Healthy Mouth, Healthy Body:
THE LINK BETWEEN ORAL AND OVERALL HEALTH

A Blue Report on the Costs and Disease Prevalence Associated with Poor Dental Health

Part of a Series of Special Industry Reports From BlueCross BlueShield of Tennessee
The Blue Report series is also made available on the BlueCross BlueShield of Tennessee Web site at bcbst.com
Executive Summary:

Conclusion: This study confirms that an association exists between a person's oral health and his or her overall health care status. BlueCross BlueShield of Tennessee (BlueCross) members with diagnostic and preventive dental services had lower health care costs and less disease prevalence of coronary artery disease (CAD), congestive heart failure (CHF), diabetes and hypertension compared to members with periodontal treatment or members not utilizing dental services of any kind. A 2 percent health care cost difference between members utilizing preventive dental services versus members not utilizing dental services of any kind could result in approximately $5.5 million in medical claims savings over the course of one year.

Background: Oral health is essential to the general health and well-being of everyone. Periodontal (gum) disease, including gingivitis and periodontitis, is a chronic bacterial infection that affects the gums and bone supporting the teeth. Recent health care research literature has found links between periodontal treatment and chronic conditions, including preterm birth and low-birth weight, HIV, strokes, nervous disorders, hepatitis C virus, and increased medical costs.

Objectives: To explore the association between oral health status and overall health care costs and to evaluate overall comprehensive linkage between oral health and medical health by examining disease burden across BlueCross members.

Methods: Created three mutually exclusive study groups of members aged 18-64 for comparison:

1. Preventive Dental Services – members with evidence of preventive or diagnostic services and no evidence of periodontal treatment during the study period, hereafter referred to as preventive group
2. No Dental Services – members that did not utilize any dental services during the study period, hereafter referred to as no-dental-services group.
3. Periodontal Dental Services – members with evidence of periodontal treatment, hereafter referred to as periodontal group.

Groups were compared on a multitude of metrics, including health care costs, medical services, inpatient admissions and days, pharmaceutical dollars and prescriptions, and chronic disease prevalence.

Results:

• After removing costs associated with periodontal treatment and dental services, health care costs on a per-member-per-month (PMPM) basis was 4 percent lower for Preventive Group versus Periodontal Group.
• Inpatient admissions were approximately 16 percent higher for no-dental-services group compared to preventive group.
• Imaging costs were approximately 12 percent higher for periodontal group compared to preventive group.
• CAD, diabetes, hypertension prevalence was consistently higher in no-dental-services group.
• Cost differences associated with pharmaceutical utilization help explain observed differences in chronic conditions as well as conditions not originally studied, e.g. hepatitis C and gastroenterological inflamations.
Background:

Public acknowledgment and published research suggest a link between oral disease and overall health. The U.S. Department of Health and Human Services and the Surgeon General report that oral health is essential to a person’s general health and well-being\(^1\). Fungal, bacterial and viral pathogens may reside within the mouth and can potentially spread to other organs and tissues throughout the body\(^2\).

Periodontal (gum) disease, including gingivitis and periodontitis, is a chronic bacterial infection that affects the gums and bone supporting the teeth. Periodontal disease may increase the risk of developing diabetes. Conversely, diabetes may increase the risk of severe periodontal disease\(^3,4\). The American Academy of Periodontology recognizes the negative impact of periodontitis on heart disease, citing research indicating people with periodontal disease are nearly twice as likely to experience coronary artery disease as those without periodontal disease. Additionally, periodontal disease has been linked to preterm birth and low-birth weight, HIV, strokes, nervous disorders and hepatitis C virus\(^5\). And finally as you might expect, a patient’s medical costs can ultimately be influenced by their oral health.

Patients with periodontal disease had higher medical PMPM expenditures associated with chronic conditions compared to members without periodontal disease\(^6\).

