Assessing the Association Between Receipt of Dental Care and Diabetes Outcomes: An Example from Kaiser Permanente Northwest (KPNW)

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Today’s Objectives

- Within the KPNW Dental Program:
  - Discuss the association of ongoing receipt of dental care with: 1) clinical outcome measures and 2) cost measures among population with diabetes-mellitus (DM)
  - Briefly discuss future dental-medical interventions/evaluations to improve care for adults with DM
Background

- Diabetes imposes a large burden on the U.S. health care system.
  - 2013: $116 billion in medical costs and $59 billion in reduced worker productivity.

- Prior research has shown a two-directional relationship between periodontal disease and diabetes.
  - Diabetes exacerbates severity of periodontal disease.
  - Periodontal disease, in turn, contributes to poor metabolic control, which can increase diabetes-related complications.

- Regular receipt of dental care can reduce the effects of periodontal inflammation, thereby improving glycemic control.
  - Few studies have been done at the population level that also analyze key utilization and cost measures.
Dental-Diabetes-Mellitus (DM) Study Objectives

- Among adults with DM, determine association of regular receipt of dental care with the following outcomes:
  - Good glycemic control
  - DM-specific utilization
    - Hospital admissions, emergency department (ED) visits
  - Medical costs
    - Total costs
    - Hospital costs
    - ED costs
Study Setting

- **Kaiser Permanente Northwest (KPNW)**
  - Serves 499,000 members in Portland metro area (includes southwest Washington).
  - Group model health maintenance organization (HMO).
  - Includes a medical and dental health plan.

- **One of seven Kaiser Permanente (KP) regions**
  - Large integrated health system providing comprehensive, prepaid health care services to 10 million individuals.

- **KPNW Dental Program serves 229,000 members**
  - Capitated; prepaid payment model
  - 17 dental clinics; half co-located with KPNW medical offices
  - 90% of KPNW dental members also have KPNW medical insurance
Geographic location of KPNW Dental and Medical Services
Use of Panel Support Tool (PST) in KPNW Dental Clinics: Population Health Approach

- Nearly **100 percent** of our dental providers (137 KPNW dentists and 191 dental providers) are using the Patient Support Tool (PST) routinely.

- #4 in care gap closure assists (assisted in closing 23,000 care gaps in 2013) among KPNW departments.

- Example of dental-medical integration on population health level.
Study Methods: Diabetes Population

- Data-only analysis with the following inclusion criteria:
  - On KPNW diabetes registry by 12/31/05 with type II diabetes diagnosis.
  - Between ages 18–80 as of 12/31/2005.
  - > 1 outpatient visit each calendar year between 1/1/2005 and 12/31/2007.

- Retrospective cohort research design
  - Dental population received > 2 dental-related hygiene and/or periodontal visits each calendar year between 1/1/2005 and 12/31/2007.
  - Matched exactly on gender, age (within 1 year), and ED utilization/hospital admissions (during 2005).

- Outcome measures and cost information tracked in 2007

Total population that met dental and medical insurance eligibility requirements and were listed on diabetes registry between 1/1/2005 and 12/31/2007 (N=4,331)

Dental Use: Total population that met criteria for dental hygiene and/or periodontal visits (N=537; 12.4%)
No Dental Use: Total population with no dental visits over study period (N=747; 17.2%)
Excluded Population: Total population who had some dental visits that did not meet threshold (N=3,047; 70.4%)

Final Analytic Sample (N=986)
Dental Use = 493 of 537 (91.8%) patients matched to non-dental population
No Dental Use = 493 of 747 patients match to dental population with regard to sex, age (within one year), 2005 emergency department visits, and 2005 hospital admissions
Outcome Measures: Glycemic Control, Utilization and Medical Costs

- HbA1c control (2007)
- Utilization (2007)
- Medical costs, per patient per month:
  - Total costs (2007)
  - Inpatient costs (2007)
  - ED costs (2007)
  - Costs based on CPT-4 intensity weighted procedure codes
Covariate Measures

- **Matched variables**
  - Age (within 1 year; as of 12/31/2005)
  - Sex
  - Diabetes-specific ED utilization (2005)
    - 1+ visits vs. none
  - Diabetes-specific hospital admissions (2005)
    - 1+ admissions vs. none

- **Non-matched variables**
  - Race/ethnicity (white vs. non-white)
  - HbA1c (< 7% vs. ≥ 7%; closest value to 12/31/2005)
  - Charlson comorbidity score (CCI; continuous)
  - Periodontal risk factors (moderate vs. elevated)
  - Body mass index (≥ 30 vs. < 30)
  - Yearly primary care utilization (2005-2007; continuous)
### Population Characteristics (Diabetes Population)

