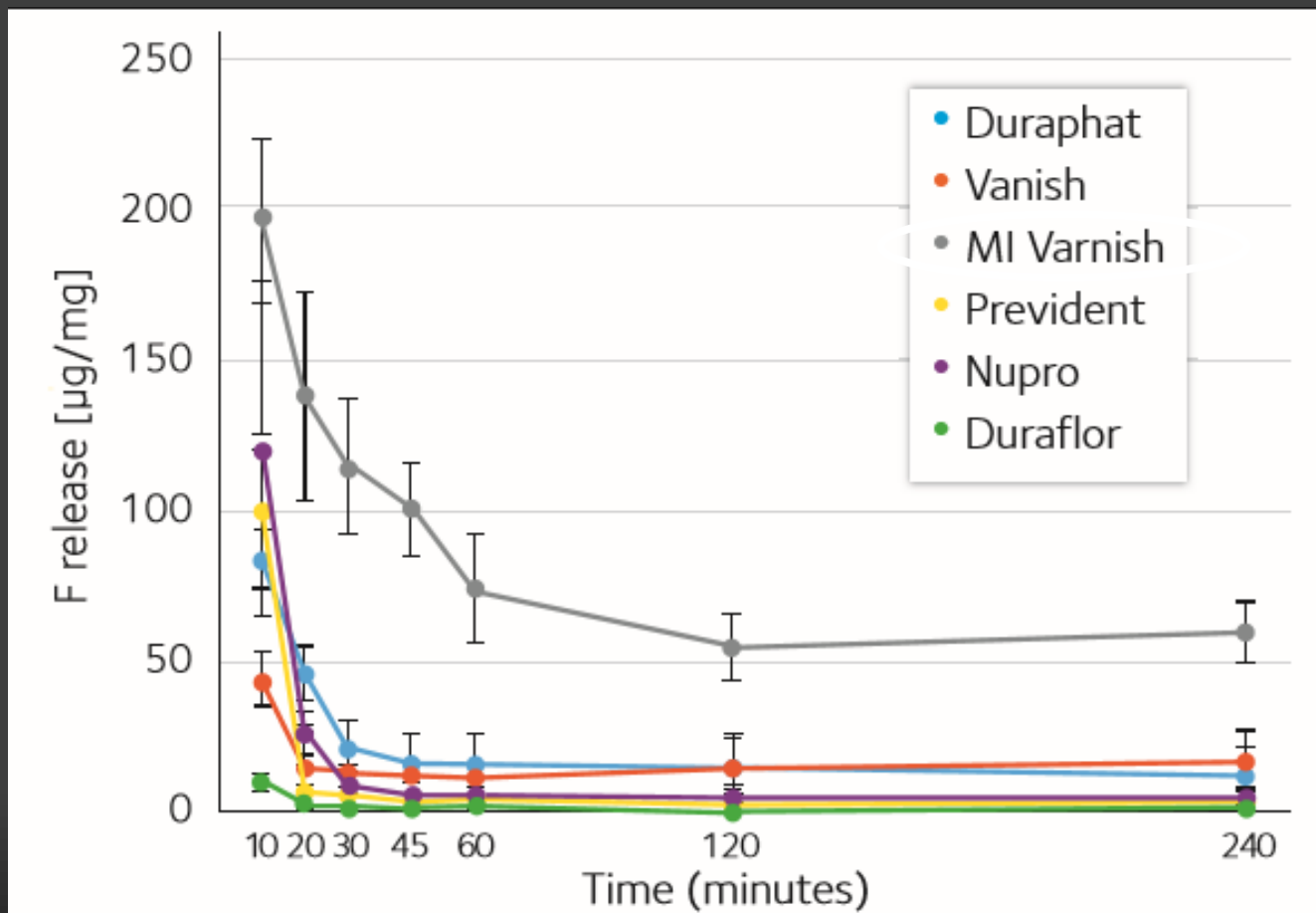
5% NaF = 50mg NaF/ml,  
2.26% F = 22.6mgF/ml



