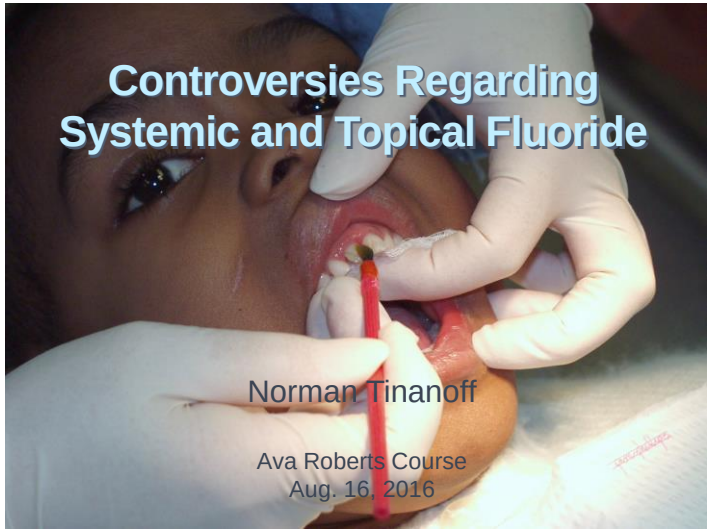
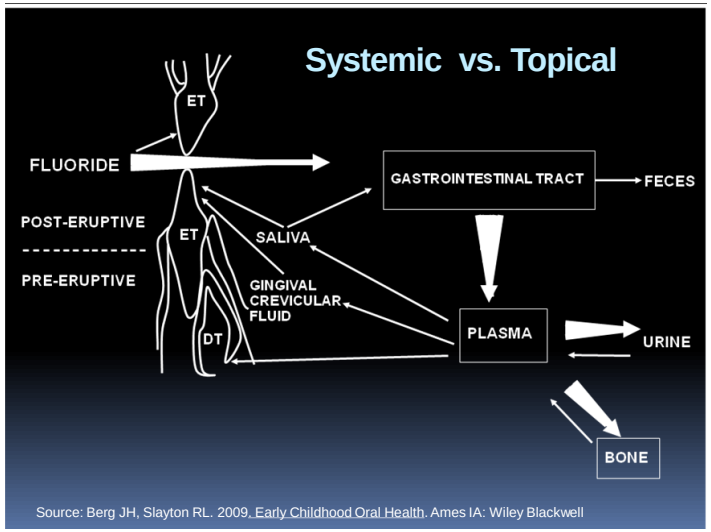


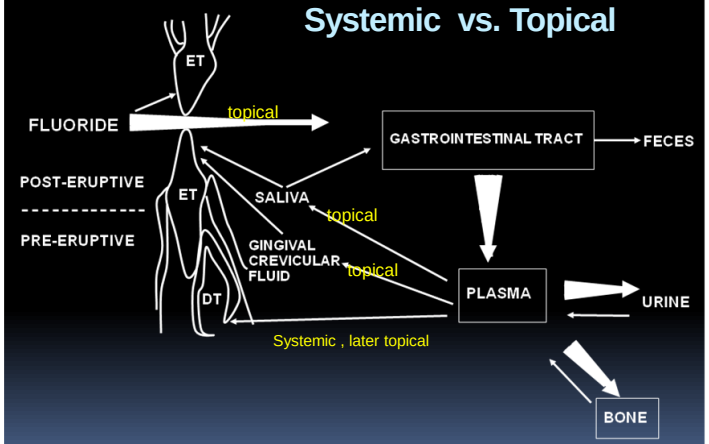
Controversies

- Systemic Route/Topical Effect?
- F Mechanisms?
- Systemic F Supplements?
- Optimally F Water to Make Infant Formula?
- EPA Reducing the Level of F in Drinking Water?
- Age to Start Brushing Teeth with F Toothpaste?
- Topical F
  - Who should get it?
  - How much?
  - Prophy before F?



