An update on Evidence-Based Approaches for Caries Prevention and Management

Margherita Fontana, DDS, PhD
Clifford Nelson Endowed Professor of Dentistry
University of Michigan School of Dentistry
Department of Cariology, Restorative Sciences and Endodontics

mfontan@umich.edu
Personalized Caries Management

- Best evidence
- Risk-Based; Person-Centered
- Focus on prevention and remineralization
- MI

Goal: Advance health and preserve tooth structure
Figure. Past, present, and future aspects of prevention and minimal intervention in cariology.
Caries Management For The Modern Age: Improving Practice One Guideline At A Time

By 2021-2022

What are the most effective strategies to keep teeth caries free?
Recommendations for caries prevention (2019)

What is the most accurate way to detect and diagnose caries?
Recommendations for detection and diagnosis of carious lesions (2021)

What are the most effective non- and minimally-invasive treatments for carious lesions?
Recommendations for the use of nonrestorative treatments for carious lesions (2018)

What are the most effective restorative treatments for carious lesions?
Recommendations for the use of restorative treatments for carious lesions (2020)

Compile all recommendations to develop final guideline on caries management for primary and permanent teeth (2022)

By 2022

Figure 1. Timing and scope of each chapter for the ADA clinical practice guideline series on caries management.
Nonrestorative Treatments for Caries: Systematic Review and Network Meta-analysis


Evidence-based clinical practice guideline on nonrestorative treatments for carious lesions

A report from the American Dental Association

Rebecca L. Slayton, DDS, PhD; Olivia Urquhart, MPH; Marcelo W.B. Araujo, DDS, MS, PhD; Margherita Fontana, DDS, PhD; Sandra Guzmán-Armstrong, DDS, MS; Marcelle M. Nascimento, DDS, MS, PhD; Brian B. Nový, DDS; Norman Tinanoff, DDS, MS; Robert J. Weyant, DMD, DrPH; Mark S. Wolff, DDS, PhD; Douglas A. Young, DDS, EdD, MS, MBA; Domenick T. Zero, DDS, MS; Malavika P. Tampi, MPH; Lauren Pilcher, MSPH; Laura Banfield, MLIS, MHSc; Alonso Carrasco-Labra, DDS, MSc

JADA, 2018
Lesion(s) should be monitored (e.g., hardness/texture, color, radiographs) periodically throughout the course of treatment.
<table>
<thead>
<tr>
<th>Expert Panel Recommendation</th>
<th>Certainty in the Evidence</th>
<th>Strength of Recommendation</th>
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| To arrest advanced cavitated carious lesions on any coronal surface of primary teeth, the expert panel recommends clinicians* prioritize the use of 38% silver diamine fluoride (SDF) solution (biannual application) over 5% sodium fluoride varnish (application once per week for 3 weeks).

To arrest advanced cavitated carious lesions on any coronal surface of primary teeth, the expert panel recommends clinicians* prioritize the use of sealants + 5% sodium fluoride varnish (application every 3–6 months) or sealants alone over 5% sodium fluoride varnish alone (application every 3–6 months), 1.23% acidulated phosphate fluoride gel (application every 3–6 months), resin infiltration + 5% sodium fluoride varnish (application every 3–6 months), or 0.2% sodium fluoride mouthrinse (once per week).

To arrest or reverse noncavitated carious lesions on facial or lingual surfaces of primary teeth, the expert panel suggests clinicians* use 1.23% acidulated phosphate fluoride gel (application every 3–6 months) or 5% sodium fluoride varnish (application every 3–6 months).

To arrest or reverse noncavitated carious lesions on approximal surfaces of primary teeth, the expert panel suggests clinicians* use 5% sodium fluoride varnish (application every 3–6 months), resin infiltration alone, resin infiltration + 5% sodium fluoride varnish (application every 3–6 months), or sealants alone.