<table>
<thead>
<tr>
<th>Characteristic – Matched Variables</th>
<th>Dental Group¹ N=493</th>
<th>Non-Dental Group² N=493</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (mean +/- S.D.)</td>
<td>61.4 +/- 9.0</td>
<td>61.3 +/- 9.0</td>
</tr>
<tr>
<td>Female (%)</td>
<td>58.0</td>
<td>58.0</td>
</tr>
<tr>
<td>2005 ED Use (% with 1+ visits)</td>
<td>6.7</td>
<td>6.7</td>
</tr>
<tr>
<td>2005 Hospital Utilization (% with 1+ admissions)</td>
<td>9.1</td>
<td>9.1</td>
</tr>
</tbody>
</table>

¹ Received ≥ 2 dental-related hygiene and/or periodontal visits each calendar year between 1/1/2005 and 12/31/2007.

² Received no dental contact between 1/1/2005 and 12/31/2007.
Population Characteristics (DM Population)

<table>
<thead>
<tr>
<th>Characteristic: Non-Matched Variables</th>
<th>Dental Care Group ¹ N=493</th>
<th>Non-Dental Care Group ² N=493</th>
</tr>
</thead>
<tbody>
<tr>
<td>White (%)</td>
<td>86.0%</td>
<td>88.0%</td>
</tr>
<tr>
<td>2005 HbA1c values &lt; 7%</td>
<td>54.8%</td>
<td>43.2%</td>
</tr>
<tr>
<td><strong>Health Status Measures</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Charlson comorbidity index score (mean +/- SD)</td>
<td>0.41 +/- 0.71</td>
<td>0.47 +/- 0.81</td>
</tr>
<tr>
<td>Body Mass Index (mean +/- SD)</td>
<td>32.9 +/- 6.6</td>
<td>34.9 +/- 7.5</td>
</tr>
<tr>
<td>Moderate periodontal risk (diabetes only, %)</td>
<td>79.3%</td>
<td>74.2%</td>
</tr>
<tr>
<td>Elevated periodontal risk (diabetes + smoking, %)</td>
<td>20.7%</td>
<td>25.8%</td>
</tr>
<tr>
<td><strong>Primary Care Utilization</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2005 primary care visits (mean +/- SD)</td>
<td>2.8 +/- 2.0</td>
<td>2.8 +/- 2.2</td>
</tr>
<tr>
<td>2006 primary care visits (mean +/- SD)</td>
<td>2.8 +/- 2.0</td>
<td>2.8 +/- 2.2</td>
</tr>
<tr>
<td>2007 primary care visits (mean +/- SD)</td>
<td>2.8 +/- 2.0</td>
<td>3.0 +/- 2.6</td>
</tr>
<tr>
<td><strong>HbA1c Testing</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Receipt of HbA1c testing (% &gt; 1 tests, 2005)</td>
<td>97.8%</td>
<td>99.2%</td>
</tr>
<tr>
<td>Receipt of HbA1c testing (% &gt; 1 tests, 2006)</td>
<td>99.2%</td>
<td>99.2%</td>
</tr>
<tr>
<td>Receipt of HbA1c testing (% &gt; 1 tests, 2007)</td>
<td>99.6%</td>
<td>98.4%</td>
</tr>
</tbody>
</table>

¹ Received > 2 dental-related hygiene and/or periodontal visits each calendar year between 1/1/2005 and 12/31/2007. ² Received no dental contact between 1/1/2005 and 12/31/2007.
## Multivariate results: HbA1c Control and Health Care Utilization

<table>
<thead>
<tr>
<th></th>
<th>HbA1c &lt; 7%**</th>
<th>ED Utilization**</th>
<th>Hospital Admissions**</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
<td>OR 95% CI</td>
</tr>
<tr>
<td>Receipt of regular dental care</td>
<td>1.29 0.97-1.72</td>
<td>0.61 0.40-0.92*</td>
<td>0.61 0.39-0.95*</td>
</tr>
<tr>
<td>Non-receipt of dental care</td>
<td>1.00 NA</td>
<td>1.00 NA</td>
<td>1.00 NA</td>
</tr>
</tbody>
</table>