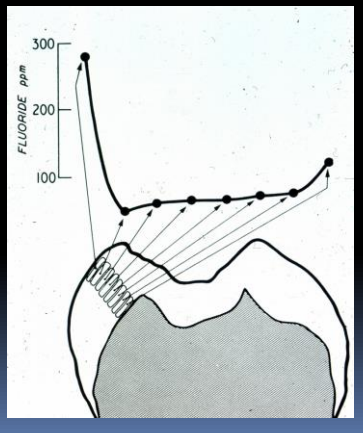
- Fluoride incorporated throughout unerupted tooth development (pure systemic)
- Fully developed, but unerupted tooth bathed in fluoride for months before eruption (topical)
- Fluoride released into salivary and crevicular fluids to affect erupted teeth (topical)

Systemic vs. Topical



Source: Berg JH, Slayton RL. 2009. Early Childhood Oral Health. Ames IA: Wiley Blackwell

Fluoride Rich Zone



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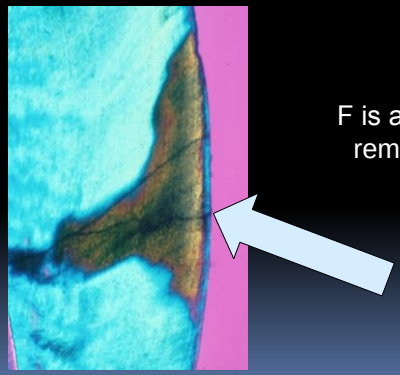
Fluoride Mechanism

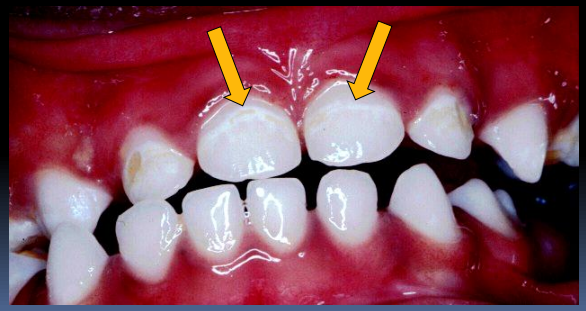
- Reduces solubility of HAP
- Remineralizes affected enamel
- Fluoride reservoirs in enamel (CaF_2 and fluoridated hydroxyapatite) liberated during carious attack
- Antimicrobial effect

Remineralization – White Spot Lesion with Intact Surface

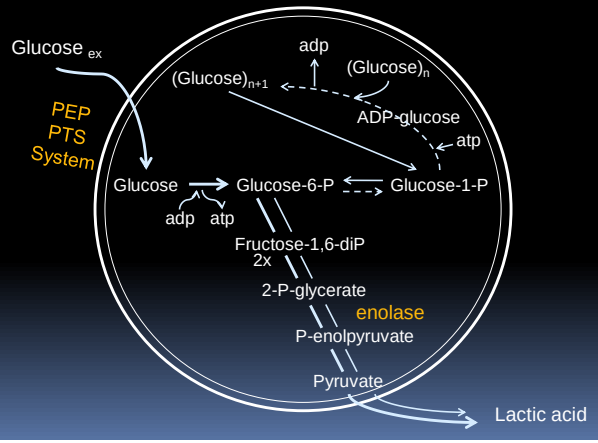


F is a “catalyst” for remineralization

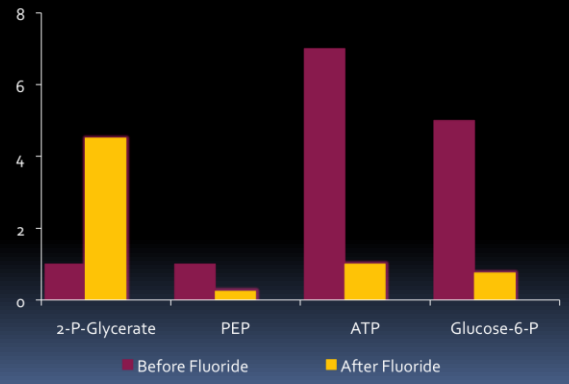
Remineralized Lesions on Maxillary Anterior Primary Teeth



