The Magic of Effective Caries Management

John D.B. Featherstone
Distinguished Professor and Dean
School of Dentistry
University of California San Francisco

Caries Risk Assessment as the Basis for Caries Management

- You will learn the science behind dental caries – enough to use in your practice
- You will learn how to assess the risk of the patient having new carious lesions or cavities in the future
- You will learn what chemical therapy to use to reduce the risk level and prevent progression of the disease

Disclosure

- I have no personal financial interest in any company relevant to this presentation.
- I have consulted for, or have done research funded or supported by: Arm and Hammer, Beesham, Cadbury, GSK, KaVo, Novamin, Omnii Oral Pharmaceuticals, Oral B, Phillips Oralcare, Procter and Gamble, 3M ESPE Preventive Care, Wrigley, and the National Institutes of Health.

Some Cold Hard Facts About Dental Caries
Protective Factors

*White spot* lesion

Childhood Caries

Courtesy Dr. Ling Zhan

Frank occlusal cavity

Root caries
Protective Factors

- Saliva flow and components
- Fluoride, Calcium, Phosphate: remineralization
- Antibacterials: chlorhexidine, xylitol, silver, HClO, New?

Pathological Factors

- Acid-producing bacteria
- Frequent eating/drinking of fermentable carbohydrates
- Sub-normal saliva flow and function

Featherstone, Community Dent Oral Epidem, 1999

Pathological Factors

- Cariogenic bacteria: mutans streptococci (S. mutans and S. sobrinus) and lactobacillus species and others
- Frequency of ingestion of fermentable carbohydrates: sucrose, glucose, fructose, cooked starch
- Reduced salivary function (medication induced; radiation therapy; disease; genetic)

Demineralization:

Step 1

Cariogenic Bacteria
S. Mutans
S. Sobrinus
Lactobacillus

Fermentable Carbohydrates
Sucrose
Glucose
Fructose
Cooked starch

Organic Acids
Which penetrate enamel and dentin
Dissolve tooth mineral
Additional Species strongly related to high caries in children

- Tanner and co-workers 2010 and 2011
- Bifidobacteria
- Veillonella
- Scardovia wiggsiae
- Watch this space
- Any bacteria that produce acid as a byproduct of metabolism
- Biofilm is a cooperative city

Additional Species strongly related to occlusal caries in dentin

- Lactobacillus casei and Lactobacillus fermentum
- Veillonella species
- Actinomyces species
- Bifidobacterium species
- Any bacteria that produce acid as a byproduct of metabolism
- Biofilm is a cooperative city

Pathological Factors

- Cariogenic bacteria: mutans streptococci (S. mutans and S. sobrinus) and lactobacillus species and others
- Frequency of ingestion of fermentable carbohydrates: sucrose, glucose, fructose, cooked starch
- Reduced salivary function (medication induced; radiation therapy; disease; genetics)

Cariogenic foods contain fermentable carbohydrates such as sucrose, glucose, fructose and cooked starch
Pathological Factors
- Cariogenic bacteria: mutans streptococci (S. mutans and S. sobrinus) and lactobacillus species and others
- Frequency of ingestion of fermentable carbohydrates: sucrose, glucose, fructose, cooked starch
- Reduced salivary function (medication induced; radiation therapy; disease; genetic)

The Caries Balance
Pathological Factors
- Acid-producing bacteria
- Frequent eating/drinking of fermentable carbohydrates
- Sub-normal saliva flow and function

Protective Factors
- Saliva flow and components
- Fluoride, Calcium, Phosphate
- remineralization
- Antibacterials: chlorhexidine
- xylitol, Silver, HClO, new?

Featherstone, Community Dent Oral Epidem, 1999
The Caries Balance

Pathological Factors
- Acid-producing bacteria
- Frequent eating/drinking of fermentable carbohydrates
- Sub-normal saliva flow and function

Protective Factors
- Saliva flow and components
- Fluoride, Calcium, Phosphate: remineralization
- Antibacterials: - chlorhexidine, xylitol, Silver, HClO, new?