5.6 mgF, 0.25ml

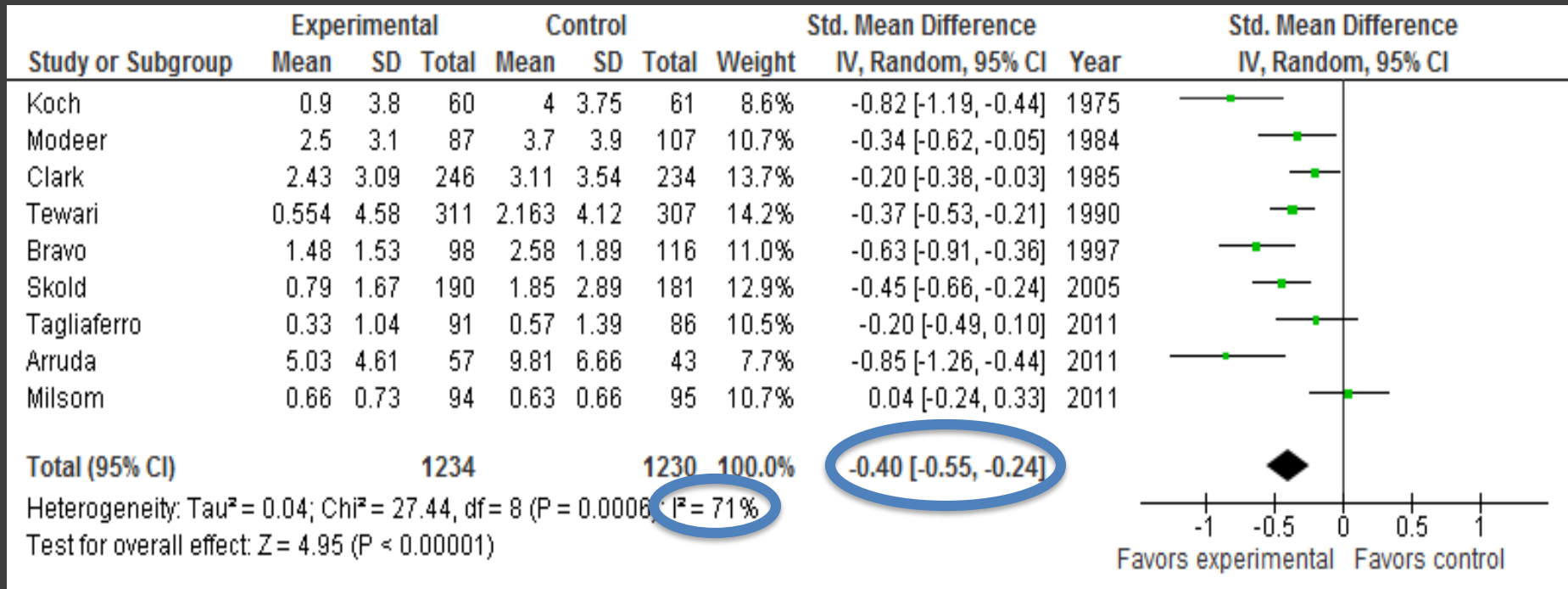


# Fluoride Release from Varnishes



# 5% NaF varnish on permanent teeth [DMFS]

PF=40%

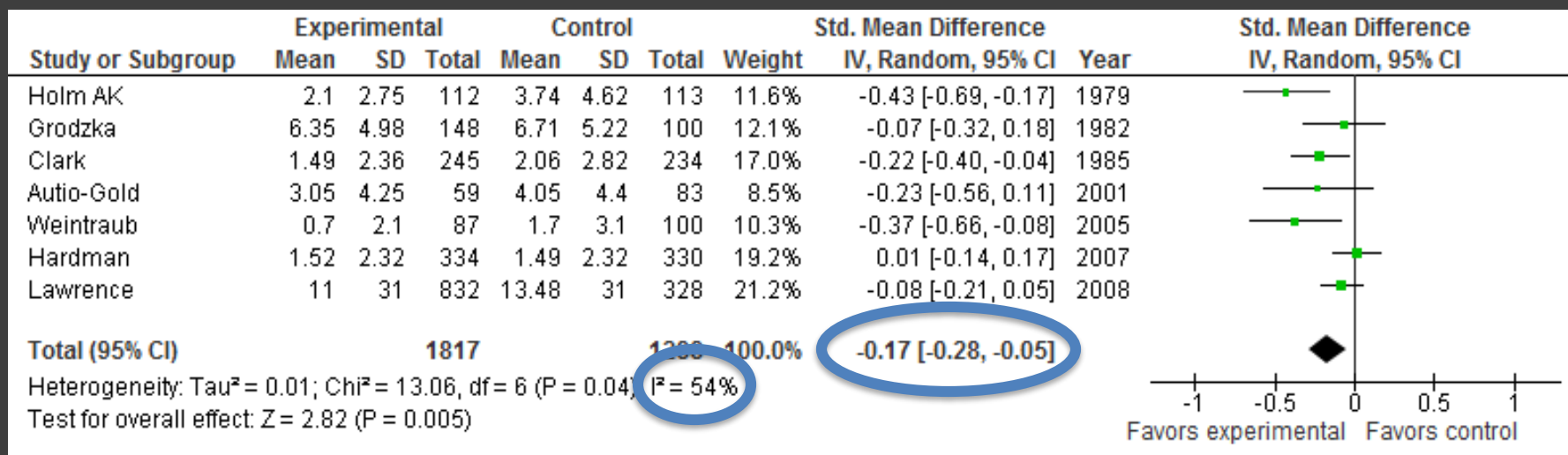


**Moderate certainty** for a **benefit** of 5% NaF FV application at least x2/year for caries prevention in the permanent teeth

Weyant et al 2014