Fluoride’s Effect on Cell Metabolism

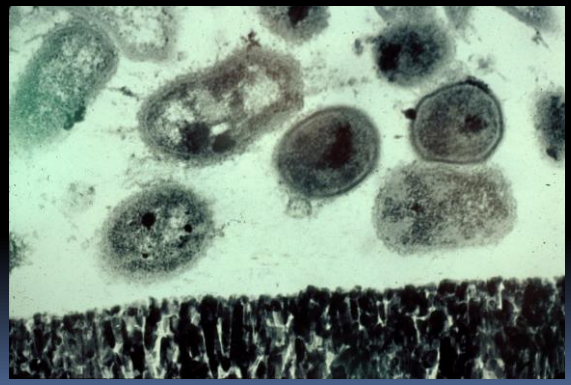


Fluoride Effect on Cell Metabolism



Antibacterial Properties of SnF_2 vs NaF

Tin Binding to Plaque Bacteria



Silver Diamine Fluoride

Indication and Usage: Treatment of dentinal hypersensitivity. For use in adults over the age of 21.

Controversies

- Systemic Route/Topical Effect?
- F Mechanisms?
- Systemic F Supplements?
- Optimally F Water to Make Infant Formula?
- EPA Reducing the Level of F in Drinking Water?
- Age to Start Brushing Teeth with F Toothpaste?
- Topical F
  - Who should get it?
  - How much?
  - Prophy before F?

Original Systemic Fluoride Regimen
1950s–1979

Age	< 0.3 ppm	> 0.6 ppm
Birth – 3 yrs	0.5 mg F	0.0 mg F
3 – 6 yrs	1.0 mg F	0.0 mg F

Effects of Fluoride Supplementation on Permanent Teeth

	Mean DFS Score	Very Mild Fluorosis	Mild Fluorosis	Moderate Fluorosis
Fluoride Supplement	**1.57**	34.0	18.0	14.0
No Fluoride Supplement	**7.93**	3.2	1.1	0
F Water	**3.16**	21.7	8.7	2.2

Source: Aasenden R, Peebles TC. 1974. Effects of fluoride supplementation from birth on human deciduous and permanent teeth. *Archives of Oral Biology* 19(4):321–326

Fluoride Dosage Relative to Age and Fluoride Content of Water (1994 – present)

Age	< 0.3 ppm	0.3–0.6 ppm	> 0.6 ppm
6 mo – 3 yrs	0.25 mg F	0.0 mg F	0.0 mg F
3 – 6 yrs	0.50 mg F	0.25 mg F	0.0 mg F
6 – 16 yrs	1.0 mg F	0.50 mg F	0.0 mg F

Only for children at caries risk, CDC, 2001

Issues with Fluoride Supplements

- Prescribers do not:
  - Test water supplies for fluoride
  - Consider the caries risk status
  - Weigh risks vs benefits
- Confusion exists on how to prescribe supplements for time spent away from home
- Fluorosis perhaps due to spikes in the plasma fluoride levels
- Poor compliance with administration; parents of high risk children are less likely to comply

Controversies

- Systemic Route/Topical Effect?
- F Mechanisms?
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  - Who should get it?
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  - Prophy before F?

Fluoride Content in Formula, 1978

Formula	Fluoride Content	Fluoride Content with Addition of Equal Parts of Water (1 ppm F)
Enfamil, ready to feed	0.2	
Enfamil, concentrate	< 0.1	0.52
Sililac, ready to feed	0.86	
Similac, concentrate	0.13	0.52
Isomil, concentrate	< 0.1	0.65
SMA , concentrate	0.17	
SMA , concentrate	0.17	0.60
Cows milk	< 0.1	
Human breast milk	< 0.1	

Source: Tinanoff N, Mueller B. 1978. Fluoride content in milk and formula for infants. *Journal of Dentistry for Children* 45:53–55

