Public Health Aspects of Periodontal Diseases

CDC’s Initiative to Develop Non-clinical Methods for Periodontal Disease Surveillance

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- George Taylor
- Gina Thornton-Evans
- Scott Tomar
Overview

• Current status of periodontal disease surveillance
• Surveillance of health using self-report
• Developing self-report methodology for periodontal disease surveillance
CDC’s Role in Oral Health

- Primary responsibility is to support state- and community-based programs to prevent oral disease, promote oral health nationwide, and foster applied research to enhance oral disease prevention in community settings.
Surveillance of Periodontal Disease at State and Local Levels

• **Current Status** – No state/local level surveillance of periodontal disease

• **Why ?**
  – No surveillance systems that includes periodontal disease
  – Requirement of resource intensive clinical measures for identifying cases of periodontal disease
  – Variations in measures of periodontal diseases from state to state
Why Monitor Periodontal Disease at State and Local Levels?

- Increasingly older population
- Adults are retaining more of their teeth
- Prevalence may vary widely between/within states
- Disparities in SE determinants of disease
- Associations between periodontal health and other systemic diseases
- Tooth loss/periodontal health and quality of life
- Monitor disease at jurisdiction level where interventions can occur
  - Information for resource allocation
  - Evaluation of prevention programs
U.S. National Objective on Periodontal Disease

- Objective 21.5: “Reduce destructive periodontal disease in adults aged 35 to 44 years.”
  - Baseline (1999-00): 20%
  - Target: 14%

- Prevalence in States, counties, cities?
Traditional Approaches to Monitoring Periodontal Diseases in Populations

- Original data collection through clinical exams
- Array of clinical protocols, indexes, definitions
  - E.g., full mouth, half-mouth, sextants, selected teeth, varying # of sites per tooth
  - CAL, CPI, radiographic bone loss, other
- Sporadic surveys
Problems with Current Approach

- Resource intensive
- Few data at state/local level
- Not timely
- Questionable sustainability
Alternative Approaches to Periodontal Surveillance

• Existing clinical data, e.g. dental records
  – Inconsistent, limited accessibility

• Administrative / claims data
  – Misses uninsured; questionable relation between periodontal status and claims

• Sentinel surveillance, e.g. specific clinics
  – Limited generalizability; logistical issues

• Self-report
Some Conditions/Risk Factors Using Self-Reports for Surveillance

- Overweight/obesity
- Diabetes
- Hypertension
- Hypercholesterolemia
- Smoking
- Mammography
- Pap smear
The Behavioral Risk Factor Surveillance System (BRFSS)

- Provides county and metropolitan level estimates
- Standardized
  - Allows state-to-state comparisons
  - Allows local area to local area comparisons
- Flexible
  - Addition of questions to address relevant topics
- Timely
  - Address urgent and emerging health issues
- Relatively inexpensive
- Technical details see: www.cdc.gov/brfss
Uses for BRFSS

• Tracking health risk trends
• Identify emerging health problems
• Program development
• Policy development
• Program evaluation

1990
No Data        <4%             4%–6%             6%–8%               8%–10%           >10%

1996

2003

Legend:
- No Data
- <4%
- 4%–6%
- 6%–8%
- 8%–10%
- >10%
Obesity Trends Among U.S. Adults

1991

1996

2003

No Data <10% 10%-14% 15%-19% 20%-24% ≥ 25%
Validity of Some Self-Reported Measures in the Behavioral Risk Factor Surveillance System (BRFSS)

- **Smoking** (vs. Cotinine levels in urine)
  - Sensitivity 87.5%  Specificity 89.2%

- **Mammogram**
  - Sensitivity 71 to 100%  Specificity 34% to 94%

- **Clinical Breast Examination**
  - Sensitivity 88%  Specificity 59%

- **Pap Smear**
  - Sensitivity 61 to 97% Specificity 19 to 76%
  - *Sensitivity 98.7  Specificity 47.8% (Self-report among HMO)*

- **Blood Pressure** (vs. medical records)
  - Sensitivity 99%  Specificity 23%
Validity of Some Self-Reported Measures in the Behavioral Risk Factor Surveillance System (BRFSS)

- **Cholesterol Screening**
  - Sensitivity 86%  Specificity 33%

- **Hypertension**
  - Sensitivity 80%  Specificity 80 to 90%

- **Diabetes**
  - Sensitivity >85%  Specificity >95% (K >0.80)
  - *Sensitivity 73%  Specificity 99% (Self-report in HMO)

- **Hypercholesterolemia** (vs. measurements)
  - Sensitivity 43%  Specificity 86%
  - *Sensitivity 59%  Specificity 84% (Self-report in HMO)