* p < .05


** Models adjusted for age, sex, baseline DM-specific ED utilization, DM-specific hospital admissions, race/ethnicity, baseline HbA1c value, charlson comorbidity index (CCI), periodontal risk factors, obesity status, and primary care utilization 2005-2007
## Cost Results: Cost Analysis (in dollars) – Receipt of Dental Care vs. Non-Receipt

<table>
<thead>
<tr>
<th>Population</th>
<th>Total costs per patient per month (2007; mean +/- SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental Care</td>
<td>740 +/- 1,119</td>
</tr>
<tr>
<td>No Dental Care</td>
<td>1,002 +/- 1,665</td>
</tr>
<tr>
<td>p-value</td>
<td>0.004</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Population</th>
<th>Total inpatient costs per patient per month (2007; mean +/- SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental Care</td>
<td>110 +/- 526</td>
</tr>
<tr>
<td>No Dental Care</td>
<td>269 +/- 906</td>
</tr>
<tr>
<td>p-value</td>
<td>0.009</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Population</th>
<th>Total ED costs per patient per month (2007; mean +/- SD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dental Care</td>
<td>27 +/- 76</td>
</tr>
<tr>
<td>No Dental Care</td>
<td>43 +/- 110</td>
</tr>
<tr>
<td>p-value</td>
<td>0.008</td>
</tr>
</tbody>
</table>
## Cost Results: Multivariate Regression Results (adjusted per patient per month costs)

<table>
<thead>
<tr>
<th>Cost Metrics: per patient per month</th>
<th>Receipt of Dental vs. Non Receipt&lt;sup&gt;1&lt;/sup&gt;</th>
<th>Beta coefficients +/- SE</th>
<th>p-value&lt;sup&gt;2&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td></td>
<td>-129 +/- 82</td>
<td>.500</td>
</tr>
<tr>
<td>Inpatient</td>
<td></td>
<td>-101 +/- 44</td>
<td>.011</td>
</tr>
<tr>
<td>ED</td>
<td></td>
<td>-13 +/- 6</td>
<td>.008</td>
</tr>
</tbody>
</table>

<sup>1</sup> Models adjusted for age, sex, baseline DM-specific ED utilization, DM-specific hospital admissions, race/ethnicity, baseline HbA1c value, charlson comorbidity index (CCI), periodontal risk factors, obesity status, and primary care utilization 2005-2007

<sup>2</sup> Beta coefficients reported in absolute dollars.

<sup>2</sup> P-values assessed using log-transformed costs.
Conclusions: DM Outcomes and Costs

- **HbA1c control**
  - Dental group not statistically significant from non-dental group; but trended in the anticipated direction

- **Utilization**
  - Dental group had lower DM-specific hospital admissions and ED visits compared to non-dental group, adjusting for patient characteristics

- **Medical costs**
  - Dental group had $101 lower inpatient costs and $13 lower ED costs per patient per month compared to the non-dental group, adjusting for patient characteristics
Limitations

- Differences in outcomes may be due to patient differences between two groups; rather than receipt of dental care (e.g. lifestyle choices, adherence to treatment regimens, diet, etc.)

- Limited information regarding adherence to diabetes medications

- Because of differences in dental/non-dental population, cost extrapolations to entire population should be interpreted with caution

- Despite limitations, analysis adjusted for a comprehensive set of covariate measures
Next Steps: Target Outreach to Adults with Diabetes Who Do Not Utilize Dental Care
Pilot Intervention: Outreach to DM Population Not Seen for Dental Care in Previous 15 months

- KPNW conducting pilot to reach adults with DM who are overdue for dental visits
  - Two groups targeted:
    - Group 1: receiving letter mailing + targeted follow-up by live caller to schedule dental visit (while on phone)
    - Group 2: usual care

- Key outcome metrics
  - Scheduled and/or completion of dental visit (90 days post mailing)
  - Longer-term outcomes (12 months post mailing)
    - Changes in periodontal risk status
    - Changes in HbA1c values
    - DM-specific hospital admissions and ED visits
Future Integration Research: DM Population

- Develop innovative interventions to reduce care gaps in the dental setting
  - Develop targeted interventions to reduce DM and non-DM care gaps in the dental setting
    - “Warm transfer” to medical centers to complete needed labs (HbA1c tests, LDL-c tests)
    - For population with no recent primary care utilization, help to schedule primary care visit and provide linkage to needed DM care management services

- Develop targeted interventions in medical offices
  - Identify members with no dental utilization in previous 12-24 months and schedule dental visit during primary care visit
  - Develop “Dental PST” and flag dental care gaps for DM population