# 5% NaF varnish on primary teeth demfs

## PF=17%



**Moderate certainty** for a **small benefit** of 2.26% fluoride varnish application x2/year for caries prevention in the primary teeth

Weyant et al 2014

# FV and Reversal of Early carious lesions

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**COVER STORY**

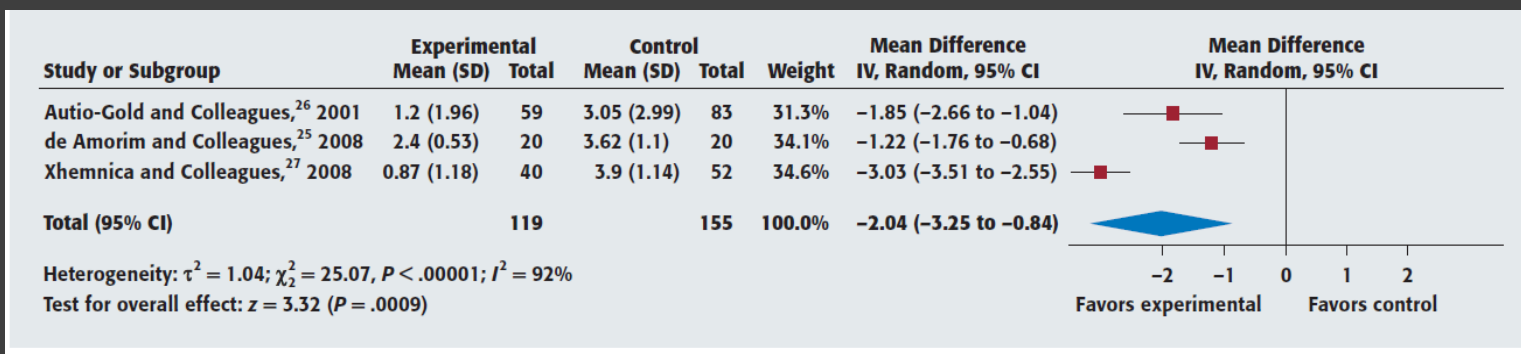
# Are topical fluorides effective for treating incipient carious lesions?