To arrest or reverse noncavitated carious lesions on coronal surfaces of primary teeth, the expert panel suggests clinicians* do not use 10% casein phosphopeptide-amorphous calcium phosphate paste if other fluoride interventions, sealants, or resin infiltration is accessible. | Moderate to Low | Conditional |

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To arrest or reverse noncavitated carious lesions on occlusal surfaces of primary teeth, the expert panel recommends clinicians* prioritize the use of sealants + 5% sodium fluoride varnish (application every 3–6 months) or sealants alone over 5% sodium fluoride varnish alone (application every 3–6 months), 1.23% acidulated phosphate fluoride gel (application every 3–6 months), resin infiltration + 5% sodium fluoride varnish (application every 3–6 months), or 0.2% sodium fluoride mouthrinse (once per week).

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Sealants on Sound Surfaces

Strong evidence for prevention (when used on sound surfaces)

PF on sound teeth $\sim 80\%$ at 12 months to $11\text{-}57\%$ at 2 years and longer

Ahovuo-Saloranta et al., 2004, 2008, 2013, 2017
Sealants (Sealing Carious Lesions)

- **PF on carious teeth ~71%**
  - Griffin et al., 2008

- **Bacterial reductions ~99%**
  - Oong et al., 2008

**To arrest or reverse noncavitated carious lesions on occlusal surfaces of primary teeth**, the expert panel recommends clinicians* prioritize the use of sealants + 5% sodium fluoride varnish (application every 3-6 months) or sealants alone over 5% sodium fluoride varnish alone (application every 3-6 months), 1.23% acidulated phosphate fluoride gel (application every 3-6 months), resin infiltration + 5% sodium fluoride varnish (application every 3-6 months), or 0.2% sodium fluoride mouthrinse (once per week).*

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* JADA 2018
Type of Material to Choose

• Unclear if one sealant material is superior to another

• Choose based on likelihood of experiencing lack of retention
  • If dry isolation is difficult, then a material that is more hydrophilic (e.g., GI) would be preferable
  • If isolation is possible to ensure a dry site and long-term retention is desired, then a resin-based sealant is preferable

• Monitor sealants over time, especially sealants showing a higher risk of experiencing retention loss (i.e., GI)
Can We Seal Moderate Lesions?

- Sealed sound, initial and moderate lesions in a high risk group
- Sealants were 99% effective in arresting caries for ~4 years (annual repairs if needed)
- Excellent retention (89% at 1-y; 78% at 2-y; 72% at 3.8 y)

BUT

7-y survival on moderate lesions:
- 37% for sealants (without repair) vs.
- 91% for MI restorations

If sealed, might need frequent repair

Schwandicke et al., 2016

Qvist et al., 2016
Infiltration (ICON)

“White Lesions” post-Orthodontics

Infiltrating/Sealing Proximal Caries Lesions: A 3-year Randomized Clinical Trial
S. Martignon, K.R. Ekstrand, J. Gomez, J.S. Lara and A. Cortes
J DENT RES 2012 91: 288 originally published online 17 January 2012
DOI: 10.1177/0022034511435328

Kim et al., 2011
Can We Stop The Caries Process In Advanced/Severe Caries Lesions?

• Difficult to arrest

• But if self-cleansing is possible…
38% Silver Diamine Fluoride (SDF)

Mei et al., 2014
Lesion(s) should be monitored (e.g., hardness/texture, color, radiographs) periodically throughout the course of treatment.
38% SDF (~44,800 ppm F)

\[ Ca_{10}(PO_4)_6(OH)_2 + Ag(NH_3)_2F \rightarrow CaF_2 + Ag_3PO_4 + NH_4OH \]

Alkaline environment

Yamaga et al., 1972; Chu and Lo, 2008

- **Ag precipitate** (weakly soluble; turns black with sunlight or reducing agents) = Black, hard layer
- Silver is antimicrobial (long-term this effect might be lost; Mitwalli et al., 2019)
- Silver affects dentin metalloproteinases, cathepsins, etc. (involved in dentin degradation) (Zhao et al., 2017)