- **Colorectal Cancer Screening**: Blood stool test
  - Sensitivity 92%  Specificity 71%
CDC Initiative on Surveillance for Periodontal Disease

• Began April 2003
• Goal:
  – Develop surveillance system for periodontal infections using self-reported measures;
  – Could include variables on signs, symptoms, behaviors, demographics, co-morbidities;
  – Primary focus is USA;
  – Outcomes should be at least state-specific and possibly county and local;
  – Ideally could yield subpopulation estimates
The Challenges

- Individual questions lack validity or reliability to use alone
- Needs to be relatively inexpensive
- Needs to be relatively brief
- Needs to be accepted as valid by clinicians, researchers, public
- Could multivariable modeling approach enhance validity?
Steps of Process

**Step 1:** Literature Review

**Step 2:** Identification of Datasets

**Step 3:** Development of Case Definitions

**Step 4:** Bivariate and Multivariable Analyses

**Step 5:** Field Testing of Promising Questions

**Step 6:** Develop Statistical Scoring Algorithm for U.S Population
Systematic Review: Validity of Self-Reported Periodontal Disease

• Total: 16 studies, 1966 – June 2004
  – 8 validated “periodontal disease”, 13 validated gingivitis, 5 included both
  – Clinical “gold standard” varied widely
  – 20 questions assessed for validity of self-reported periodontal disease; 16 in review

• “Good validity”: Sens + Spec ≥ 120% or PVP + PVN ≥ 120%
  – 13 of 16 perio. dis. measures considered valid
  – Few had high sens and high spec in gen’l pop.
  – 5 of those 13 valid for >1 clinical measure

Analyses of Data from Existing Studies
Data Sources

1. Predictors of Oral Health of African Americans (AADENT)
2. Periodontal Infections and Risk for Myocardial Infarction (MI-Perio)
3. The Buffalo and Erie County Periodontal Disease Study (Erie County)
4. The Florida Dental Care Study (Florida)
5. Nurses Health Study (NHS)
6. Health Professionals’ Follow-up Study (HPFS)
7. The Accuracy of Self-reported Items to Determine Periodontal History (German)
### Study Populations

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>Age</th>
<th>%Female</th>
<th>%NHWhite</th>
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<tr>
<td>German</td>
<td>246</td>
<td>20-80</td>
<td>59</td>
<td>~100</td>
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</table>
Clinical Case Definitions

• **Severe periodontitis:**
  
  ≥ 2 interproximal sites (not on same tooth) with ≥ 6 mm CAL
  
  AND
  
  ≥ 1 interproximal site(s) with PPD ≥ 5 mm

• **Moderate periodontitis:**

  ≥ 2 interproximal sites with ≥ 4 mm CAL (not on same tooth)
  
  OR
  
  ≥ 2 interproximal sites with ≥ 5 mm PPD (not on same tooth)

• **No/Mild periodontitis:** Neither moderate nor severe
Radiographic Case Definitions

**Severe periodontitis:**

- ≥ 2 interproximal sites (not on same tooth) with ≥ 6 mm radiographic bone loss (bite-wing or periapical exposures)

  or

- ≥ 2 interproximal sites (not on same tooth) with ≥ 7 mm radiographic bone loss (panoramic exposures)

**Moderate periodontitis:**

- ≥ 2 interproximal sites (not on same tooth) with ≥ 4 mm radiographic bone loss (bite-wing or periapical exposures)

  or

- ≥ 2 interproximal sites (not on same tooth) with ≥ 5 mm radiographic bone loss (panoramic exposures)
# Prevalence of Periodontitis (%)

<table>
<thead>
<tr>
<th>Study</th>
<th>N</th>
<th>No/Mild</th>
<th>Moderate</th>
<th>Severe</th>
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<td>N/A</td>
<td>N/A</td>
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<td>German</td>
<td>246</td>
<td>34</td>
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</table>
Perio-related BRFSS Variables

- Age
- Gender
- Race
- Education
- Employment status
- Annual household income
- Been told by doctor to have diabetes
- Self-rated general health
- Cigarette smoking
- Tooth loss
- Length of time since last dental visit for any reason
- Length of time since last dental cleaning
Types of Periodontal Health-related Self-report Variables Used

- Bleeding
- Think have perio dz
- Loose teeth
- Malodor / bad taste
- Noticed change
- Oral hygiene aid use
- Number of teeth
- Pain / discomfort
- Previous diagnosis
- Use of rinses
- History of perio tx
- Self-rating of gingival health
- Widening of spaces
Analysis Methods

Dichotomous Case Definitions

1. [None/Mild periodontitis] vs. [Moderate or Severe periodontitis]