Infant Formula Issues

Powdered Formula Reconstituted with Fluoridated Water

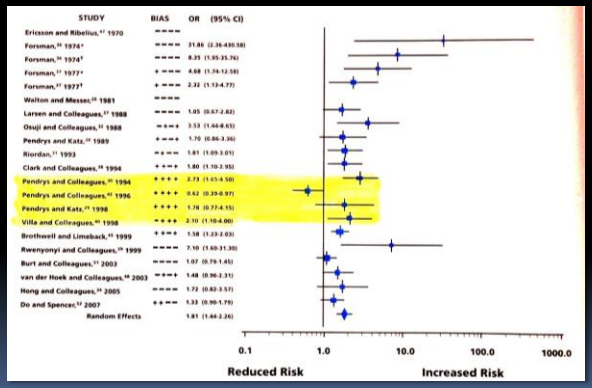
Optimal fluoride dose = 0.05 mg/kg

Case study: 1-year-old child, weighing 10 kg, consumes 32 ounces (1 liter) of powdered formula/day that is reconstituted with optimally fluoridated water – 1.0 ppm F.

Ingestion of 1 liter of formula at 1 ppm F = 1 mg of fluoride/day

1 mg F per day/10 kg body weight = 0.1 mg/kg

Risk of Experiencing Fluorosis
Use of Infant Formula vs. Breast or Cow's Milk



Source: Hujoel PP, Zina LG, Moimaz SAS, Joana Cunha-Cruz J. 2009. Infant formula and enamel fluorosis: a systemic review. *Journal of the American Dental Association* 140:841- 854.

Risk of Experiencing Fluorosis
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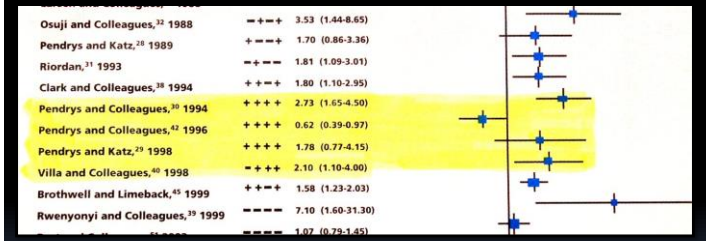


Source: Hujoel PP, Zina LG, Moimaz SAS, Joana Cunha-Cruz J. 2009. Infant formula and enamel fluorosis: a systemic review. *Journal of the American Dental Association* 140:841- 854.

Plasma Fluoride Concentration Curves
fasting or milk

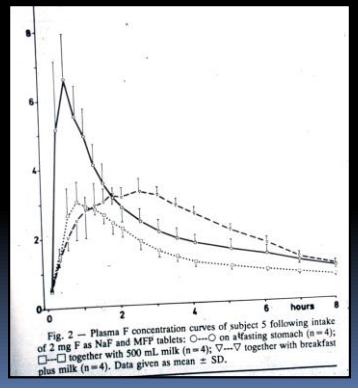
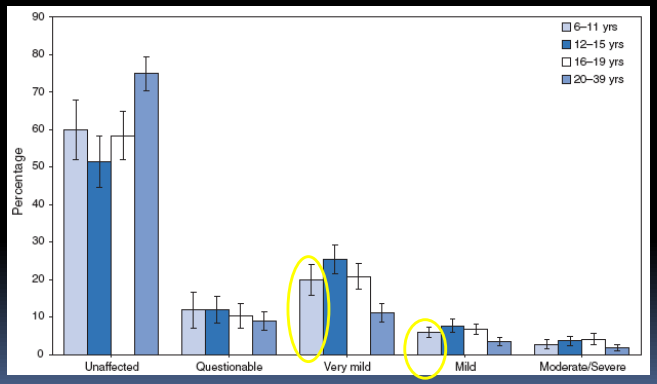


Fig. 2 — Plasma F concentration curves of subject 5 following intake of 2 mg F as NaF and MFP tablets: ○—○ on a fasting stomach (n = 4); □—□ together with 500 mL milk (n = 4); ▽—▽ together with breakfast plus milk (n = 4). Data given as mean ± SD.

Prevalence of Enamel Fluorosis by Age and Severity of Fluorosis



Source: United States National Health and Nutrition Examination Survey, 1999-2002

Mild-Moderate Fluorosis

CDC's Recommendation

Parent who are concerned about the effect that mixing their infant's formula with fluoridated water may have in developing enamel fluorosis can lessen this exposure by mixing formula with low fluoride water.