Objectives of the Study:

This Blue Report describes a research study conducted using BlueCross BlueShield of Tennessee administrative data to determine if an association between oral and medical health could be established within our member population. The objectives of this study were:

1. Explore the association between oral health status and PMPM costs
2. Evaluate overall comprehensive linkage between oral health and medical health by examining disease burden across the study population

Methods:

Study Period
August 2004 – July 2006
THE LINK BETWEEN ORAL AND OVERALL HEALTH

Study Population:
- Members enrolled in a commercial health plan with 24 months of continuous medical and dental benefits during the study period
- Utilized medical or pharmacy service at least once during the study period
- Had prescription benefits with BlueCross BlueShield of Tennessee
- Had diagnostic cost group\(^7\) (DCG) risk score for illness burden assessment
- Age 18-64

Data Sources:
- Dental data extracted from claims data warehouse
  - Diagnostic and preventative services
  - Evidence of periodontal treatment
- Medical Data extracted using MCSource v 6.0\(^8\)
  - Allowed dollars and services (Professional, Outpatient and Other, Inpatient, Rx)
  - Evidence of chronic conditions (CAD, COPD, Diabetes, CHF, HTN) and allowed dollars associated with the treatment of these chronic conditions

Treatment Groups:
Three mutually exclusive study groups based on dental code procedures were created for comparison:
1. Preventive Group – members with evidence of preventive or diagnostic services and no evidence of periodontal treatment during the study period
2. No Dental Services – members that did not utilize any dental services during the study period
3. Periodontal Group – members with evidence of periodontal treatment

Groups were compared on several key metrics, including:
- Health care costs, represented as per-member-per-month (PMPM) – overall (medical + pharmacy + dental) and medical (medical + pharmacy) only
- Professional, outpatient and other services
- Inpatient admissions and days
- Pharmaceutical dollars and prescriptions
- Chronic disease prevalence, including
  - Coronary artery disease (CAD)
  - Congestive heart failure (CHF)
  - Chronic obstructive pulmonary disease (COPD)
  - Diabetes
  - Hypertension
- Integrated condition categories (ICC), i.e. internally developed higher-level grouping of symmetry’s episode treatment groups (ETGs)
Member Age and Cost Relationship:

To account for potential bias due to age/allowed dollars distributions (Figure 1), all comparative analyses were additionally performed at two levels:

1. All members aged < 65
2. Members aged 18 – 64

![Figure 1. Interaction between age and allowed dollars for study group (Age < 65)](image)

As you can see in Figure 1, member age and cost are complexly related. Members less than 18 years of age comprise a relatively large percentage of the total study population (blue line), yet their relative costs (gray line) are much lower. For example, 15-year old members make up 2.3 percent of the study population, however their proportional costs total only 0.8 percent. Proportional cost is approximately equal to member volume for members aged 18 – 43. However, the relationship inverts after age 43 where proportional costs (gray line) now exceed member volume (blue line). This relationship is very important to consider when comparing groups of members, as distributions of members by age may vary.

To prevent bias due to this age-cost interaction, analyses presented here are for the 18-64 age group.
Results:

**Healthcare Costs - Per-Member-Per-Month**

Per-member-per-month (PMPM) is the cost for each enrolled member each month. Medical PMPM, i.e. costs associated with medical and pharmaceutical services, was approximately 4 percent higher for the periodontal group ($308) compared to the preventive group ($297). Medical PMPM for the no-dental-services group ($303) was approximately 2 percent higher than the preventive group (Table 1; Figure 2).

Medical costs were lowest for people receiving preventive dental services.

<table>
<thead>
<tr>
<th>Group</th>
<th>Preventative</th>
<th>No Dental Services</th>
<th>Periodontal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Members</td>
<td>7,392</td>
<td>1,514</td>
<td>1,021</td>
</tr>
<tr>
<td>Average Age</td>
<td>43</td>
<td>44</td>
<td>46</td>
</tr>
<tr>
<td>Average DCG Risk Score</td>
<td>1.14</td>
<td>1.20</td>
<td>1.26</td>
</tr>
<tr>
<td>PMPM</td>
<td>$315</td>
<td>$303</td>
<td>$340</td>
</tr>
<tr>
<td>PMPM excluding dental and medical periodontal costs(^1)</td>
<td>$297</td>
<td>$303</td>
<td>$308</td>
</tr>
</tbody>
</table>

\(^1\)Periodontal costs covered under medical benefit

**Figure 2.** Adjusted PMPM across treatment groups. Adjusted PMPM excludes costs associated with dental costs and periodontal treatment covered under medical benefit.
Per member per month (PMPM) can be divided into three major categories:

1. **Inpatient services** – represents costs associated with inpatient acute and non-acute stays
2. **Outpatient** – represents costs associated professional and other ancillary services rendered in an inpatient setting but billed independent of an inpatient claim, and all professional and ancillary services performed in an ambulatory/outpatient care setting
3. **Pharmaceutical services** – represents costs associated with filling new and refilling existing drug prescriptions

PMPM for the periodontal group was higher than the preventive group across inpatient and professional and other services, but was $1 PMPM less for pharmaceutical dollars (Figure 3).

