

**Silver Diamine Fluoride**  
a non-operative treatment  
for dental caries

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# disclosures

I have no financial interest in SDF.

Actually, I have a financial disinterest in SDF.



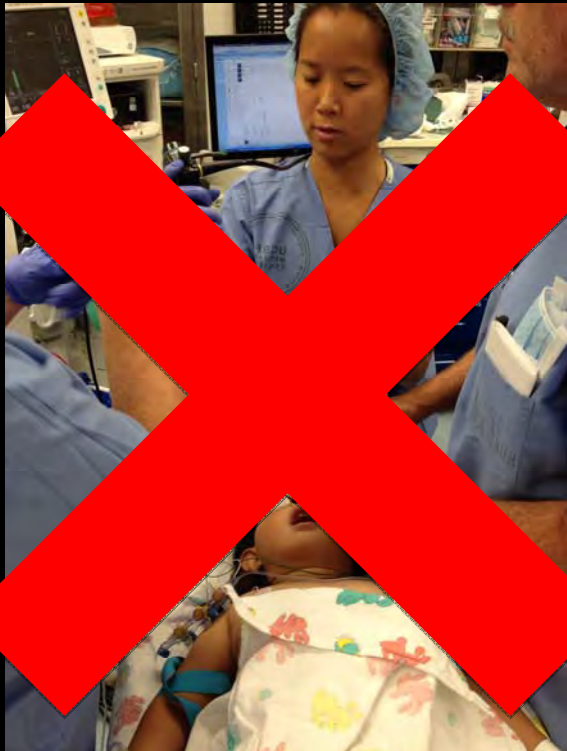
SILVER NITRATE

CAUTION









# Silver Nitrate

- Used in medicine for ages
- First dental use in 1840s
- Used by founding DDS's
- 61% arrest (1891)
- Arrests initial lesions (1973)
- Prevention in overdenture abutments (1978)
- Disappeared with local anesthetic
- Rediscovered by Duffin\*
- 30,000 patients in Oregon
- Placeholder for SDF



Stebbins, 1891

Hyde, 1973

Toolson & Smith, 1978

Duffin, 2012

# Silver diamine fluoride



**= treatment.**

- AgF used in Japan for ~millennium.
- **NH<sub>3</sub> added 80 years ago.**
- Prevents decay in other teeth.
- **Compatible with ART.**
- Arrest = stained lesion.
- **Potassium iodide decreases staining.**
- Products available in Japan, Brazil, Argentina...
- **... and US. Cleared by FDA !!!**





# SDF clearance same as F varnish



U.S. Food and Drug Administration  
Protecting and Promoting *Your* Health

SEARCH

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## Product Classification

FDA Home Medical Devices Databases



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<b>Device</b>	Diammine Silver Fluoride Dental Hypersensitivity Varnish
<b>Regulation Description</b>	Cavity varnish.
<b>Definition</b>	Applied to tooth enamel to block dentinal tubules for the purpose of reducing tooth sensitivity.
<b>Physical State</b>	liquid, gel
<b>Technical Method</b>	precipitates upon application resulting in a physical blockage of dentinal tubules
<b>Target Area</b>	tooth enamel
<b>Regulation Medical Specialty</b>	Dental
<b>Review Panel</b>	Dental
<b>Product Code</b>	PHR
<b>Premarket Review</b>	<a href="#">Office of Device Evaluation (ODE)</a> Division of Anesthesiology, General Hospital, Infection Control, and Dental Devices (DAGRID) Dental Devices Branch (DEDB)
<b>Submission Type</b>	510(k)
<b>Regulation Number</b>	<a href="#">872.3260</a>
<b>Device Class</b>	2
<b>Total Product Life Cycle (TPLC)</b>	<a href="#">TPLC Product Code Report</a>
<b>GMP Exempt?</b>	No
<b>Third Party Review</b>	Not Third Party Eligible

# SDF is now available in the U.S.



- **Today**
- ~\$100 per 5mL bottle
- **200 drops: 50¢/drop**
- CDT code for caries arrest approved for 2016
- **Advantage Arrest,** by Elevate Oral Care

FDA clearance =  
hypersensitivity.