Cdc.gov/fluoridation/safety/infant_formula.htm Accessed Aug. 20, 2009.

HHS and EPA announce new scientific assessments and actions on fluoride

- HHS' recommendation of 0.7 milligrams of fluoride per liter of water replaces the current recommended range of 0.7 to 1.2 milligrams.

Department of Health and Human Services.
Public Health Reports 2015;130:1-14

Infant Formula Issues

Powdered Formula Reconstituted with Fluoridated Water

Optimal fluoride dose = 0.05 mg/kg

Case study: 1-year-old child, weighing 10 kg, consumes 32 ounces (1 liter) of powdered formula/day that is reconstituted with optimally fluoridated water – 1.0 **(0.7)** ppm F.

Ingestion of 1 liter of formula at 1 **(0.7)** ppm F = 1 **(0.7)** mg of fluoride/day

1 **(0.7)** mg F per day/10 kg body weight = 0.1 (0.07) mg/kg

Controversies

- Systemic Route/Topical Effect?
- F Mechanisms?
- Systemic F Supplements?
- Optimally F Water to Make Infant Formula?
- EPA Reducing the Level of F in Drinking Water?
- Age to Start Brushing Teeth with F Toothpaste?
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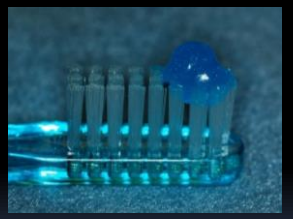
Fluoridated Toothpaste Doses for Preschoolers



"Smear"– under 2(3) yrs.

"Pea-sized"– 2(3)-5 yrs.

NOTE: JADA Feb. 2014 -- "smear" should be continued until age 3

Controversies

- Systemic Route/Topical Effect?
- F Mechanisms?
- Systemic F Supplements?
- Optimally F Water to Make Infant Formula?
- EPA Reducing the Level of F in Drinking Water?
- Age to Start Brushing Teeth with F Toothpaste?
- Topical F
  - Who should get it?
  - How much?
  - Prophy before F?

Topical Fluoride

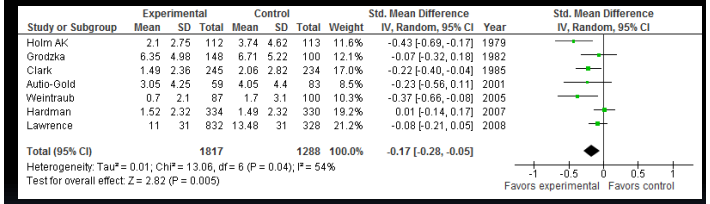
Risk Category	> 6 Years	6-18 Years	18+ Years
Low	None	None	None
Moderate	Varnish or foam at 6 month intervals	Varnish or gel at 6 month intervals	Varnish or gel at 6 month intervals
High	Varnish or foam at 3 or 6 month intervals	Varnish or gel at 3 or 6 month intervals	Varnish or gel at 3 or 6 month intervals

Source: Hunter et al. 2006. Professionally applied topical fluoride: evidence-based clinical recommendations. JADA 137:1151-1159.

Professional Fluoride Treatment

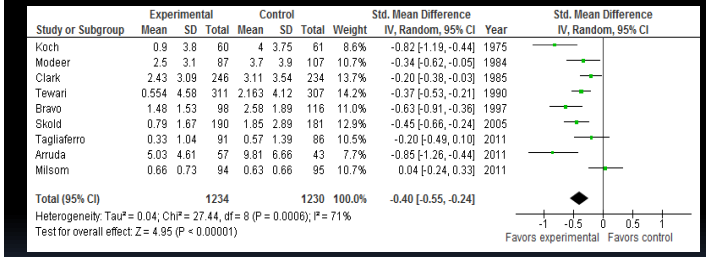
- Either 1.23% APF, 2% NaF or 2.3% F varnish
- Four minute application time
- Not to eat or drink for 30 minutes
- Minimum amount of fluoride and saliva ejector
- No need to precede with pumice prophy