2. [None/Mild or Moderate periodontitis] vs. Severe periodontitis]
Methods: Statistical Analyses

Manual logistic regression model development

SAS automated selection routines to perform logistic regression analyses:
- Forward selection routine
- Backward selection routine
- Stepwise selection routine
- Score selection routine
Criteria for Model Assessment

- C-statistic
- Sensitivity
- Specificity
- False positive
- False negative
- Likelihood Ratio Chi Square
- R-square
Predictors of Oral Health of African Americans (AADENT)

School of Dentistry & Institute for Social Research
University of Michigan

NIDR Grant DE10145
AADENT

No/Mild Periodontitis
vs.
Moderate or Severe Periodontitis
### [No/Mild Periodontitis] vs [Moderate or Severe]

**Best of the “Best” Unforced Models**

<table>
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<tr>
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</table>

#### VARIABLES

- Think gum disease
- Noticed tooth
- Age
- Smoke
- Race
- Painful gums
- Rinse
- Gender
AADENT

No/Mild or Moderate Periodontitis vs. Severe Periodontitis
## [No/Mild or Moderate Periodontitis ] vs. [Severe] 
Best of the “Best” Unforced Models

<table>
<thead>
<tr>
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<tr>
<td>Specificity</td>
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<td>0.26</td>
<td>0.27</td>
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### VARIABLES

- Noticed tooth: x x x x x x
- Loose tooth: x x x x x
- Age: x x x x
- Gender: x x x x
- Stimudents: x x x
- Rinse: x x x
- Think gum disease: x
- Problems brushing: x
Summary of results from all studies
<table>
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<th>NO/MILD vs MOD_SEV</th>
<th>AADENT</th>
<th>MI-Perio</th>
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<th>HPFS</th>
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<tr>
<td>Age</td>
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<td>Race</td>
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<td>Smoking</td>
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<td>Gender</td>
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<td>Diabetes</td>
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<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Think have gum disease</td>
<td>x</td>
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</tr>
<tr>
<td>Noticed tooth not looking right</td>
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<tr>
<td>Painful gums</td>
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<tr>
<td>Gum surgery in the past</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<tr>
<td>Sore gums in the past</td>
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<td>Bleeding gums now</td>
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<tr>
<td>Number of teeth</td>
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<tr>
<td>Loose tooth</td>
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<tr>
<td>Malodor/bad taste</td>
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</table>
## Model Performance Statistics for [No/Mild] vs. [ Moderate or Severe] Periodontitis

<table>
<thead>
<tr>
<th></th>
<th>AADENT</th>
<th>MI-Perio</th>
<th>Erie County</th>
<th>NHS</th>
<th>HPFS</th>
<th>German</th>
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<td>0.85</td>
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<tr>
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<td>Noticed tooth not looking right</td>
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<tr>
<td>---------------------</td>
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<td>----------</td>
<td>-------------</td>
<td>------</td>
<td>-----</td>
<td>------</td>
</tr>
<tr>
<td>Age</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Race</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Smoking</td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Gender</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Diabetes</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>High school grad.</td>
<td></td>
<td></td>
<td></td>
<td>x</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Model Performance Statistics for [No/Mild or Moderate] vs. [Severe] Periodontitis

<table>
<thead>
<tr>
<th></th>
<th>AA-DENT</th>
<th>MI-Perio</th>
<th>Erie County</th>
<th>FDCS</th>
<th>NHS</th>
<th>HPFS</th>
<th>German</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-statistic</td>
<td>0.93</td>
<td>0.76</td>
<td>0.75</td>
<td>0.80</td>
<td>0.93</td>
<td>0.97</td>
<td>0.88</td>
</tr>
<tr>
<td>Sensitivity</td>
<td>89%</td>
<td>68%</td>
<td>65%</td>
<td>76%</td>
<td>82%</td>
<td>99%</td>
<td>58%</td>
</tr>
<tr>
<td>Specificity</td>
<td>82%</td>
<td>67%</td>
<td>69%</td>
<td>68%</td>
<td>71%</td>
<td>25%</td>
<td>92%</td>
</tr>
<tr>
<td>Se + Sp</td>
<td>171</td>
<td>135</td>
<td>134</td>
<td>144</td>
<td>153</td>
<td>124</td>
<td>150</td>
</tr>
</tbody>
</table>
Summary and Conclusions

- Trends among variety of studies suggest validity of self-report for periodontal disease presence

- Consistency
  - Different populations
    - Health professionals
    - Community dwelling elders
    - Community dwelling adults of all ages
    - Patients with heart disease
    - Patients requiring endodontic treatment
    - Race / Ethnicity
Summary and Conclusions, cont’d.