Off label use =  
caries treatment.

# silver ion = wrecking ball

## Antimicrobial:

- denatures *all* proteins.
- breaks cell walls & membranes.
- inhibits DNA replication.

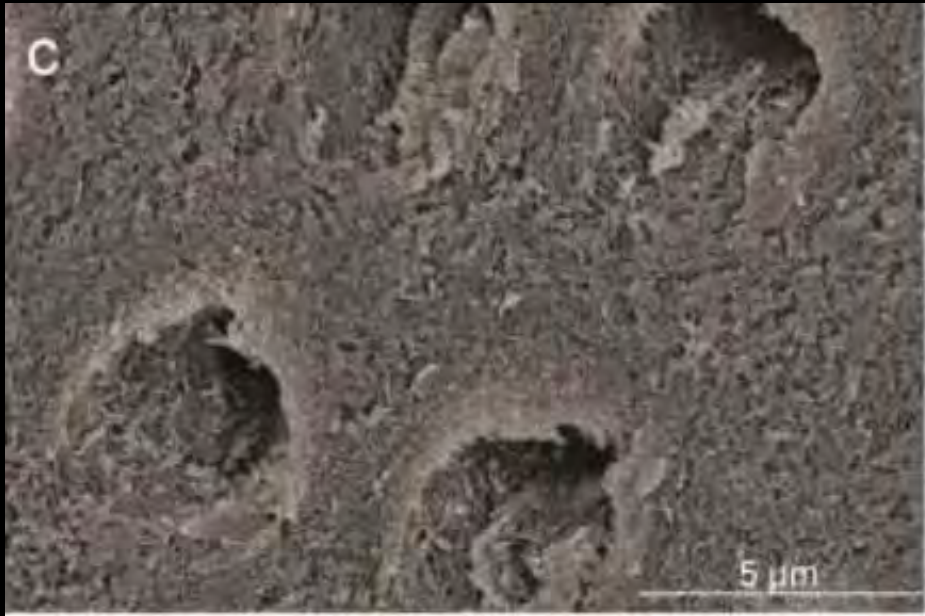
## Strengthens dentin:

- protective layer formed by reaction with dentin proteins is acid resistant (Hill & Arnold, 1937).
- penetrates ~50 $\mu$ m.

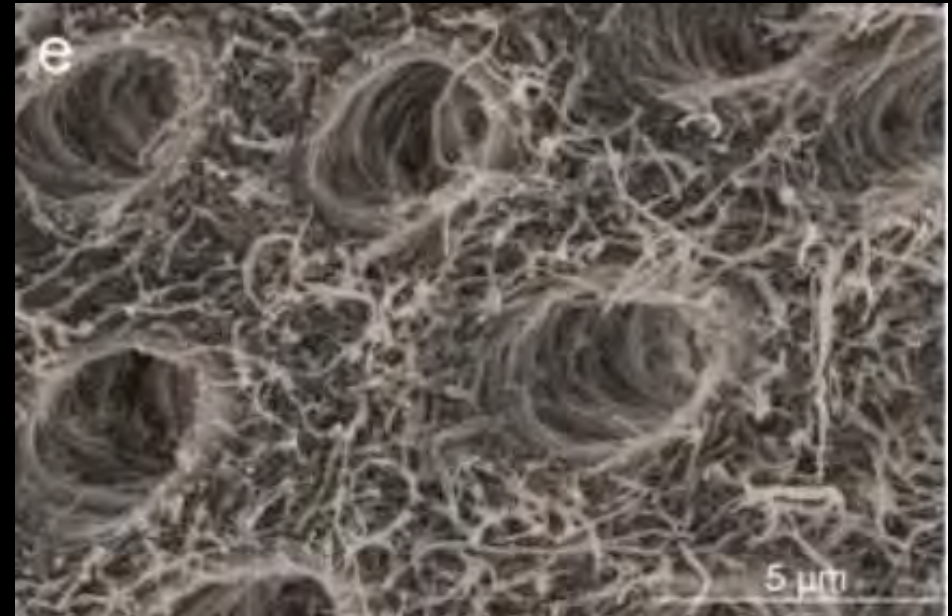




# SDF resists demineralization



silver diamine fluoride



control

# SDF application



0. (cotton isolation)
1. dry tooth gently
2. apply with micro-sponge
3. remove excess to prevent taste & excess ingestion