No Caries

Caries

Fluoride works primarily via topical (surface) mechanisms
(Fluoride in water, foods, beverages, products)

- Fluoride inhibits demineralization
- Fluoride enhances remineralization
- Fluoride can inhibit plaque bacteria

Featherstone, Community Dent Oral Epidem, 1999

What can we do with this knowledge?

Numerous clinical trials showed ~30% reduction with fluoride toothpaste 1000-2800 ppm F.

Curnow, Pine, et al, 2002 reported 56% reduction with supervised brushing 2 x daily with a 1000 ppm F toothpaste compared with unsupervised
Brushing at least twice daily with a fluoride-containing toothpaste is one of the most effective ways to control dental decay. High bacterial challenge overcomes the therapeutic effects of fluoride.

**Clinpro™ 5000 1.1% NaF Dentifrice**  
3M Oral Care  
Contains Tri-calcium phosphate

**FluorideVarnish for High Caries Risk of All Ages**  
White “Vanish” Varnish – 3M Oral Care

**The Caries Balance**

Pathological Factors
- Acid-producing bacteria  
- Frequent eating/drinking of fermentable carbohydrates  
- Sub-normal saliva flow and function

Protective Factors
- Saliva flow and components  
- Fluoride, Calcium, Phosphate: remineralization  
- Antibacterials: chlorhexidine, xylitol, silver, HClO, new?

Featherstone, Community Dent Oral Epidem, 1999
Caries Res, 2012

A Randomized Clinical Trial of Anticaries Therapies Targeted according to Risk Assessment (Caries Management by Risk Assessment)


University of California, San Francisco, Calif, USA

Decayed Surfaces vs. log MS and log LB

Baseline Bacterial Levels vs Decay

High Bacterial Challenge

Existing Cavity = High Risk

Caries Management Study

Baseline Observations
Saliva Sample
MS, LB and F Radiographs
DMFS 1-7 cavities

Restorations
Conventional Treatment Plan
Restorations S2
All Restorations Complete
Final Observations Radiographs DMFS

N=116
(CHX + F)

N=115

Restorations + Anti-bacterial and Fluoride Treatment
All Restorations Complete
Final Observations Radiographs DMFS

2 Years

Randomization

Control

Intervention
Chlorhexidine plus Fluoride

Chlorhexidine Gluconate 0.12%, 10 ml, daily for 1 week reduces MS markedly and LB somewhat after restorations completed. Repeat every month.

ΔDMFS (SE)
24% reduction (p=0.02)

What about the clinical relevance?

Does drilling and filling really fix caries?
Patients With Cavities

- One or more frank cavities indicates high risk for future new carious lesions
- Moderate to high levels of mutans streptococci
- Moderate to high levels of lactobacilli
- Patients have a high bacterial challenge that most likely cannot be completely overcome by fluoride alone
- Placing restorations does not reduce the bacterial loading in the rest of the mouth

Much to Reflect Upon

Caries Management by Risk Assessment (CAMBRA®):

- Use the caries balance to assess the caries risk
What is Caries Risk?

- Caries Risk is the likelihood of a person having new or extended tooth decay in the coming months or years.
- You will learn how to assess caries risk and how to manage the risk.
- First you have to learn the science behind the disease we call dental caries.

Caries Risk Assessment

Risk Levels
- Low
- Moderate
- High
- Extreme (High risk plus hyposalivation)

Putting into practice the results of many years of research. “Caries Management by Risk Assessment” October, November 2007. On line, free California Dental Association Journal based upon the “Caries Balance” http://www.cdafoundation.org/journal

Caries Risk Assessment Form
- Featherstone et al, CDAJ, 2007
- Circle Yes’s
- Visualize the Balance
- Decide on caries risk level: Low, Moderate, High, Extreme
- Used in UCSF student clinics and beyond
- Used in many private practices, with modifications
Validation of the CDA CAMBRA Caries Risk Assessment — A Six-Year Retrospective Study
Sophie Domejean, Joel M White, John D Featherstone