**Figure 3.** PMPM by Medical Services across treatment groups for members aged 18 – 64

The following sections describe the itemization of PMPM differences across the groups, detailing costs and/or services rendered in each of the three major PMPM categories.
Inpatient Services:

Inpatient dollars refer to costs associated with services and supplies rendered during a hospital stay. Inpatient days represent the number of days from admission to discharge, not counting the last day of an inpatient stay.

Inpatient admissions and days were lowest for the preventive group compared to both the no-dental-services and periodontal group (Figure 4).

Inpatient admissions and days per 1000 are calculated for a 1-year time period. It is derived for a given group by averaging the total number of admissions (and days), dividing by 2 (i.e. 2-year study period) and multiplying by 1000.

![Figure 4. Inpatient services across treatment groups for members aged 18 – 64](image)

The differences seen here help to explain the inpatient PMPM differences between the groups. The no-dental-services group (PMPM=$59) had the highest number of admissions, as well as the number of days once admitted. Note that the admission rate for the no-dental-services group is only 1 per 1000 higher than the periodontal group, yet the number of days per 1000 is approximately 27 percent higher. This difference could be the result of several factors, including but not limited to contracting differences, severity of patient illness, hospital efficiency, etc.
Professional, Outpatient & Other Services:

Professional, outpatient & other services (PFO) represent professional and ancillary services performed in an ambulatory/outpatient care setting and/or ancillary services rendered in an inpatient setting but billed independent of an inpatient claim. Outpatient services are medical procedures, surgeries, or tests that are done in a qualified medical center without the need for an overnight stay. These services were divided into 1 of 6 categories using the Berernson-Eggers Type of Service Coding System (BETOS):

1. **Evaluation & Management (E&M)** – includes services such as a doctor’s office visits, hospital clinic visits, emergency room visits, home visits, and nursing home visits.
2. **Procedures** – includes anesthesia and surgical procedures, as well as endoscopies and renal dialysis services
3. **Imaging** – includes various services that allow a practitioner to visualize internal structures using non-invasive technology such as X-rays, magnetism, or ultrasound
4. **Tests** – includes examination of blood, urine, etc., in a laboratory; the drawing of blood; and various electrical monitoring of heart and brain activity
5. **Durable medical equipment (DME)** – medical supplies, surgical supplies, and orthotics
6. **BETOS Other** – services not included in one of the other classes

The $6 PFO PMPM difference between the preventive group ($183) and the periodontal group ($189) is mostly explained within the imaging and other services (Figure 5).

**The outpatient cost difference between the preventive services group and the periodontal group is most noticeable in the imaging area.**

![Figure 5. PMPM for professional, outpatient & other services classified by BETOS category](#)
Pharmaceutical Data:

Prescription drugs were categorized using a standardized coding system known as the generic product identifier (GPI) code (Medi-Span™ Facts & Comparisons). These codes were used to determine the allocation of prescription dollars across each GPI category for the treatment groups (Figure 8). The difference in percent allocation was calculated by comparing the Periodontal Group to the preventive group. For example, the figure below indicates 2.5 percent of pharmaceutical dollars for the periodontal group were for hepatitis C agents, whereas the preventive group allowed dollars for these drugs was only 0.3 percent of their total prescription allowed dollars (Figure 6).

The top five differences shown in this figure complement the disease prevalence results discussed in the next section. In addition, two new conditions are highlighted that were not originally studied (hepatitis C and inflammatory bowel agents). Differences in inflammatory bowel agents seen here complement the gastroenterological inflammations episodic differences discussed later in the Integrated Condition Categories – Episode Data section.