A systematic review and meta-analysis

Tathiane Larissa Lenzi, MSc, PhD; Anelise Fernandes Montagner, MSc, PhD; Fabio Zovico Maxnuck Soares, PhD; Rachel de Oliveira Rocha, MSc, PhD

**ABSTRACT**

**Background.** This systematic review and meta-analysis evaluated the effectiveness of professional topical fluoride



- There was a significant trend of effectiveness of fluoride varnish on the reversal of incipient enamel carious lesions ( $P < .05$ ).
- Both, 4 applications at weekly intervals or 2 applications of fluoride varnish over 4 months were effective in reversing active enamel caries lesions in primary dentition.

# The Evidence, recommendations and good practice points for the use of fluoride Varnishes

<i>Modality</i>	<i>Grade of Evidence</i>	<i>Recommendations</i>	<i>Good practice points and clinical advice</i>
<b>Varnish</b> (22600 ppm F)	<b>Primary and Permanent teeth</b> Moderate	Conditional for both primary and permanent dentition < 6 years old  Australia 10 years old	<ul style="list-style-type: none"> <li>• Application 2-4 times per year , depending on patient's caries risk</li> <li>• Dental plaque removal before the application</li> <li>• Apply a thin film on caries predilection tooth sites</li> <li>• No food and liquid consumption for 20'-30'</li> </ul>

Australia 2020, AAPD 2018, EAPD, 2019

## IAPD 2020

- Professionally applied topical fluoride treatments as 2.26 percent NaFV and 1.23 percent F gel preparations are efficacious in reducing caries in children at caries risk.
- Fluoride varnish, because of unit dosing, is the approach recommended for children younger than age six.



# Outline

- Fluoride Caries Protective Mechanisms
- Fluoride Modality, Efficacy & Guidelines
  - Systemic Fluorides
  - Topical Fluorides
  - F as therapeutic agents in non-restorative caries treatment



FDA Approval in USA 2014 as a Class II device for treating tooth sensitivity in patients over the age of 21

# SDF anticaries mechanisms

- **Effects of SDF on Bacteria**
- **Effects of SDF on Enamel and Dentin**

# SDF application

- Remove gross debris from cavity
- Excavation of caries optional
- Protective coat of Vaseline on lips to avoid tattoo
- Isolate teeth with cotton rolls
- Gently dry lesion
- Apply with microbrush SDF in lesion for 1 min, only one drop
- Remove excess, try to keep dry for 3 min to dry
- Follow up 2-4 weeks for caries arrest
- If not restored continue with semi annual application
- Restore with GI or adhesives



RESOURCES: SDF CHAIRSIDE GUIDE

Chairside Guide: Silver Diamine Fluoride in the Management of Dental Caries Lesions\*

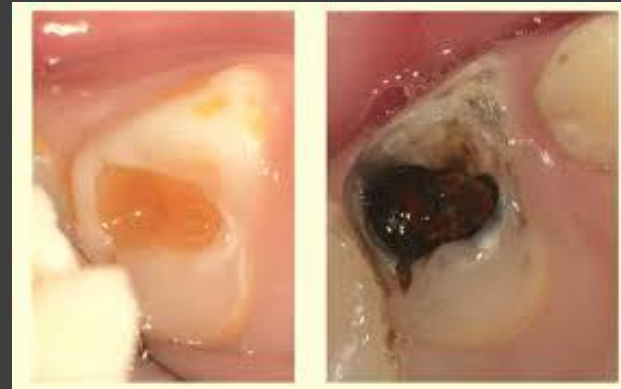
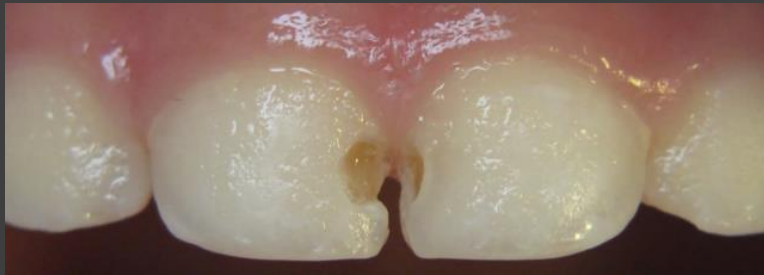
- One drop (0.05ml) enough to treat six teeth
- One drop (0.05ml) =9.5 mg Silver Diamine Fluoride
- 2.24mg F
- Silver Diamine Fluoride LD50=520mg/Kg oral  
380mg/Kg subcutaneous