## Considerations:

- vasoline
- cooperation

## Contraindications:

- Silver allergy
- Ulcerative gingivitis
- Stomatitis



# typical SDF stains



time 0



1 day



1 week

NDC 0245-0003-31

**SSKI®**

Potassium Iodide  
Oral Solution, USP  
(saturated)

1 g/mL

Calibrated  
Dropper  
Enclosed

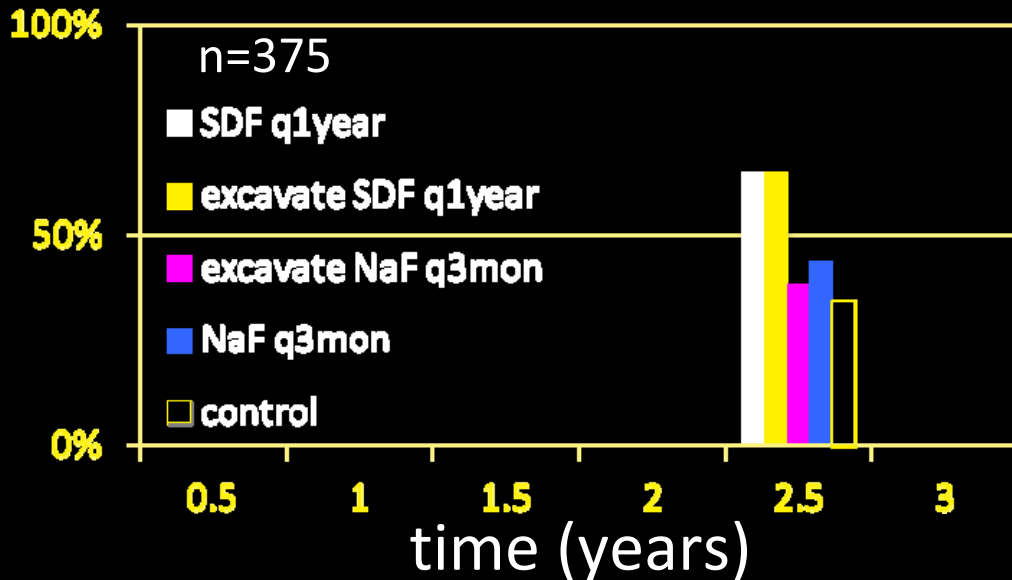
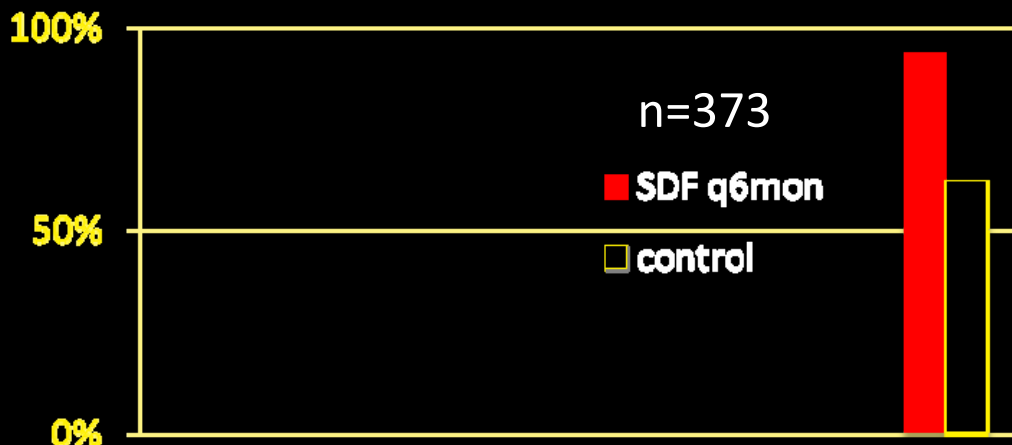
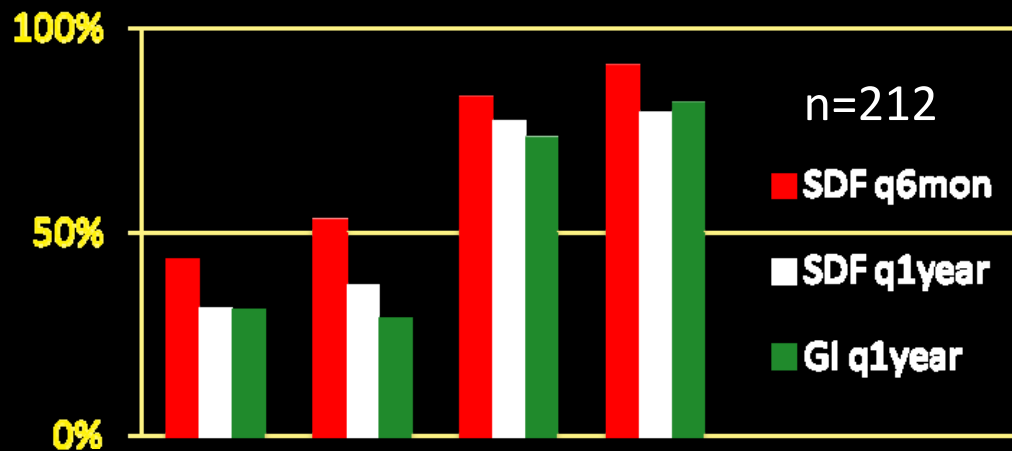
# Color stain? Potassium iodide