Meta-analysis of 2.26% fluoride varnish on primary teeth [d(e/m)fs]



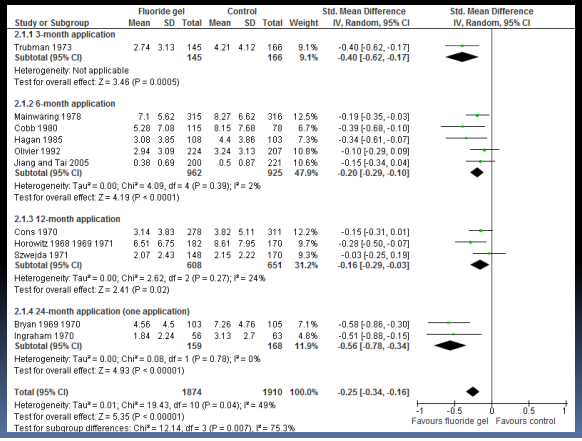
The panel concluded with **moderate certainty that there is a small benefit of 2.26% fluoride varnish application at least twice per year for caries prevention in the primary teeth among children aged 6 months to 8 years**.

Meta-analysis of 2.26% fluoride varnish on permanent teeth [DMFS]



The panel concluded with **moderate certainty that there is a small benefit of 2.26% fluoride varnish application at least twice per year for caries prevention in the permanent teeth among children aged 5 to 15 years**.

Meta-analysis of 1.23% APF gel applied on permanent teeth by frequency of application



Professional Fluoride Treatment

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- Four minute application time
- Not to eat or drink for 30 minutes
- Minimum amount of fluoride and saliva ejector
- No need to precede with pumice prophy

Professional Fluoride Treatment

- Either 1.23% APF, 2% NaF or 2.3% F varnish
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- Minimum amount of fluoride and saliva ejector
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- Either 1.23% APF, 2% NaF or 2.3% F varnish
- Four minute application time
- Not to eat or drink for 30 minutes
- Minimum amount of fluoride and saliva ejector
- No need to precede with pumice prophy

Fluoride Dose Using Trays

Small tray with 5 ml fluoride

Large tray with 10 ml fluoride

Fluoride Foam and Tray with Fluoride Foam

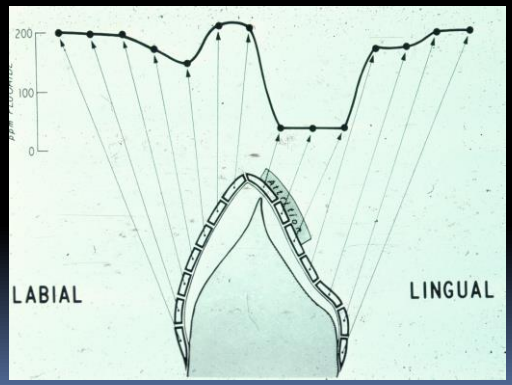
Density = 1/10 that of gels

Fluoride Varnish

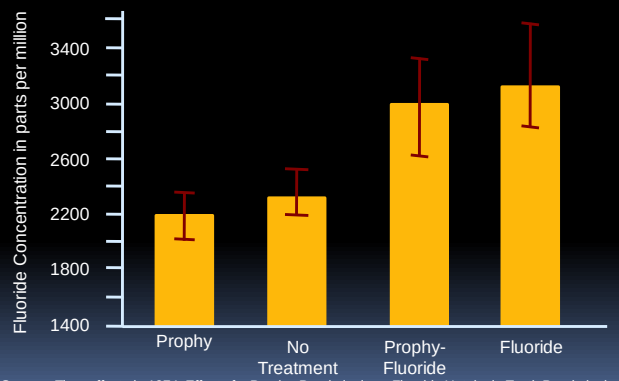
Professional Fluoride Treatment

- Either 1.23% APF or 2% NaF
- Four minute application time
- Not to eat or drink for 30 minutes
- Minimum amount of fluoride and saliva ejector
- No need to precede with pumice prophy