Helps with caries control
Meta-analysis of studies using 38% SDF to arrest dentin caries

Gao et al., 2016

Meta-analysis (5 papers); overall proportion of arrested dentin caries was \textbf{65.9\%}  

Gao et al., 2016b

Meta-analysis (8 papers) using 38% SDF on primary teeth= proportion of arrested dentin caries was \textbf{81\%}

JADA, 2018

**Oral Hygiene Effect**

- Lesions with visible plaque have a lower chance of being arrested (Fung et al., 2016)
- Caries lesions might reactivate within the year if salivary function and oral hygiene is poor (Deutsch, 2016)
- Anterior and buccal/lingual surfaces more likely to become arrested (Zhi et al., 2012)
Dentifrices (toothpastes)

Types of Dentifrices available in the US Market
- Fluoridated and Fluoride Free

Type of Fluoride
- SnF$_2$
- NaF
- NaMFP

Fluoride Concentration
- 1,100 ppm
- 5,000 ppm (prescription)
Quantity
Remineralization in situ

- Brushing duration and dentifrice fluoride concentration

Fluoride and Dentin

% Inhibition of Demineralization

Fluoride Concentration (ppm)

Enamel
Dentin

ten Cate et al., 1998
Prescription toothpastes

- 5,000 ppm (1.1% NaF)

% subjects with one or more Root Caries lesions becoming hard (i.e., remineralized)
Mouthrinses

- **Types of Mouthrinses available in the US Market**
  - Fluoridated and Fluoride Free (antimicrobial, for halitosis, etc.)
- **OTC Fluoride Concentration:**
  - 0.05% NaF (226 ppm)
  - 0.02% NaF (100 ppm)
- **RX F Concentration:**
  - 0.2% NaF (900 ppm) - School programs
  - 0.63% SnF\(_2\) (1500 ppm)
- **Most at neutral pH, some at low pH**
- **Some has alcohol**
- **Evidence: About 26 % incidence reduction**
### Fluoride In-Office

<table>
<thead>
<tr>
<th>Risk Group</th>
<th>&lt; 6 Years</th>
<th>6 – 18 Years</th>
<th>&gt; 18 Years</th>
<th>Root Caries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>May not receive additional benefit from topical fluoride</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moderate/High</td>
<td>2.26% Fluoride Varnish every 3-6 months</td>
<td>2.26% Fluoride Varnish every 3-6 months or 1.23% APF fluoride gel application for 4 min every 3-6 months</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Weyant et al., 2013 (ADA)

<table>
<thead>
<tr>
<th>TFT Type (number of studies)</th>
<th>Prevented Fraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Varnish (3)</td>
<td>40% - 37%</td>
</tr>
<tr>
<td>Gel (13)</td>
<td>21%</td>
</tr>
<tr>
<td>Rinse (30)</td>
<td>26%</td>
</tr>
<tr>
<td>Toothpaste (70)</td>
<td>24%</td>
</tr>
<tr>
<td>Overall (116)</td>
<td>24%</td>
</tr>
</tbody>
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Marinho et al., 2013
Fluoride Dilemmas

We need to find the ideal balance for each patient

Frequency vs. Concentration
Calcium-Based Strategies: Reviews

- Azarpazhood and Limeback [2008]: Quantity and quality of evidence was insufficient to make conclusions about long term effectiveness of CPP-ACP

- Yengopal and Mickenautsch [2009]: Syst. review of 5 in situ short term (7-21 days) studies supported a short term remineralization effect (18%) of CPP-ACP

- ADA [2011]: Insufficient evidence that these products lower incidence of either coronal or root caries

- Li et al. [2014]: Included 8 studies (3-24 months) and concluded there was a remineralizing effect of CPP-ACP compared to a placebo, but unclear compared to F