- reduces Ag to *white* oxidation state.
- *in vitro* studies show no impact on antimicrobial.
- it does decrease stain.
- avoid in pregnant/lactating women.



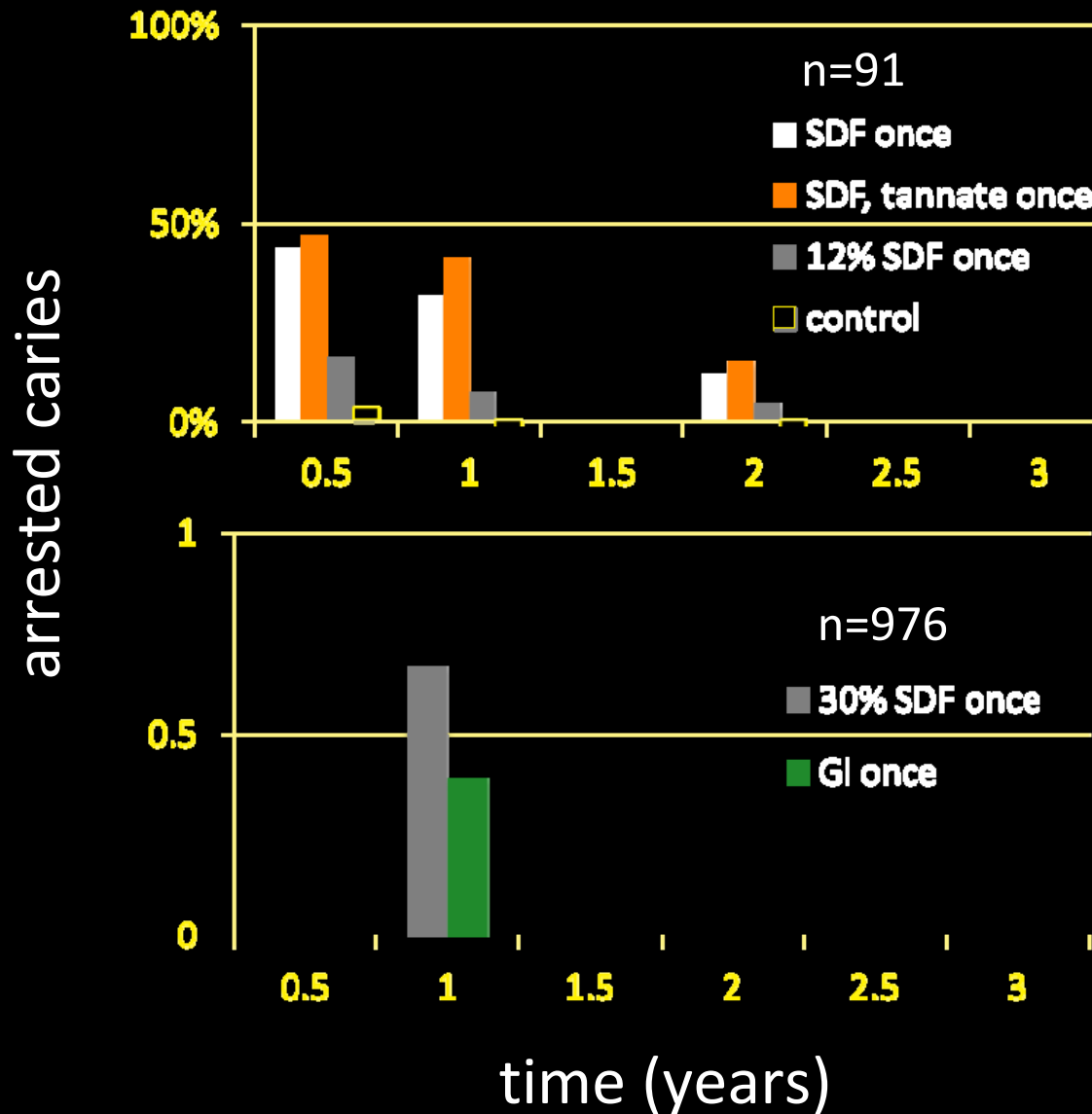
the clinical evidence  
for caries arrest by SDF