Enamel Fluoride Levels After Abrasion



Enamel Fluoride Levels after Prophy



Source: Tinanoff, et al., 1974. Effect of a Pumice Prophylaxis on Fluoride Uptake in Tooth Prophylaxis on Fluoride Uptake in Tooth Enamel. JADA 88:384-389

Meta-analysis of 1.23% prophylaxis prior to topical fluoride application

Outcomes Measure	Number and type* of studies	Number of participants	Standardized Mean Difference [95% Confidence Interval] (negative favors intervention, positive favors control)
Permanent teeth data			
DMFS increment, cavitated lesions	2 RCT and 1 CCT	1363	0.00 [-0.11, 0.11]
Primary teeth data			
defs increment, cavitated lesions (Johnston)	1 RCT	86	0.03 [-0.39, 0.46]

The panel to conclude with moderate certainty that there is no benefit from using prophylaxis paste containing fluoride applied for 4 minutes twice per year for caries prevention in the permanent teeth of 8-16 year olds.
The panel to conclude with low certainty that there is no benefit from using prophylaxis paste containing fluoride applied for 4 minutes twice per year for caries prevention in the primary teeth of 3-5 year olds.
(NOTE – "low certainty" will produce a recommendation of "expert opinion" rather than a data driven recommendation)

Fluoride Protocol for Children

	0-2 years	3-5 years	>6 years
Low Risk	--Twice daily brushing with F toothpaste	--Twice daily brushing with F toothpaste	--Twice daily brushing with F toothpaste
Moderate Risk parent engaged	--Twice daily brushing with F toothpaste --Fluoride supplements* -- Prof. topical F every 6 mo.	--Twice daily brushing with F toothpaste --Fluoride supplements* --Prof. topical F every 6 mo.	--Twice daily brushing with F toothpaste --Fluoride supplements* --Prof. topical F every 6 mo.
Moderate Risk parent not engaged	--Twice daily brushing with F toothpaste --Prof. topical F every 6 mo.	--Twice daily brushing with F toothpaste --Prof. topical F every 6 mo.	--Twice daily brushing with F toothpaste --Prof. topical F every 6 mo.
High Risk parent engaged	--Twice daily brushing with F toothpaste --Fluoride supplements* --Prof. topical F every 3 mo.	--Brushing with high potency F gel (with caution) ** --Fluoride supplements* --Prof. topical F every 3 mo.	--Brushing with high potency F gel --Fluoride supplements* --Prof. topical F every 3 mo.
High Risk parent not engaged	--Twice daily brushing with F toothpaste --Prof. topical F every 3 mo.	--Brushing with high potency F gel (with caution) ** --Prof. topical F every 3 mo.	--Brushing with high potency F gel --Prof. topical F every 3 mo.

* Need to consider fluoride levels in drinking water
** One needs to carefully weigh the risk/benefits (risk of fluorosis versus the value of caries reduction)

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

Summary

	The way the product is advertised	Converting to ion or compound
Professional strength		
APF	1.23% F	2.7% NaF
NaF	2% NaF	0.9% F
SnF_2	10% SnF_2	2.5%F
NaF varnish	50 mg NaF/ml	2.26%F
Silver diamine F	38%	5%F
Tray or Brush-on		
Prevident	0.5% F	1.1% NaF
Gel Kam	0.4% SnF_2	0.1% F
Weekly Rinses	0.2% NaF	0.09% F
Daily Rinses	0.05% NaF	0.02% F
Dentifrices	1,000 ppm F	0.1% F

Summary

- Major fluoride mechanisms include remineralization and antimicrobial. Primarily topical affect.
- Dietary supplements are effective in reducing dental caries and should be considered for children at caries risk who drink fluoride-deficient (<0.6 ppm) water. Problems with prescriptions and compliance.
- Fluoridated toothpaste is effective in reducing dental caries in children. New recommendations is “smear” under 3; “pea-size” 3-6
- Professionally-applied topical fluoride treatments as 5% NaF varnish or 1.23% F gel preparations are efficacious in reducing caries in children at caries risk.
- 0.2% sodium fluoride mouthrinse and 1.1% NaF brush-on pastes also are effective in reducing dental caries in children.