Ongoing in vivo research is needed to confirm the efficacy (mixed results right now), but in the meantime they can be positive adjuncts to fluoride use for at risk patients (DO NOT use them as substitutes for fluoride therapy until evidence is stronger and more consistent)
<table>
<thead>
<tr>
<th>AGENTS</th>
<th>EFFECT ON CARIES</th>
<th>APPLICATION</th>
<th>RECOMMENDATION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Polyol Sugars</td>
<td>Reduction of coronal</td>
<td>Use of sucrose-free polyol (xylitol only or polyol combinations) chewing gum</td>
<td>Recommended on weak evidence</td>
</tr>
<tr>
<td></td>
<td>caries</td>
<td>for 10-20 minutes after meals by children 5 years or older</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Use of sucrose-free polyol (xylitol only or polyol combinations) chewing gum</td>
<td>No evidence; expert opinion only</td>
</tr>
<tr>
<td></td>
<td></td>
<td>for 10-20 minutes after meals by adults</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>Daily use of xylitol-containing lozenges or hard candies (5-8 g/day divided</td>
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<tr>
<td></td>
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<td>into 2-3 doses) that are dissolved slowly in the mouth after meals by</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td>children 5 years or older</td>
<td></td>
</tr>
<tr>
<td>Chlorhexidine</td>
<td>Prevention / Reduction</td>
<td>Application of 1:1 mixture of Chlorhexidine-thymol varnish every 3 months</td>
<td>Recommended on evidence</td>
</tr>
<tr>
<td></td>
<td>of root caries</td>
<td>Application of any of the following either alone or in combination with</td>
<td>Not recommended</td>
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<tr>
<td></td>
<td></td>
<td>fluoride: 0.5-1.0% Chlorhexidine gel</td>
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<tr>
<td></td>
<td></td>
<td>0.12% Chlorhexidine rinse</td>
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ADA Evidence-based Recommendations on Non-fluoride Caries-Preventive Agents (ADA Council on Scientific Affairs, 2011)
Probiotics

Living microorganisms (principally bacteria) safe for consumption and when ingested in sufficient quantities have beneficial effects on human health beyond basic nutrition (United Nations & World Health Organization)

Hypothesis for caries management:
• Probiotic strains interfere and/or inhibit other microorganisms, especially pathogens.
• Systemic modulation of immunological parameters.
Prebiotics

Arginine and Caries

1) Arginine and Calcium (available in the US for sensitivity)

2) Arginine, Ca and F (not available in the US, but the one with the caries data)
1.5% Arginine+Ca+F – Example Reviews

- Li et al., 2015 – Systematic Review and Meta-analysis
  - Potentially provides a superior effect than F alone
  - Level of evidence reduced due to potential bias

- Fontana, 2016 – Literature Review
  - Potentially provides a superior effect than F alone
  - All studies sponsored by Colgate

- Astvaldsdottir et al., 2016 – Systematic Review
  - Insufficient evidence due to commercial bias
Prospective, split-mouth, RCT

Active early buccal lesions, are pretreated with sodium hypochlorite and then etched

Alkilzy et al. 2018
Conclusions

1. Caries Management: Prevention of the disease at the individual level + site-specific targeted strategies at the lesion/surface level

2. Best practice guidelines on caries management should be implemented in practice

3. Effective strategies to arrest non-cavitated caries lesions help preserve tooth structure and should be advocated as the preferred method (vary by surface)

4. Need to closely monitor over time lesions that are being treated in order to determine if the treatment is effective at arresting/reversing
5. Restorative care is considered the standard of care for management of cavitated lesions, as it helps control the disease process and restore tooth function, esthetics, etc.

6. The guiding principle should be to preserve tooth structure and preserve pulp health, while reducing discomfort and pain.

7. 38% SDF can be used effectively as an alternative or interim non-restorative management for cavities or root caries lesions.

8. Need to support implementation efforts in all populations.

Thank you!

QUESTIONS?