arrested caries



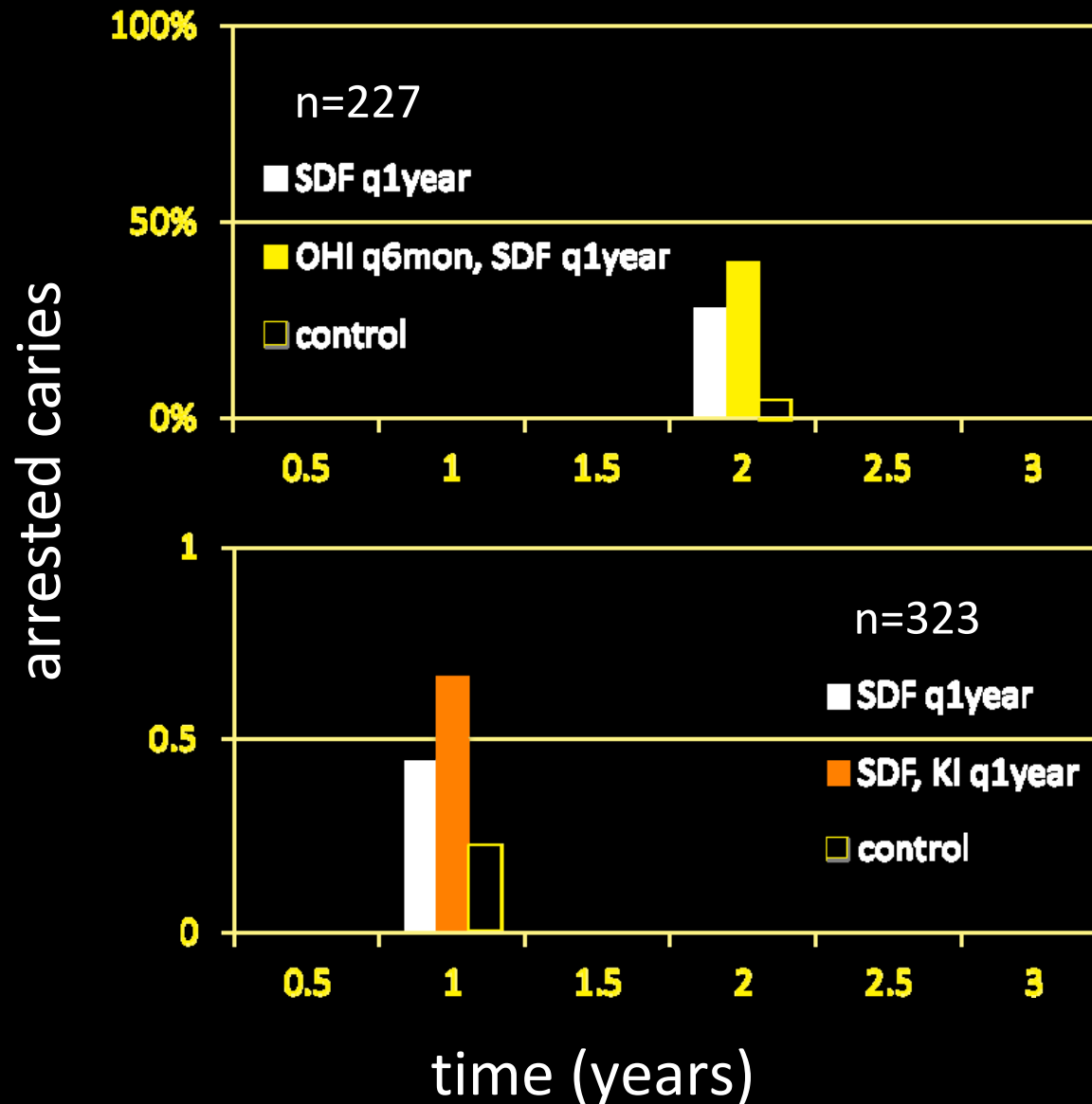
SDF caries arrest  
in children with  
repeat application