Caries Risk Assessment
12,954 Patients over 6 years
2,571 at Follow Up

- Caries risk assessment method validated and can be improved even further
- Need effective remineralizing and antibacterial therapy to deal with high and extreme risk patients

Caries Management Step by Step

- Dental/medical history
- Clinical exam
- Detect caries lesions early enough to reverse or prevent progression
- Assess caries risk
- Treatment plan including chemical therapy
- Use fluoride and/or antibacterial therapy based on observations
- Use minimally invasive restorative procedures to conserve tooth structure
- Recall and review
Risk Assessment
Assessing the risk for caries in the future

Caries Risk? - Joe Cornish
- 55 year old male
- Two new cavities since last visit two years ago
- Four new approximal lesions by radiograph
- Exposed root surfaces
- Bacteria - likely high
- Frequent snacker – truck driver
- No symptoms of dry mouth
- No hyposalivatory meds
- 1X daily F toothpaste?

The Caries Balance-High Risk
Disease Indicators and Pathological Factors
- Two new cavities
- Four new approximal lesions
- Acid-producing bacteria
- Frequent eating/drinking of fermentable carbohydrates
- 55 year old = exposed roots

Protective Factors
- Saliva flow and components normal
- Fluoride, 1X F toothpaste daily

Caries Risk Assessment Form
- Featherstone et al, CDAJ, 2007
- Circle Yes’s
- Visualize the Balance
- Decide on caries risk level: Low, Moderate, High, Extreme

High Risk
Featherstone, Community Dent Oral Epidem, 1999
One week a month
10 ml once daily
2-3 x daily
3-4 x daily
2X daily
10 ml 2 x daily three weeks a month

High Risk

CariFree Treatment Rinse
Another Antibacterial Rinse

- Sodium hypochlorite and buffering agents in separate bottles mixed before use
- Clinical trial - unpublished, indicates very good clinical efficacy
- No microbiological data published
- Sodium fluoride maintenance rinse

Silver Diamine Fluoride

- Silver antibacterial
- Fluoride available
- Paint on lesions
- Black on dentin, cavities and clothing
- Repeat depending on risk level
- Adults as well as children
Cynthia Pine - Caries Risk?

- 25 year old female
- No new caries lesions in the last 5 years
- Bacteria?
- Not a frequent snacker
- No symptoms of salivary dysfunction
- No medications with salivary side effects
- 2X daily F toothpaste

Caries Risk Assessment Form
- Featherstone et al, CDAJ, 2007
- Circle Yes's
- Visualize the Balance
- Decide on caries risk level: Low, Moderate, High, Extreme

Low Risk

The Caries Balance-Low Risk

Pathological Factors
- Acid-producing bacteria-LOW
- Frequent snacker-NO
- Sub-normal saliva-NO

Protective Factors
- Saliva flow and components NORMAL
- Fluoride, 2X DAILY
- Antibacterials- NO NEED

Caries

No Caries

Featherstone, Community Dent Oral Epidem, 1999

Therapy for Low Caries Risk Individual

- Maintain 2 x daily fluoride toothpaste brushing and other habits.
- Recall 12 months
What is the Caries Risk of Mary Smith?

- 15 year old female
- Several lesions into dentin
- Bacteria?
- Symptoms of salivary dysfunction (dry mouth), taking anti-anxiety medications and other medications
- Frequent snacker
- F toothpaste 1X daily

Caries Risk Assessment Form

- Featherstone et al, CDAJ, 2007
- Circle Yes’s
- Visualize the Balance
- Decide on caries risk level: Low, Moderate, High, Extreme

The Caries Balance

Extreme Risk

Disease Indicators and Pathological Factors
- Several lesions into dentin
- Acid-producing bacteria
- Frequent eating/drinking of fermentable carbohydrates
- Hyposalivatory medications
- Sub-normal saliva flow and Function - YES

Protective Factors
- Saliva-INADEQUATE
- Fluoride, 1X daily or LESS
- Antibacterials - NONE