Fluoride content in SDF and Fluoride Varnish commercial unit doses

Fluoride product	Unit dose	Concentration	F ion mg/ml	F ion mg/dose
SDF 38%	1 drop (0.05 ml)	44,800 PPM	44.8	2.24
Fluoride Varnish 5% NaF	0.25 ml	22,600 PPM	22.6	5.65
	0.4 ml	22,600 PPM	22.6	9.04
	0.5 ml	22,600 PPM	22.6	11.3

F content equivalence (aprox.): 2 drops SDF = small (.25 ml) FV



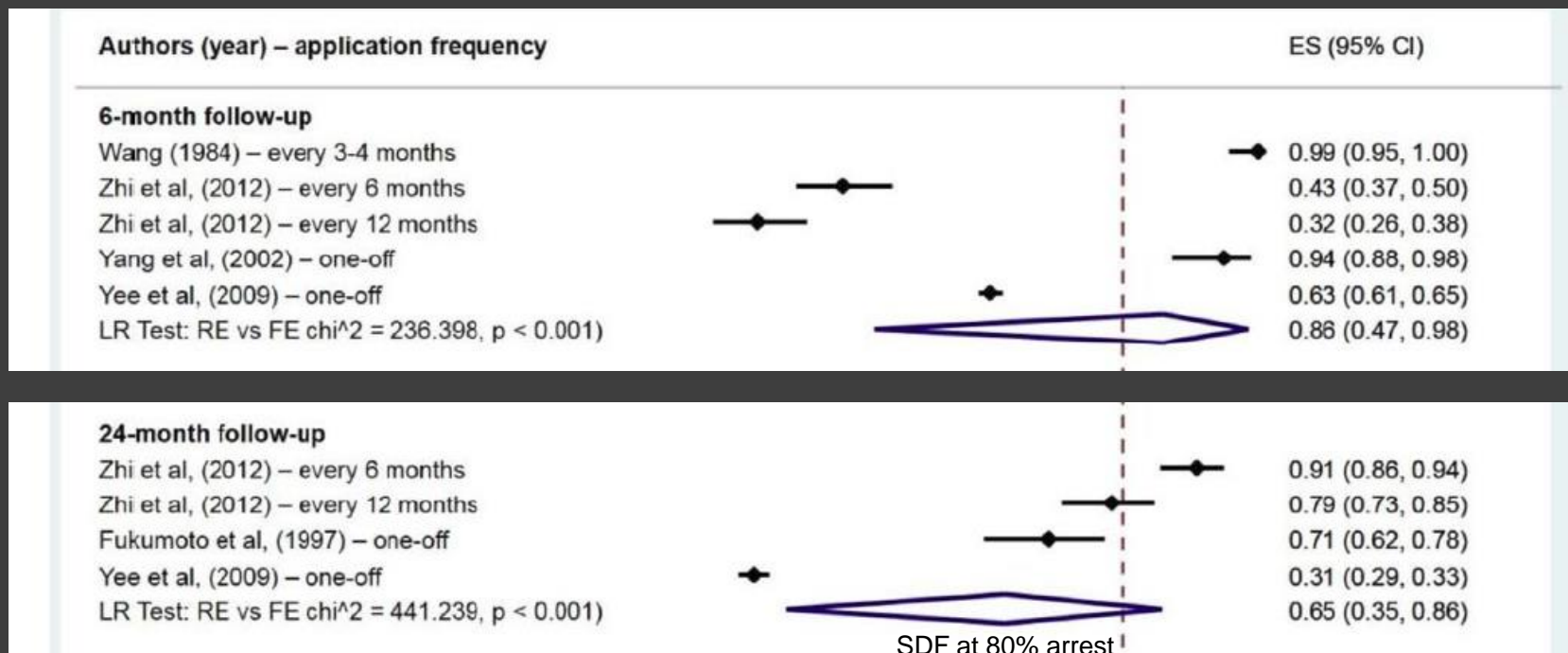
REVIEW

# Clinical Trials of Silver Diamine Fluoride in Arresting Caries among Children: A Systematic Review

S.S. Gao<sup>1</sup>, I.S. Zhao<sup>1</sup>, N. Hiraishi<sup>2</sup>, D. Duangthip<sup>1</sup>, M.L. Mei<sup>1</sup>, E.C.M. Lo<sup>1</sup>, and C.H. Chu<sup>1</sup>

- 16 RCT on primary teeth, 3 RCT on permanent teeth
- 14 38%, 3 30%, 2 10%

Gao et al, JDR Clinical and Translational Research, 2016



All studies rated as low-quality of evidence; high heterogeneity.

From the 24 month data, the carious lesion arrests in the treatment group was 72% and the control group arrests was 50%



Group	Group 3 (38% SDF, Annual), n/N (%)	Group 4 (38% SDF, Semiannual), n/N (%)
All surfaces		
Baseline	(n = 1,073)	(n = 1,024)
24 mo	620/971 (63.9)	698/912 (76.5)
30 mo	650/971 (66.9)	685/905 (75.7)
Upper anterior teeth		
Baseline	(n = 619)	(n = 585)
24 mo	422/572 (73.8)	446/518 (86.1)
30 mo	442/572 (77.3)	441/515 (85.6)
Upper posterior teeth		
Baseline	(n = 143)	(n = 138)
24 mo	49/125 (39.2)	71/122 (58.2)
30 mo	52/125 (41.6)	69/121 (57)
Lower anterior teeth		
Baseline	(n = 29)	(n = 27)
24 mo	26/28 (92.9)	25/26 (96.2)
30 mo	26/28 (92.9)	22/24 (91.7)
Lower posterior teeth		
Baseline	(n = 282)	(n = 274)
24 mo	123/246 (50.0)	156/246 (63.4)