# SDF caries arrest in children with single application





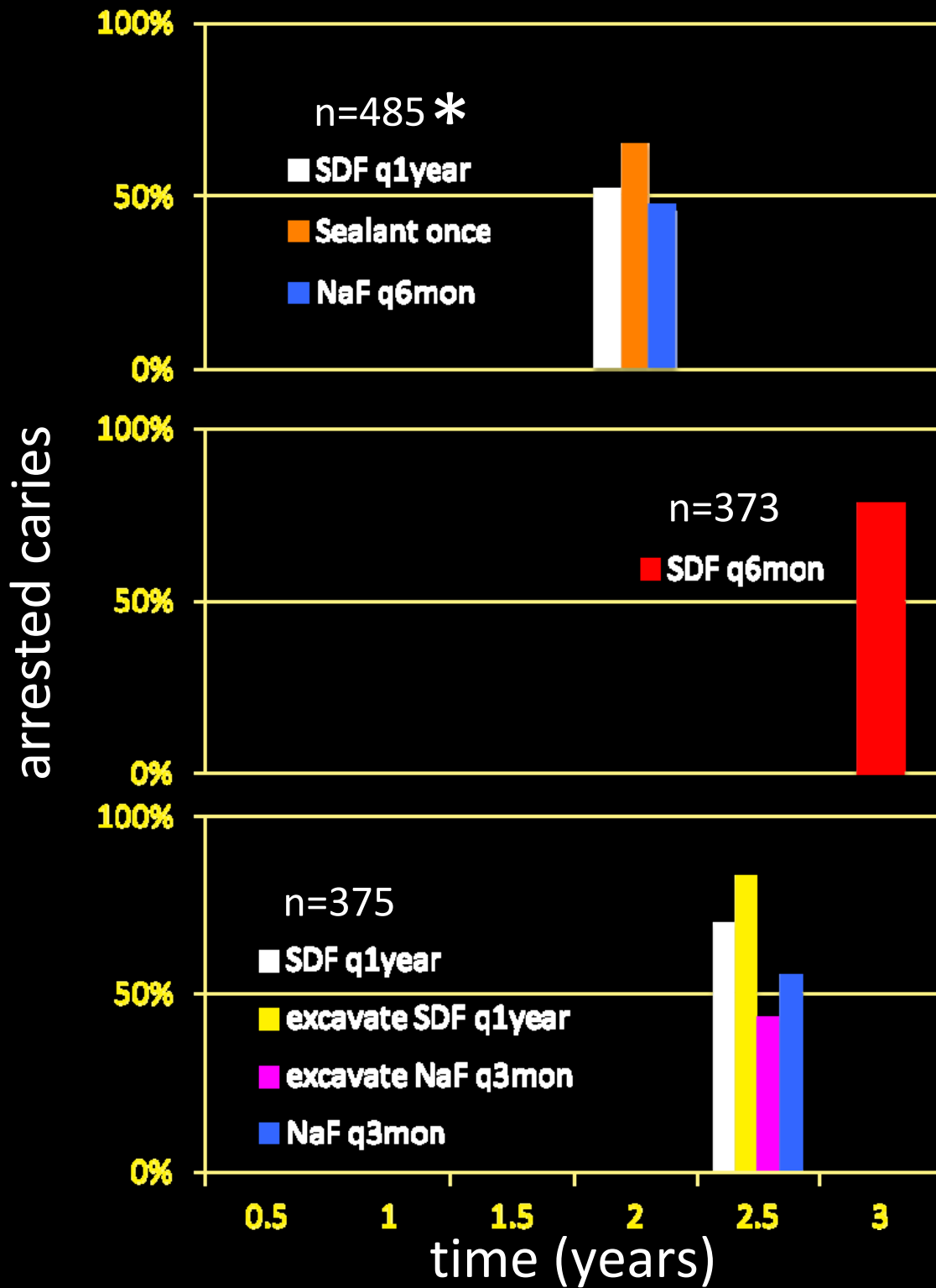
# SDF caries arrest in older adults with repeat application