• Different assessment methods
  – Varied clinical periodontal exam measures
  – Varied radiographic measures

• Different geographic areas
  – Rural vs urban
## Periodontal Screening Questions

### Questions

<table>
<thead>
<tr>
<th>Question</th>
<th>Response categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Do you think you have gum disease?</td>
<td>Yes/No/Don’t know</td>
</tr>
<tr>
<td>Has a dental professional ever told you that you have lost bone around your teeth?</td>
<td>Yes/No/Don’t know</td>
</tr>
<tr>
<td>Have you ever had scaling, root planing, surgery or other treatment for gum disease?</td>
<td>Yes/No/Don’t know’</td>
</tr>
<tr>
<td>Have you ever had any teeth that have become loose by themselves without some injury (not baby teeth)?</td>
<td>Yes/No/Don’t know</td>
</tr>
<tr>
<td>How often during the last seven days did you use mouthwash or any dental rinse product?</td>
<td>Literal response</td>
</tr>
</tbody>
</table>
### Periodontal Screening Questions to Test Further, cont’d

<table>
<thead>
<tr>
<th>Questions</th>
<th>Response categories</th>
</tr>
</thead>
<tbody>
<tr>
<td>How often during the last seven days did you use dental floss, tape or</td>
<td>Literal response</td>
</tr>
<tr>
<td>interdental brush to clean between your teeth, other than just to</td>
<td></td>
</tr>
<tr>
<td>remove food particles stuck between your teeth?</td>
<td></td>
</tr>
<tr>
<td>How would you rate the health of your gums?</td>
<td>Excellent / VG / G /</td>
</tr>
<tr>
<td>Have you noticed that you have a tooth that doesn’t look right?</td>
<td>Yes/No/Don’t know</td>
</tr>
</tbody>
</table>
Next step: Validation pilot

- Australian Research Center for Population Oral Health
- National Survey of Adult Oral Health, 2004/06
  - Gary Slade, University of Adelaide
  - CDC
Six states, two territories
Population 20 million
~65% of population resides
in 8 capital cities

Data for this interim analysis
- Red: Data collection completed
- Yellow: Data collection underway
- White: Data collection scheduled
Australian National Survey of Adult Oral Health: Overview of survey methods

- Sampling – three stage, clustered design
  - Metropolitan, regional and rural areas
- Computer-assisted telephone interviews (CATI) of 13,560 people, ages 15 +
- Oral examination of those interviewed
CATI, 69 questions, 15 min

- Oral health status
  - Tooth loss, self-rated oral health, dental pain and other symptoms
  - Questions screening for periodontal disease
- Pattern of past dental visits
  - Waiting time for last dental visit
  - Dental treatments received in last 12 months
- Perceived need for dental care
- Barriers to receipt of dental care
- Dental insurance and eligibility for public dental services
- Socio-economic factors
Examination procedures

• Conducted at public health department clinics

• Based on US National Health and Nutrition Examination Survey 2004 and UK Adult Dental Health Survey 1998

• Periodontal (gum) assessment
  – Plaque, gingivitis and calculus on six teeth
  – Periodontal recession and pocket depth at three sites on all teeth excluding 3rd molars
<table>
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</table>
Periodontal Screening Questions Tested for CDC Working Group, cont’d

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<tr>
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<tbody>
<tr>
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<td></td>
</tr>
<tr>
<td>food particles stuck between your teeth?</td>
<td>Excellent / VG / G / F / Poor</td>
</tr>
<tr>
<td>How would you rate the health of your gums?</td>
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</tr>
<tr>
<td>Have you noticed that you have a tooth that doesn’t look right?</td>
<td>Yes/No/Don’t know</td>
</tr>
</tbody>
</table>
## Participation in the survey (through 3 Mar 2006)

<table>
<thead>
<tr>
<th>Category</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>No. of people interviewed (to 03Mar06)</td>
<td>11,019</td>
</tr>
<tr>
<td>Edentulous</td>
<td>953</td>
</tr>
<tr>
<td>Dentate but out of scope for exam</td>
<td>179</td>
</tr>
<tr>
<td>Dentate and in scope for exam</td>
<td>9,887</td>
</tr>
<tr>
<td>No. in scope who said “OK” to further contact for examination</td>
<td>7,921</td>
</tr>
<tr>
<td>(80% of 9,887)</td>
<td></td>
</tr>
<tr>
<td>No. of dentate people contacted who completed an examination*</td>
<td>3,855</td>
</tr>
<tr>
<td>(49% of 7,921)</td>
<td></td>
</tr>
<tr>
<td>No. of dentate people with periodontal assessment used in interim analysis</td>
<td>2,999</td>
</tr>
</tbody>
</table>