30 mo	130/246 (52.8)	153/245 (62.4)

Fung et al, J. Dent Res. 2018, 97:171-178

# SDF Side Effects



# SDF Contra indications

- Silver allergy
- Disquamative mucositis or gingivitis
- Pregnant women and during the first 6 months of breastfeeding ( for SSKI)

*Horst et al 2016, AAPD 2017*



## SDF Recommendations around the globe

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<b>IAPD 2020</b>	<b>Use of 38% silver diamine fluoride is effective for the arrest of cavitated caries lesions.</b>
AAPD 2017	The use of 38 % SDF for the arrest of cavitated caries lesions in primary teeth is supported as part of a comprehensive caries management program. Conditional recommendation due to low-quality evidence
Australian 2019	SDF might be used for people with caries in situations where traditional treatment approaches to caries management might not be possible
EAPD 2019	Conditional recommendation

# Conclusions

## Community based Fluoridation

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- WF is a safe and effective community measure at concentrations of 0.5-1.mg/L
- F milk or salt are alternatives to community WF that merit further research
- Fluoride supplements have limited use for high risk patients when other topical sources non available
- Be aware of the F halo effect, regular monitoring of community enamel fluorosis
- **Topical Fluorides**
- Effective in reducing caries for home use : F toothpastes >1000ppm, F concentration toothpastes, gels rinses effective in reducing caries
- Effective in reducing caries for Professional use: Topical F gels children > 6years old, FV

## F as therapeutic agents in non-restorative caries treatment - SDF