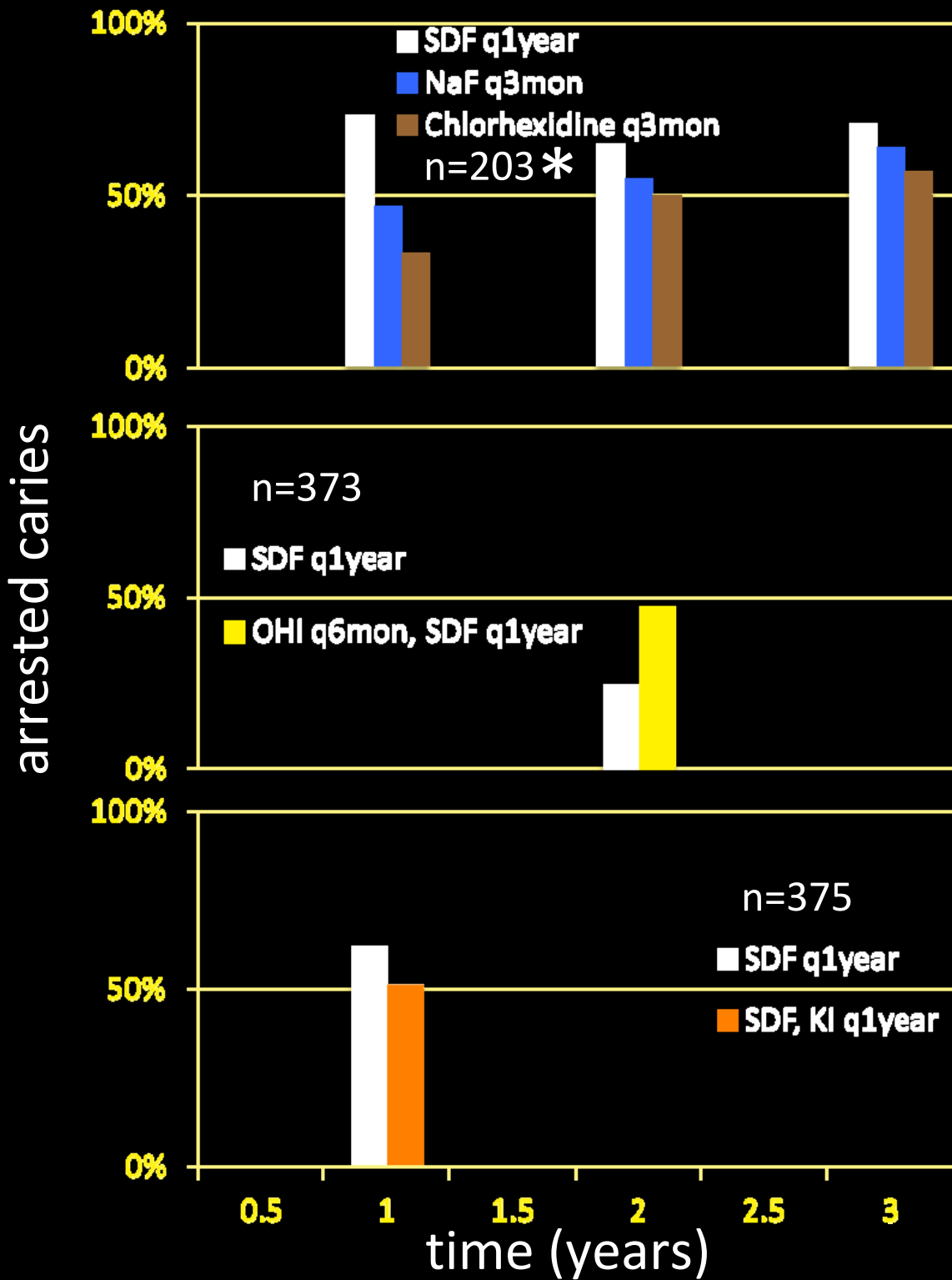
Radiation-treated oral cancer Survivor  
with SDF arrested dental caries, 3 year follow-up