Caries

No Caries

Featherstone, Community Dent Oral Epidem, 1999

Extreme Caries Risk Individuals

- High Risk plus severe hyposalivation. Measure stimulated saliva flow rate (less than 0.5 ml/minute)
- High bacterial challenge
- Same therapy as for high risk individuals PLUS:
  - Baking soda rinse 4x daily (2 teaspoons in 8 ounces water)
  - Consider fluoride trays for home use (1.1% neutral sodium fluoride gel) daily
  - Consider calcium phosphate home use gel
  - Recall 3 months and repeat F varnish etc.
One week a month
10 ml once daily
2–3 x daily
3–4 x daily
10 ml 2 x daily three weeks a month
2X daily
Extreme Risk
PLUS
Baking soda rinse (2 teaspoons) 8 ounces water
2X daily

Caries Risk - Charles Gomez?
- 60 year old male
- Root canal 6 years ago. No new caries by exam
- No symptoms of salivary dysfunction
- One medication has potential dry mouth side effects
- Not a frequent snacker
- Exposed root surfaces
- Bacteria?
- 2X F toothpaste daily

The Caries Balance – Risk Level?

Disease Indicators and Pathological Factors
- Root canal 6 years ago
- Acid-producing bacteria?
- One hyposalivatory medication
- 60 years old - Exposed roots

Protective Factors
- Saliva flow and components normal – no hyposalivation
- 2 X F toothpaste daily
- Antibacterials: None

Featherstone, Community Dent Oral Epidem, 1999

The Caries Balance – Moderate Risk

Disease Indicators and Pathological Factors
- Root canal 6 years ago
- Acid-producing bacteria?
- One hyposalivatory medication
- 60 years old - Exposed roots

Protective Factors
- Saliva flow and components normal – no hyposalivation
- 2 X F toothpaste daily
- Antibacterials: None

Featherstone, Community Dent Oral Epidem, 1999
Caries Risk Assessment Form
- Featherstone et al, CDAJ, 2007
- Circle Yes’s
- Visualize the Balance
- Decide on caries risk level: Low, Moderate, High, Extreme

Moderate Risk

Moderate Risk

Caries Management Step by Step
- Dental/medical history
- Clinical exam
- Detect caries lesions early enough to reverse or prevent progression
- Assess caries risk
- Treatment plan including chemical therapy
- Use fluoride and/or antibacterial therapy based on observations and risk level
- Use minimally invasive restorative procedures to conserve tooth structure
- Recall and review

Brushing 2x daily

Moderate Risk Option 2

Does the therapy really work?
Future caries by treatment among high-risk patients

Chaffee et al, BMC Oral Health: 2015: N=2,724

<table>
<thead>
<tr>
<th>Treatment</th>
<th>New Decayed/Filled Teeth (count)</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
<td>1.82</td>
</tr>
<tr>
<td>Single-Time</td>
<td>1.70</td>
</tr>
<tr>
<td>Twice or More</td>
<td>1.47</td>
</tr>
</tbody>
</table>

DFT (95% CI -0.65, -0.08) p = 0.02

20% Redcn

Future caries by treatment among high-risk patients, separated by payer type

Chaffee et al, BMC Oral Health: 2015

DentiCal

42% Redcn

CAMBRA® therapy for high risk costs about $200 a year
Potential savings conservatively $100 a year
12 million DentiCal patients in California
If all participated and complied would save $1.2 billion a year
Hypothesis: specific laser irradiation of the tooth surface can precisely remove decayed tissue and convert the remaining mineral to a caries resistant form prior to placing a restoration.

- **Pulsed Laser light with high absorption coefficient**
- **Enamel**
- **Dentin**
- **Walls of preparation heated to 800-1000 °C**
- **Pulp temperature rise < 4 °C**

**Solea – Convergent Dental**
- Carbon Dioxide Laser 9.3 µm
- Rapid caries removal
- Minimal anesthetic
- Caries preventive therapy
- Soft tissue surgery