- **Hepatitis C agents** – used in the treatment of patients with hepatitis C virus
- **Antiretroviral combinations** - medications for the treatment of infection by retroviruses, primarily HIV
- **Thienopyridine derivatives** – anti-platelet agents used to reduce risk of blot clotting and serious vascular events, e.g. stroke
- **Inflammatory bowel agents** – agents used to treat inflammation of bowels
- **Calcium channel blockers** – used to treat high-blood pressure (hypertension)

![Figure 6](image-url)

**Figure 6.** Percentage of allowed pharmaceutical dollars by GPI description showing top five largest differences between periodontal groups versus the preventive group

Prescription usage data supports the study findings that oral health affects overall health care status.
Disease Prevalence:

Members were identified as having a chronic disease if they had a related episode during the study period.

Disease prevalence was lowest within the preventive group for CAD, CHF, diabetes and hypertension (Figure 7).

Notably, the disease prevalence within the no-dental-services group was comparable to, and often higher than, the periodontal group across all chronic conditions.

**Figure 7.** Proportion of members aged 18-64 by treatment group with chronic conditions, e.g. 26.4 percent of members within the preventive group had a hypertension-related episode during the study period.

This data was aggregated at the disease level using episode data. With COPD as an exception, these results support the findings of others, substantiate our objective and contribute to explaining the pharmaceutical allocation differences of allowed dollars.
Integrated Condition Categories – Episode Data:

Episode treatment groups were grouped to reduce granularity using in-house integrated condition categories (ICC) methodology. An individual episode refers generally to the course of treatment. The graph below illustrates the percentage of dollars allocated to each of the top five ICC (episode type) by treatment group sorted in descending order for the periodontal group (Figure 8). For example, 14.3 percent of episode dollars were attributed to the joint degeneration / inflammation ICC for the periodontal group. Comparatively, only 11.5 percent of episode dollars were attributed to the joint degeneration / inflammation ICC for the preventive group.

![Graph showing percentage of allowed dollars by ICC code by treatment group](image)

**Figure 8.** Percentage of allowed dollars by ICC code by treatment group, sorted in descending order for the periodontal group, members aged 18-64

This data further confirms the association between periodontal disease and chronic illness (hypertension, coronary disease) as well as episodes related to diabetes and unhealthy lifestyles (joint degeneration). Additionally, it also supports the pharmaceutical data differences. For example, recall a disproportionate amount of allowed dollars were allocated to calcium channel blockers. Figure 7 illustrates this as a larger percentage of allowed dollars were attributed to hypertension episodes.
THE LINK BETWEEN ORAL AND OVERALL HEALTH

Conclusions:

This study confirmed an association exists between oral health and overall health care status. BlueCross and BlueShield of Tennessee members with diagnostic and preventive dental services had lower health care costs and less disease prevalence of coronary artery disease (CAD), congestive heart failure (CHF), diabetes and hypertension compared to members with periodontal treatment or members not utilizing dental services of any kind.

Associations not of initial interest were discovered, including a correlation between oral health and hepatitis C and gastroenterological episodes. Additionally, this research serves as a comprehensive body of work that draws associations between a person’s oral health, medical health, pharmaceutical services, and disease prevalence. However, it is important to note that these findings only show an association between health care costs and disease prevalence as it relates to oral health status. These findings are not causative in nature and should not be interpreted as such.

Key findings include:

- After removing costs associated with periodontal treatment and dental services, overall health care costs on a per-member-per-month (PMPM) basis was 4 percent lower for the preventive group versus the periodontal group.
- Inpatient admissions were approximately 16 percent higher for the no-dental-services group compared to the preventive group.
- Imaging costs were approximately 12 percent higher for periodontal group compared to preventive group.
- CAD, diabetes, hypertension prevalence was consistently higher in no-dental-services group regardless of age.
- Cost differences associated with pharmaceutical utilization help explain observed differences in chronic conditions, as well as conditions not originally studied, e.g. hepatitis C and gastroenterological inflammations.

In addition to periodontitis education, it may be important to focus any disease specific, e.g. hypertension, diabetes, interventions on members not using dental services. A 2 percent health care cost difference between members utilizing preventive dental services versus members not utilizing dental services of any kind could result in approximately $5.5 million in medical claims savings over the course of one year.