the clinical evidence  
for caries prevention by SDF



SDF caries prevention in children with repeat application



SDF caries prevention in older adults with repeat application



# Safety of silver diamine fluoride

- 10 kg child = 4 teeth per visit.
- Does not harm gingiva, vaseline sometimes recommended.
- Irritating to pulp in deep lesions (though pulp cap).
- Protect eyes, pH 10.
- No evidence of fluorosis if used properly.  
(Health Dept of Western Australia)
- 80 years of use in Japan, 12 clinical trials: If there were going to be problems they would have shown up.
- Will stain face, clothes, counters. Always wear gloves. Wash any exposed areas with water. Stain will go away in days.

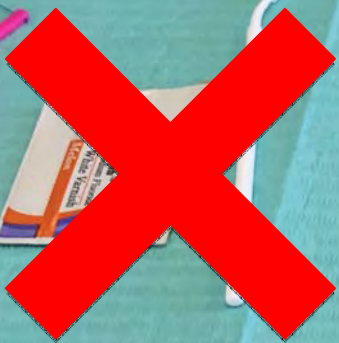




SILVER FLUORIDE

CAUTION

Advantage Arrest  
Silver Diamine Fluoride 38%  
Contents 8 mL Rx only



# UCSF SDF indications

1. Difficult to treat carious lesions.
2. Carious lesions in patients with extreme caries risk (Xerostomia).
3. Patients with carious lesions that may not all be treated in one visit.
4. Treatment challenged by behavioral or medical management.

# where we are now

- Technique taught in >50% of pedo programs.
- 30,000 application of SN, will switch to SDF.
- Cleared by FDA, same as fluoride varnish.
- Effort to gain approval as drug for caries.
- Compatible with glass ionomer bonding.
- May decrease adhesion of composites: prep.
- **??? Why do some lesions not arrest ???**



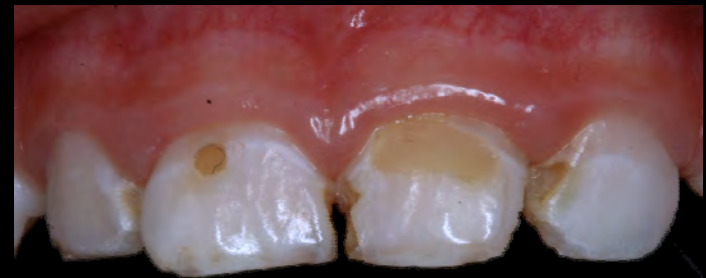
# what I want from you

Ask questions.

Give advice.

Drive demand.

Change expectations.



# wrap up

- This is a public health issue.
- This is an ethical issue.
- Dental workforce doesn't meet disease burden.
- SDF is the only material with potential.
- **Advantage Arrest**, by Elevate Oral Care

# THANK YOU



Prof. Edward Lo  
Univ of Hong Kong



Prof. Peter Milgrom  
Univ of Washington